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European Association for Practitioner
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PREFACE

EAPRIL is …

EAPRIL is the European Association for Practitioner Research on Improving Learning. The association promotes practice-based and practitioner research on learning issues in the context of formal, informal, non-formal, lifelong learning and professional development with the aim to professionally develop and train educators and, as a result, to enhance practice. Its focus entails learning of individuals (from kindergarten over students in higher education to workers at the workplace), teams, organisations and networks.
More specifically

- Promotion and development of learning and instruction practice within Europe, by means of practice-based research.
- To promote the development and distribution of knowledge and methods for practice-based research and the distribution of research results on learning and instruction in specific contexts.
- To promote the exchange of information on learning and instruction practice, obtained by means of practice-based research, among the members of the association and among other associations, by means of an international network for exchange of knowledge and experience in relation to learning and instruction practice.
- To establish an international network and communication forum for practitioners working in the field of learning and instruction in education and corporate contexts and develop knowledge on this issue by means of practically-oriented research methods.
- To encourage collaboration and exchange of expertise between educational practitioners, trainers, policy makers and academic researchers with the intent to support and improve the practice of learning and instruction in education and professional contexts.
- By the aforementioned goals the professional development and traning of practitioners, trainers, educational policy makers, developers, educational researchers and all involved in education and learning in its broad context are stimulated.

Practice based and Practitioner research

Practice-based and practitioner research focuses on research for, with and by professional practice, starting from a need expressed by practice. Academic and practitioner researchers play an equally important role in the process of sharing, constructing and creating knowledge to develop practice and theory. Actors in learning need to be engaged in the multidisciplinary and sometimes trans-disciplinary research process as problem-definers, researchers, data gatherers, interpreters, and implementers.

Practice-based and Practitioner research results in actionable knowledge that leads to evidence-informed practice and knowledge-in-use. Not only the utility of the research for and its impact on practice is a quality standard, but also its contribution to existing theory on what works in practice, its validity and transparency are of utmost importance.

Context

EAPRIL encompasses all contexts where people learn, e.g. schools of various educational levels, general, vocational and professional education; organisations and corporations, and this across fields, such as teacher education, engineering, medicine, nursing, food, agriculture, nature, business, languages, … All levels, i.e. individual, group, organisation and context, are taken into account.

For whom

Practitioner researchers, academic researchers, teachers, teachers educators, professional trainers, educational technologists, curriculum developers, educational policy makers, school leaders, staff developers, learning consultants, people involved in organisational change and innovation, L&D managers, corporate learning directors, academics in the field of professional learning and all who are interested in improving the learning and development of praxis.

How

Via organising the annual EAPRIL conference where people meet, exchange research, ideas, projects, and experiences, learn and co-create, for example via workshops, training, educational activities, interactive sessions, school or company visits, transformational labs, and other opportunities for cooperation and discussion. Via supporting thematic sub communities 'Clouds', where people find each other because they share the same thematic curiosity. Cloud coordinators facilitate and stimulate activities at the conference and during the year. Activities such as organizing symposia, writing joined projects, speed dating, inviting keynotes and keeping up interest/expertise list of members are organised for cloud participants in order to promote collaboration among European organisations in the field of education or research, including companies, national and international authorities. Via newsletters, access to the EAPRIL conference presentations and papers on the conference website, conference proceedings, regular updates on cloud meetings and activities throughout the year, access to Frontline Learning Research journal, and a discount for EAPRIL members to the annual conference.

More information on the upcoming 2025 Conference in Valletta (Malta) can be found on our conference website http://www.eapril.org.

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REALIST EVALUATION OF AN ART-BASED INTERVENTION TO ENHANCE CREATIVE LEARNING IN AN ORGANIZATIONAL SETTING

S.G.M. Verdonschot*, A. Hofhuis**, J. Meijer***, A. Burggraaf****

* Director of research, Foundation of Corporate Education, Maliebaan 45 3581 CD Utrecht The Netherlands, sverdonschot@kessels-smit.com, ** Arts teacher, Montessori College Arnhem, Utrechtseweg 174 6812 AL Arnhem The Netherlands, annebelhofhuis@gmail.com, *** Intern, Foundation of Corporate Education, Maliebaan 45 3581 CD Utrecht The Netherlands, jolienmeijer02@gmail.com, **** Intern, Foundation of Corporate Education, Maliebaan 45 3581 CD Utrecht The Netherlands, meinsjeanne@gmail.com.

ABSTRACT

Organizations face 'wicked problems' that cannot be solved easily. Be it the problem of understaffing in healthcare organizations or the desire to promote learning for a sustainable society. Because of their complex and interconnected nature, these intricate questions cannot be resolved by a rational problem analysis and linear approach. Rather, these questions require a form of creative learning in which the given variables are questioned, and in which new solutions are developed that radically break with the existing way of working. Mechanisms that characterize creative learning comprise combination and reframing. The present study focuses on the way art and art-based learning can contribute positively to the process of creative learning. Its aim is to explore the way art can add value to the process of innovation in organizations. This is done by evaluating an art-based learning intervention that took place in a healthcare organization. In total, 8 participants took part in the workshop. Individual interviews, observations, and poster presentations are used as primary source of data gathering in this realistic evaluation. Results show that when people are open and curious, the interventions can contribute to positive emotions, defamiliarization, identification and reflection. The cognitive flexibility that can emerge thus, seems to be relevant for creative learning.

INTRODUCTION

Learning with the intention of innovating in organizational contexts can be described as a form of creative learning (Ellström, 2002). This type of learning is necessary in order to work with the 'wicked' or intricate problems that are being faced, such as the problem

of understaffing in a healthcare organization, or the desire to promote learning for a sustainable society of a group of collaborating schools in a region. Creative learning takes place when employees encounter unclear and puzzling situations, when they succeed in questioning implicit taken-for-granted premises and established definitions of problems and manage to transform these in order to create breakthroughs (Verdonschot, 2009). The process of creative learning, in which the given variables are questioned, and in which new solutions are developed that radically break with the existing way of working, can be characterised as an uncertain process. Defining elements of this kind of learning are the processes of combination (see for instance Nahapiet & Ghoshal, 1998), experimentation (Thomke, 2003) and reframing (Nadler and Tushman, 1989). The present study aims to explore the role that art and art-based learning can play in stimulating this type of learning.

In the context of healthcare there have been experiments in which art is applied in order to improve the wellbeing of patients. And in the context of medical education, art is used in order to develop various skills of healthcare professionals. Live bedside music for instance can contribute to patients' recovery after surgery (Van der Wal-Huisman, 2024). Next to that, in the Netherlands alone, eight out of ten medical faculties deploy a form of art in their curriculum (Reijntjes et al., 2021). Most faculties collaborate with museums and use paintings as a way to educate observational skills and empathy, and there is evidence that structured visual arts curricula can facilitate the development of clinical observational skills (Mukundaa et al., 2018). These studies, however, focus on interventions developed for healthcare professionals or for patients. Less is known about the possible added value of art in order to improve the collaboration of other professionals working in healthcare or other contexts.

It appears that using art can be a stimulating way to improve learning in organizational contexts. Koenen, for instance, indicates that using art in organizational settings can help to slow down and to develop new perspectives on intricate questions (Koenen, 2007; 2012). Van de Boel (2023) argues that in the present time, in which organizations face complex questions, art can offer new metaphors and viewpoints that can help to break existing ways of working in order to develop new pathways. Research has been done in order to understand the possibilities of the way that art-based learning can stimulate reflective individual learning (Lutters, 2020 in: Hofhuis, 2023). Hofhuis (2023) conducted an explorative study to learn more about the way art-based learning interventions can stimulate a generative dialogue in a team of teachers. Hofhuis depicts art as a boundary object (Akkerman & Bakker, 2011) and found that art contributed to team members learning from each other's perspectives. The present study builds on the insights that can be derived from Hofhuis's study.

Tackling difficult issues in a smart way requires a certain kind of creativity that allows you to combine existing elements in a new way. This is known as cognitive flexibility (Ionescu, 2012). Our evaluation study aims to learn more about the extent to which an art-based learning intervention that took place in a healthcare organization can fuel the

cognitive flexibility of the participants. In addition, the study focuses on finding out more about the internal processes that take place with participants who joined the learning intervention and context factors that cause this cognitive flexibility to occur. The three questions central to our study are:

1) Does the art-based learning intervention increase the participants' cognitive flexibility?

2) What kind of internal mechanisms take place in participants of the art-based learning intervention and how do these mechanisms contribute to the functioning of the intervention?

3) In what context does the art-based learning intervention, through the internal mechanisms, lead to increased cognitive flexibility?

Cognitive flexibility plays an important role in learning with the intention of innovating. This type of learning is increasingly important for organizations. The evaluation study at hand helps to understand how art can be used in practical workshops in order to enhance cognitive flexibility. Furthermore, it adds to the present body of research by focusing on the learning of employees in relation to their improvement initiatives.

THEORETICAL FRAMEWORK

Cognitive flexibility

Art can be seen not only as a way to express creativity: it can also be the source of creativity. It can help develop new thoughts and discover other approaches to solve questions or clarify dilemmas (Koenen, 2021). Schein (2001) in his essay reflects on the role of art and the artist in organizational contexts. He explains that art and artists have the potential to broaden our flexibility of response. Many of our daily habits are in fact very stable, and that it is surprising, once we are seduced into improvising on these routines, how liberating and educational this experience can be. Art can shock or stimulate, and, by doing so, it can allow us to surface feelings that we may not have been aware of in ourselves. Incorporating those feelings and acting on them can make us, in the words of Shein, richer and more flexible human beings. Cognitive flexibility can be depicted as a property of the cognitive system. Examples include finding new solutions to a problem by switching contexts or tasks, easily adapting your behaviour when there is a new rule, or being able to create new knowledge (Ionescu, 2012). This property is based on the interaction of several cognitive mechanisms, such as executive functions, attentional mechanisms, and previous knowledge that respond to specific environmental demands, such as task demands (Ionescu, 2012). Unraveling the conditions that lead to the emergence of cognitive flexibility could help us foster creativity. (Ionescu, 2012). In the following sections the mechanisms and context factors that might play a role in the emergence of cognitive flexibility are elaborated upon.

Positive emotions

We expect that looking at art creates positive emotions that broaden participants' perspectives so that new perspectives emerge. This assumption is based on the broaden-and-build theory (Frederickson, 2005). Think of the moment when you are in a museum with a friend, viewing a work of art together in a pleasant atmosphere. You might suddenly notice something new about the painting, or have a new thought. The idea behind the broaden-and-build theory is that experiencing positive emotions results in broadening one's thinking (broadening). This broadening can cause people to expand (build) their ideas and cause new perspectives emerge.

Association and defamiliarization

Participating in an intervention with art can, next to positive emotions, also trigger other internal processes that contribute to the cognitive flexibility of attendees. First, engaging with art can evoke images and associations. Those associations can help broaden thinking (Koenen, 2007). Something you hear in a piece of music for example can make you think of a completely different experience. Associations are linkages that arise intuitively, for instance via memories and encounters, rather than rationally (Lutters, 2020). Associations can help to find a new approach to an issue a person is struggling with (Koenen, 2007). Second, defamiliarization is a mechanism that could arise. Defamiliarization occurs when a person is presented something familiar in a different way, and, because of this new presentation, the person begins to view it differently. This different viewing can lead to new ideas (Gunn, 1984). Think of a dining table that, through the eyes of a child, turns out to be a little house. Art has the ability to slow down perception, making the world strange once again, and thus, cause defamiliarization.

Learning mechanisms identification and reflection

Lastly, we expect the learning mechanisms identification and reflection to take place during an intervention with art. All learning involves boundaries. Think of the moment in which a novice learns how to operate a machine in the manufacturing hall. Or the moment in which two teams have to collaborate. In these situations, the people involved experience boundaries. Between expertise and language for example. Akkerman & Bakker (2011) found that these boundaries have learning potential. Identification and reflection are two of the four potential learning mechanisms that can take place at boundaries. In identification, the exchange with others offers insight into how different practices differ from each other. This can cause renewed insight into one's own practice. Imagine a nurse and a geriatrician who discuss their standards, and tools at their disposal in order to contribute to the patient's quality of life. This conversation might lead to better understanding of their own craftmanship and learning needs. Reflection is about the exchange of perspectives from different practices. Consider a German language teacher who is also the author of several novels. This person might look at classroom situations with a writer's perspective. And the other way round, the approach that he uses to write

novels might benefit from the systematic way of working that he developed through his teaching and that he is used to deploying in lesson preparation. The dialogue between participants that is part of the intervention with art can cause these mechanisms to emerge (Hofhuis, 2023).

Context factors

We expect that participants who are curious and open to a new experience, can especially benefit from an art-based workshop (Dlouhy & Mitchell, 2009). Their open mind can evoke cognitive flexibility. Next to this, the extent to which participants see themselves as creative and artistic, might also influence their experience of the art-based learning intervention since creativity and openness are related to one another (Swaab, 2016). Lastly, time could also be a relevant context factor. When participants feel no rush or stress but rather the space to participate, we expect that the internal mechanisms can take effect.

METHOD

When evaluating an intervention, the focus is often on 'does it or doesn't it work', while reality contains so much more nuance. An intervention takes place in a particular context, and the people who participate each have a different character and each bring their own knowledge. Whether the intervention has a particular effect is strongly related to these differences. The experience of a person who comes in curiously will differ from the experience of a person who goes to an obligatory course that doesn't appeal to him or her. When an intervention has an impact, be it positive or negative, it is never only a consequence of the intervention itself. The specific circumstances and the participants themselves influence how the intervention works. This also means that an intervention often cannot be replicated one-to-one for a different context. The goal of a realist evaluation (Pawson & Tilley, 1997) is to understand how an intervention works, why it works like that, for whom it works, and in what context it works. A realist evaluation aims to learn more about the way interventions trigger certain internal processes with the participants of an intervention, and, together with contextual factors, lead to an outcome (Haggenburg-Mohammed, 2020). In this type of research, several predetermined hypotheses are central. Such a hypothesis consists of an expectation about the context in which the intervention takes place, the mechanisms triggered in the people who participate and the outcomes that arise. The hypotheses are called CMOs. (Context, Mechanism and Outcome). The present study aims to learn more about how an art-based intervention works based on some preconceived CMOs. The CMOs stem from literature and from the rationale behind the design of the intervention. Factors related to the context (C) that might be relevant relate to the extent to which participants are open to and curious for the experience, the extent to which they consider themselves to be creative and artistic, and the extent to which they have the time and feel the space to participate. Mechanisms (M) that are expected to play a role are positive emotions (based

on Fredrickson, 2005), associations (based on Koenen, 2007), defamiliarization (based on Gunn, 1984), and identification and reflection (based on Akkerman & Bakker, 2011; Hofhuis, 2023). These contextual factors and mechanisms triggered by the intervention are expected to contribute to the outcome (O) of cognitive flexibility (based on Ionescu, 2012; Schein, 1994).

An art-based intervention

In a Dutch healthcare organization, various employees –nurses, medical specialists and staff– are working on improvement initiatives. For example, someone is committed to promoting person-centred care, and someone else took the initiative to strengthen interprofessional collaboration and learning among nurses and medical specialists. Some of them express the desire to look at their improvement initiative with different eyes, in order to take new steps. This prompted the design of an art-based intervention that took the shape of a half-day workshop. Eight artworks form the starting point for a dialogue about the questions that participants bring with them. Eight participants, each bringing an issue from their own improvement initiative, are invited to engage in a conversation about an artwork (Figure 1). This conversation took place in a small group, and it was facilitated with a specially developed viewing frame (see Figure 2) (Hofhuis, 2023). The center was cut out in order to see through, and the viewing frame contains four questions.

Figure 1. Looking at artworks through the viewing frame

Figure 2. Viewing frame 1 developed by Hofhuis (2023)

In the next phase of the workshop participants worked with the other side of the viewing frame (Figure 3 and 4). At the end of the meeting, each attendee presents a poster with the plans and thoughts that were developed during the session (Figure 5). Facilitation of the workshop was provided by the second author.

Figure 3. Developing one's own story
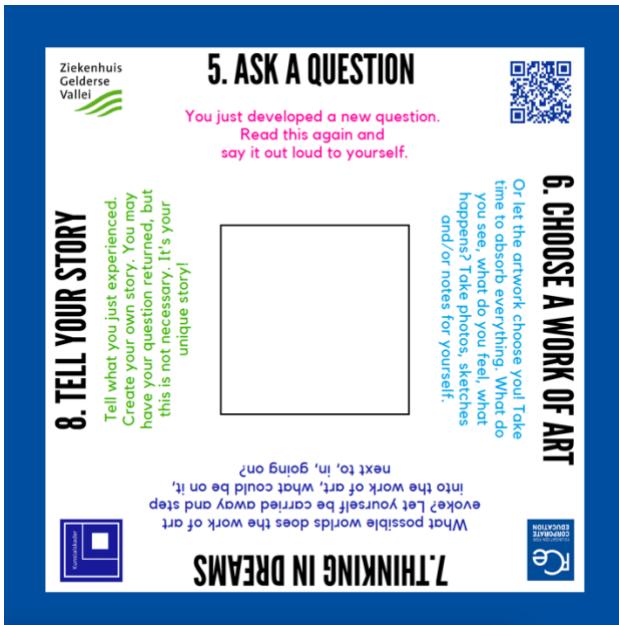
Figure 4. Viewing frame 2 developed by Hofhuis (2023)

Selection of participants

In total, 8 participants took part in the art-based intervention. Among them were the first and fourth author of the paper at hand. Six participants were employees of the healthcare organization: 2 nursing consultants, 1 medical specialist who is also senior manager, and 3 policy advisors. They were selected based on their willingness to join a workshop in which art is used to develop new perspectives. Each of them participates or initiates an improvement project. All participants in the workshop participated in the evaluation study.

Instruments

Data-gathering took place through individual interviews preceding the intervention, via observations during the intervention, and through a reflective assignment (poster presentation) as part of the workshop. The focus of data collection is to learn more about the contextual factors, about the mechanisms that are triggered by the intervention, and about the expected outcome.

The individual interviews took place via telephone, prior to the workshop session. Examples of questions that were asked are: What do you expect from the session that you'll join? How artistic do you consider yourself? For the participants these interviews had the function of an intake conversation to prepare themselves for the workshop.

For the observations a scoring scheme was made based on the CMO-hypotheses. The observation scheme contained indicators connected to all concepts from the hypotheses.

Examples: an indicator for positive emotions is 'participant shows a smile', an indicator for context factor time is 'participant is in a hurry or needs to leave earlier', an indicator for curiosity is 'participant asks questions'. During the workshop observations were noted down.

The reflective assignment was part of the last part of the intervention. Participants were asked to make a poster that showed their new thoughts, ideas and plans that came up during the workshop in relation to their question. Each participant presented the poster to the group.

RESULTS

Positive emotions

Both in the interviews and during the workshop, positive emotions were reported. In the interviews participants used words such as "fun", "nice", and "looking forward" when referring to the upcoming workshop. During the intervention they declared things such as "what a treat", "it's fun!", "nice to be thinking together", and "we are so complementary!". Enthusiastic voices also gave the impression that positive emotions were experienced. These emerged especially when participants were deep in conversation about the artworks, and also in between different parts of the session.

Negative emotions were also present. In the interviews one participant was unsure about her creativity and she wondered whether this would be a problem during the meeting. Another participant seemed to be frustrated about the urgent question that she faced in her improvement initiative. Negative emotions were also experienced during the meeting. For instance, some participants were afraid of not meeting expectations, and some doubted whether the question they brought was too big. One participant also experienced irritation about an artwork and disappointment because there was not enough time to finish a conversation.

Association and defamiliarization

While looking at the artworks, many associations were shared in the conversations. This is shown by comments such as "Oh, I see a smiley face… and I hadn't seen that before!", "I hadn't looked at it that way." An artwork that depicts a tree made a participant think of her daily run, another participant saw red shoes and associates that with having guts, and again another participant linked a black part of a painting to her own blind spots.

Defamiliarization took place during the workshop as well. Participants looked intently at the artwork. One participant says: 'I never look at trees' and explains that now that the tree is removed from its ordinary context – the forest – she does pay attention. Someone looks at a work of art upside down. And in the poster presentations, a participant says that the art has created distance from the usual words she uses to describe the issue.

Identification and reflection

During the dialogues between participants, identification took place in three ways. Firstly, participants investigated similarities and/or differences in what they notice in a work of art by explaining their own view. One participant said: "You say compartments [when describing what you see], but actually I see layers." Secondly, by talking about the artworks, the participants formed a clearer picture of their own views, and at some moments participants felt confronted with their own less positive sides. This is shown by comments and questions such as: "Why do I feel this?"; "Am I ignoring black boxes?", and "Apparently, I have stereotypical ideas". Thirdly, the dialogue made participants more aware of their own values and ideas. This was reflected in comments such as: "I try to think about my perspective on this", "I'm not usually so aware of this", and "What makes this so important to me?".

Reflection took place during the dialogue when participants where actively listening to each other and took each other's perspectives: "Oh, yes! How funny, I hadn't seen that yet". They asked each other questions (e.g. "How do you experience that?" or "What about you?"). Furthermore, we saw participants interacting in a loose and playful way, combining insights and observations that came from the conversation about the artworks with the work-related questions that they came in with. Someone suggested: "This seems to fit into your story", and someone else asked: "What would this be like with your issue?". "How would this fit into your problem?".

Contextual factors

In the intake calls all participants appeared to have positive expectations of the workshop. Three participants had very concrete expectations such as "a solution" or "new tools". Others formulated less well-defined expectations ("small steps", "awareness"). They all showed curiosity (e.g. "whether we can discover something new" or "how our questions might transform during the workshop". Openness was seen during the intervention both verbally and non-verbally. When a participant shared a perspective, others would nod or make assenting noises. One of the participants described herself as a rational thinker and told that she had challenged herself to be open to a different approach. She explained that they are dealing with difficult issues, such as staffing shortage, and that the present way of dealing with this won't offer satisfying solutions. That made her want to try something new. Curiosity was seen during the workshop in two ways: after a completed part of the session, participants walked to other artworks to point out something to each other (e.g. "I also liked this one!"); and they asked questions about the artworks (e.g. "Is this piece a photograph or a painting?"). There were short moments in which some participants were busy with something that wasn't directly related to the workshop (e.g. writing in an agenda or typing on their telephone).

With respect to their own perception of their creativity, the telephone conversations show different views. Two participants share their enthusiasm for creativity. For instance, one of them uses "images to lighten up the boring office environment". Three

participants said that they see themselves as creative in their thinking, but not per se in making things ("I do get creative with seeing possibilities or with language"). Two participants ddin't see themselves as creative or artistic (e.g. "I find it difficult to go off the beaten track"). When making poster presentations (last part of the workshop) all participants used colours and different shapes (see for example Figure 5). No differences were seen, neither in the shape of the posters, nor in the type of insights, between participants who considered themselves as creative and the ones who did not.

With respect to time and space: the workshop was held in a room in another building than the main building. Participants came by foot. They noted that they didn't come here often. Some had never been here before. One of the participants had to show up earlier to fix some unexpected logistics. This meant that she had to reschedule her other work. During the workshop participants seemed to surrender to the planning and facilitation that was given, not being concerned with time. After the meeting, participants seemed to return to reality, looking at the clock again, for example, and discussing their further plans and work-related activities for the day. All participants engaged actively and concentrated during the workshop.

Results on the outcome: cognitive flexibility

Looking at art with the viewing frames allows participants to look at their own issue from multiple and also new perspectives. One participant, for example, came up with the question: how can I involve nurses in interprofessional collaboration? Prompted by a painting, she wonders aloud: "do the nurses necessarily have to get in to participate?" At first, she saw sharp fringe lines of who was and was not involved in interprofessional collaboration, but now she realises that these lines might be running differently and that each person can participate using their own rhythm as a starting point. Perhaps rhythm looks different for nurses than for, say, medical specialists, she observed.

At the end of the workshop, some participants indicated that they experienced that no specific solutions emerged, but rather thoughts that could help to move in a different direction or try a new idea.
More than half of the participants started to approach their own issue differently ("Do I actually want this?", "Does freedom even exist?", or "Then how do I see this movement?"). Participants also became aware of assumptions they had made in formulating their issue. By paying attention to the edges or shadows in an artwork, participants got a different idea about their issue or how they want to proceed with it.
Participants experienced calmness and a sense of space at the end of the workshop. This is expressed differently by everyone. For example: "[it gives me] peace that there is always a way"; "[what we did today is] to create space to look without judgement"; "space for learning and development", "[I need] space to look outwards"; "everything has its own rhythm (...) and everyone who dances, ends up dancing along". The latter refers to one of the artworks that depicts dancing figures (Figure 6).
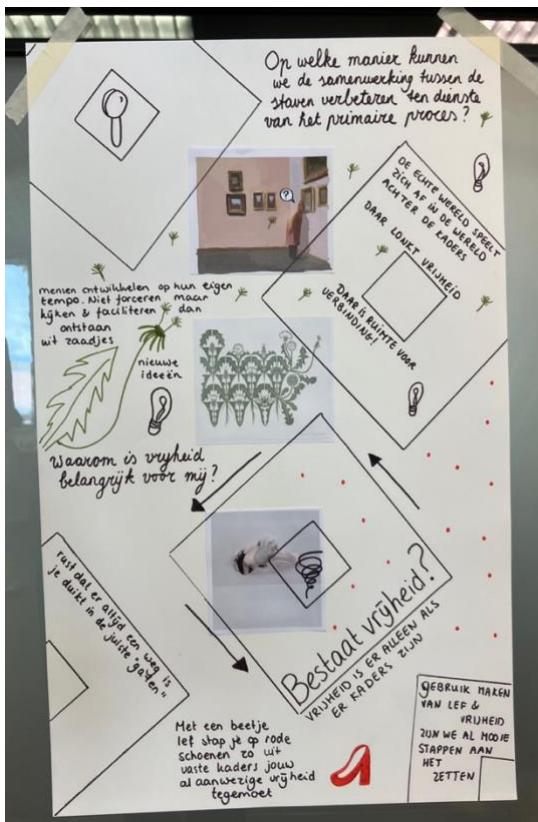
Figure 5. One of the posters that was presented

Procedure

The art-based intervention took place on April 22nd, 2024 and took three hours. For every individual interview a report was made based on the notes that were taken during the interview. The observations during the intervention were captured in the observation scheme. The poster presentations were recorded, and pictures were made of the posters. Prior to the workshop all participants received a welcome letter and a sketch book on their home address. They were invited to think of a question that kept them busy related to their own work or to their improvement initiative.

Data-analysis

All quotes from the interview reports, the entries from the observation scheme and the quotes from the poster presentation were collected in one overview. Then, the entries were coded using the concepts from the CMO-hypotheses (deductive qualitative data-analysis). Entries that appeared unrelated to one of the Context, Mechanism or Outcome factors were analysed to track down possible new patterns.

Figure 6. Participant engaging with a piece of art

CONCLUSION AND DISCUSSION

Does the art-based learning intervention increase the participants' cognitive flexibility?

Working with art does not lead to ready-made solutions to the issues brought by participants of the workshop. An intervention with art can, however, contribute to people's 'mental agility'. They develop new ideas about an issue they brought along beforehand or translate an experience they gained during the meeting to their work context. A playful looseness emerges in participants with which they combine observations and thoughts arising from engaging with art with their own and others' issues.

At the end of the workshop participants reported calmness. This seems to be a type of cognitive flexibility that is not about the content of the issue but has to do with the search process. It seems that letting go of the urge to influence or change something is a big part of the peace that is experienced. This becomes evident from comments such as "the wind cannot be influenced" and "teams know best what is needed, we only have to give space".
Interesting in this respect is the parallel with the process participants themselves went through during the workshop. In the meetings, participants gain first-hand knowledge (Kessels, 2005). About a personal new insight, one participant laughingly observes: "I could have got this insight from a cheesy management book as well". And at the same time, it is noticeable that there is value in arriving at a particular line of thought yourself. This points to an autonomous way of learning, in which participants proactively shape their own learning experience. The reflection assignments seem to play an important role in this. Van Woezik et al. (2023) confirm the idea that art-based interventions stimulate self-directed learning and thereby can bring about positive outcomes such as ownership and authenticity.

What kind of internal processes take place in participants of the art-based learning intervention and how do these processes contribute to the functioning of the intervention?

During the meetings, participants experience both positive emotions (such as cheerfulness) and negative ones (fear of making mistakes). Both seem to be relevant and contribute to valuable outcomes. An email we received afterwards revealed that one of the attendees had taken the initiative to organize a new workshop with art for her own team. This fits with the broaden-and-build theory that states that broadening leads to building.

A notable discovery is the role of negative emotions as an internal process that contributes to cognitive flexibility. During the intervention, participants become aware of their own deficits and blind spots (one participant sighs, "apparently I have stereotypical ideas"). The negative thoughts seem to make participants aware of where they get stuck and can grow. It could be that this opens up the way for positive emotions. The art forms evoke associations with issues from personal life and work, as well as defamiliarization, and this may contribute to a broadening of outlook. By engaging with art, participants learn to think outside their assumptions and habits. For example, they view a work of art upside down. These unusual perspectives may not only broaden physical perception, but also open up new ideas and possibilities. Presenting the posters, one participant says that art has created distance from the usual words she uses to describe the issue. The issue itself becomes unfamiliar, so to speak, allowing something new to be discovered in it.

The two learning mechanisms identification and reflection were observed. Most participants posed questions to each other and to themselves. The artworks seem to fulfil a role of boundary object. Such a boundary object allows attendees to connect their own world (e.g. their own view or opinion) to that of others.

In what context does the art-based learning intervention, through the internal mechanisms, lead to increased cognitive flexibility?

During the telephone interviews prior to the workshop, participants gave different answers to the question of whether they consider themselves to be creative. Contrary to expectations, participants who considered themselves creative seemed to go through a similar development as those who do not. All were open and curious about what art can bring them.

Many participants enter the workshop room with openness and curiosity. Some participants seemed rushed or still busy with something else from the working day, but they too seemed to become absorbed in the experience after a while. Initial haste, or the busyness of the working day, does not seem to have too much impact. Participants seem to experience a focus that makes them forget their surroundings and other plans, resembling a state of flow (Csikszentmihalyi, 1990). They are completely absorbed in

the activity they are engaged in. Some participants for instance only look at the clock again after the workshop ends and suddenly remember that they have other plans for the day.

The present study evaluates an art-based intervention to enhance creative learning. The intervention took place in a healthcare organization and was joined by 8 participants. Although the results show that art, in a specific context, can trigger internal mechanisms in the participants that lead to cognitive flexibility, an obvious question is whether these results can be generalised to other contexts and to other organizational settings. The results from the current study encourage us to start experimenting with art-based interventions in other organisations as well and find out the extent to which this can enhance creative learning. It would be interesting to invite professionals to bring a 'wicked problem' that they encounter in one of their improvement or innovation initiatives to the workshop, and to learn more about the way their perspectives on this issue develop as a result of the mechanisms that are triggered by the art-based intervention, and to find out whether the new perspectives lead to breakthroughs in the working practice.

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NAVIGATING DILEMMAS IN DESIGNING DIGITAL OPEN BADGES FOR SUSTAINABILITY TEACHERS

Lauren Verheijen*, Elles Kazemier**, Corine Seelen***, Eveliina Asikainen****

*Educational Advisor & Researcher, Breda University of Applied Sciences, Mgr. Hopmansstraat 2, 4817 JS Breda, verheijen.l@buas.nl,
**Senior Lecturer, Centre for Talent and Learning Hanze UAS, Zernikeplein 7, 9747 AS Groningen, e.m.kazemier@pl.hanze.nl,
***Educational Advisor, Centre for Talent and Learning Hanze UAS, Zernikeplein 7, 9747 AS Groningen, c.j.seelen@pl.hanze.nl,
****Senior Lecturer, School for Professional Teacher Education, Tampere UAS Kuntokatu 2, 33520 Tampere, Finland, eveliina.asikainen@tuni.fi

ABSTRACT

Translating the ambitions sketched for Education for Sustainable Development (ESD) to European education practice is still a work in progress. The Erasmus+ Teacher Academy EduSTA (Academy for Sustainable Future Educators) aims to bridge the gap between theory and practice on teacher competence for sustainable development. By embracing different countries, educational cultures, contexts and needs, EduSTA aimed to cocreate a generic competence-based teacher role description, based on the current teacher competencies frameworks for ESD underpinning a prototype for micro-credentials, digital open badge-driven learning pathways and accompanying learning modules for teachers. In this EAPRIL workshop participants came into conversation about designing ESD by experiencing a simulation of the EduSTA badge design processes. The workshop was structured in a design sprint of three phases: (1) sensemaking, (2) bargaining, (3) refining. In mixed groups participants were invited to, while working on a unique badge, negotiate possibilities to make room for transformative learning, assessment as learning and communal and authentic learning while building upon the developed EduSTA badge constellation prototype, its competence objectives and criteria. Through participant observation and reflection, the workshop held a mirror to the hosts' experiences in the EduSTA design process and reiterated the importance of collective understanding, and how to navigate it, when designing ESD.

INTRODUCTION

As sustainability educators we often find ourselves confronted with the complex task of trying to digest the societal challenges around us, while supporting others – our students, peers or leadership – to navigate ways of dealing with these societal challenges, such as sustainable development. The Academy for Sustainable Future Educators (EduSTA) is an Erasmus+ funded Teacher Academy (2022-2025) aimed at operationalising Education for Sustainable Development (ESD)' ambitions for educational practice. By working together in a consortium representing five European countries (Sweden, Finland, Spain, the Netherlands and Czechia) the project aims to facilitate the professional development of sustainability educators across Europe with a constellation of teaching practice-oriented micro credentials in the form of digital open badges (figure 1). EduSTA badges were piloted by all consortium members in either self-directed or facilitated learning modules.

Figure 1: EduSTA Badge Constellation

The foundation for the design process of the prototype open badges was set by a literature review and context analysis that identified the common features of the existing frameworks and gaps between literature and practise on ESD (Ametller, 2024), alongside the needs of each specific context (Gual Oliva et al., 2024). Consequently, international design teams (with representatives from each partner institution) were established for each competence area within the badge constellation. With limited guidelines on how to translate ESD to educational practise, especially on assessment (Wiek & Redman, 2022), the design teams engaged in a process of sense-making, negotiation and compromise, to ensure applicability to all contexts while holding onto the spirit of sustainability education (Asikainen et al., in press). Throughout this process various conceptual tensions arose, broadly categorizable within three main learning concepts that underpin the development of the EduSTA badge constellation: levels of

sustainability education (Sterling, 2014), transformative learning (Mezirow, 2002), and competence-based education (Brauer, 2019). Between these three concepts ESD can be identified as: (1) transformative in its 'highest' form of implementation on both individual and system level (Sterling, 2014; Garcia-Alvarez et al., 2022), (2) using transformative pedagogy (Cremers, 2024), (3) assessable through competence demonstration to validate learning sustainability teacher competence.

The EAPRIL workshop hosted by the authors served two main functions. On the one hand the workshop was an opportunity to share the lessons learned from navigating conceptual tensions in the design of ESD digital open badges for teacher competences through experiential learning, so that it may accelerate the implementation of ESD practice in Europe. On the other hand, by observing the workshop participants engaging in a simulation of the design process, the experiences of the EduSTA badge team members as described in Asikainen et al. (in press) were triangulated. In these proceedings we elucidate the main design tensions and relate these to the process and experiences of the badge design simulation in the EAPRIL workshop. As one of the four main badge areas to the EduSTA badge constellation is that of *Reflexive Praxis*, where the badges function as an impulse for educators to reflect on the educator's practice in relation to ESD, this paper ends with a reflection by the workshop hosts in relation to their own learnings as ESD practitioners.

OPERATIONALISING EDUCATION FOR SUSTAINABLE DEVELOPMENT USING MICROBADGES

Teacher's capabilities to act as active change makers in societal transitions and educate citizens and workforce to meet future challenges are central to these transitions. There still is, however, a wide gap between the research on and actual work of teachers. The starting point for EduSTA is to bridge this gap between the conceptual models on teacher's sustainability competences and the reality of teacher and educational practice, so that educators may fulfil their role as stipulated in European policies and programmes such as the European Green Deal (2019/2956(RSP)). Competence frameworks such as the Key Competences for Sustainability (KSCs) (UNESCO, 2017; Wiek et al., 2011), the EU GreenComps (Bianchi et al., 2022), CSCT framework (Sleurs, 2008) and Rounder Sense of Purpose (RSP, 2019) provide reference points for outlining teacher competence, although the frameworks themselves primarily focus on student and citizen competence. However, they provide limited guidance on integration to and operationalisation in educational practice (Wiek & Redman, 2022), including the question of how to assess competences (Vare et al., 2019), nor have they been comprehensively included in teacher education curricula or teacher's professional development plans (Mulá & Tilbury, 2023).

Within the EduSTA Teacher Academy digital open badges act as the vehicle through which to address both the literature and practice gap on teacher sustainability competence. Digital open badges provide the flexibility of independent learning pathways driven by competence-based learning, making them applicable to a variety of

contexts while still outlining outcomes of learning as markers for evaluating competence development (Brauer & Korhonen, 2022). By leveraging digital open badges as a learning tool, EduSTA badge design teams translated conceptualisations of sustainability (and) education to operationalised badges to support teacher sustainability competence development. Integrating sustainability education with digital open badges frames a conceptual space for design rooted in the design principles specific for digital open badges alongside the discussion of how to bring sustainability education to practise. In the process of designing the EduSTA badges, it was within this conceptual space that badge team members went through a process of sensemaking, negotiating, co-defining & re-defining the various badges of the EduSTA constellation (Asikainen et al., in press). Figure 2 highlights the conceptual space, which often presented itself in the form of design dilemmas. The following sections elucidate the conceptual space from the perspective of the three key concepts on each side of the triangle.

Various synergies between these three main themes – competence-based learning, levels of sustainability education, and transformative learning – can be identified that support the development of a digital open badge constellation aimed at fostering sustainability educator competence. Asikainen et al. (in press) have however shown by analysing the EduSTA design process as a collective sense-making process that the room for interpretation across these various themes independently and in relation to each other poses dilemmas for design. How these dilemmas were shaped and addressed was dependent both on the (educational and socio-political) context of the designers, as well as interpretations of the content of these themes.
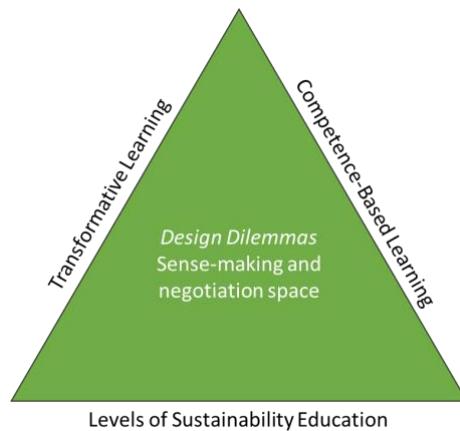
Figure 2: Conceptual framing of EduSTA digital-open badges

Competence-Based Learning

Strengthening the capacities of educators across Europe to address sustainability education in their practice, requires flexible and inclusive learning opportunities. Alongside intentional stimulation by the EU to develop, implement and recognize micro-credentials as a route for lifelong learning and professional development, digital open

badges are an evidenced tool for the development of both pre- and in-service teachers' competences (e.g., Brauer, 2019; Brauer & Korhonen, 2022; Korhonen et al., 2022). To receive an open badge, a form of electronic, standardized micro-credential, the applicant must provide evidence demonstrating the ability to apply achieved competence in practice. The badge is then granted by an evaluator, which functions as recognition of the competences acquired independent of the learning path.

In this way digital open badges are an outcome-based approach to learning, where detailed proficiency goals alongside a description of the evidence required are core to the badge design (Brauer, 2019). The road to the competence demonstration is fully open to the applicant, which allows them to relate the competence to their own experience and tap into a learning path that is relevant to them. In this way, competence-based digital open badges mimic the ESD focus on the development of professional identity in relation to determine one's own desired impact on sustainability challenges, suited to their skill set. This development was supported within EduSTA through piloting various (independent and facilitated) learning routes including online and physical learning modules.

Further, design principles for the EduSTA badge constellation follow the general design principles of digital open badges on cross-national agreements on the scope of the badges, pedagogical approaches, and ways of validating the badge constellation as credentials in relation to existing educational practices (Brauer & Korhonen, 2022). To facilitate this alignment, after initial content and pedagogical discussions the EduSTA badge design teams were each provided with an EduSTA badge template to fill in including aspects of the badge such as: badge title, description, competence outcomes, competence demonstration and learning resources.

Transformative Learning

Central to societal sustainability discussions is the necessity to transform systems and perspectives to address sustainable development (Sterling, 2014; Garcia-Alvarez et al., 2022). In relation to education this discussion is largely cemented in the pedagogies that foster transformative learning, "the process of effecting change in a frame of reference" (Mezirow, 2002, p. 1). Growing attention for transformative pedagogies as component of fostering ESD highlights capacity building for dealing with uncertainty, complexity and ambiguity (Cremers, 2024), central to sustainability competence frameworks. From the perspective of learning design, transformative learning demands a shift away from focusing on outcomes and towards process. For ESD this transformative learning process might encourage learners to explore opportunities to challenge accepted norms and the status quo to explore new possibilities, trajectories and societal innovation (Verheijen, 2022). This is crucial to addressing societal sustainability challenges as they manifest as 'wicked' problems that resist solving, hence forcing us to step away from problem-solving to problem-loving as a mindset for sustainability. Two important design principles for ESD therefore seem to be that transformative learning is (1) process-oriented and (2) open-ended, so any attempt to capture or steer learning on the basis of outcomes must take this into account.

Open badges operate as a stimulus within the learning process by offering a (gamified) form of accreditation of learning but are not necessarily integrated within the learning process itself. This provides the applicant (learner) the possibility to leverage the badge in whatever way is most useful to them in their learning, whether that is to accredit the learning they have gone through or through the learning function of an assessment. In this way, open digital badges and associated competence frameworks address the meaning-making process of transformative learning, by incorporating the outcomes of learning into a well-developed symbolic frame of reference (Mezirow, 2002). Simultaneously, accrediting the (outcomes of) learning through assessment is inherently juxtaposed to the emphasis on the learning process so central to transformative learning. Neither following the transformative learning tradition nor UNESCO is there any emphasis on (learning) outcomes other than the aim to "empower learners to question and change the ways they see and think about the world in order to deepen their understanding of it" (UNESCO, 2017, p. 55).

Part of the challenge of designing digital open badges for ESD lies in formulating learning outcomes that stimulate applicants to address and reflect upon (changing) perspectives in relation to the norms and values they hold. Additionally, it is not likely to be evident upfront where the learning process is going to end, nor what the process might look like for an individual learner. Any learning outcome must be framed accordingly to do justice to the process of learning and its emergent nature in relation to sustainability. For badge design this is a delicate dance between outcome, process and learning design that is rooted in transformative learning and operationalised through a snapshot moment in time (and learning path independent) form of assessment in the digital open badge.

Levels of Sustainability Education

ESD is based in the ambition to contribute to societal transitions that are inherently non-linear and open-ended through the transformation of educational systems. UNESCO acknowledged the complexity of this type of educational design when setting out the ambitions for ESD, and matched this with a competence framework (UNESCO, 2017) embracing the various knowledge, skills and attitudes professionals (and citizens) need to be able to address sustainability challenges. The challenge of operationalisation lies in translating this ambition to a model of formal education that is decidedly outcome-oriented. In describing this agenda it might already become clear that there is somewhat of a conflict in the discourses surrounding ESD, especially between ambition and practice. On the one hand it sketches a clear agenda for what competent sustainability professionals should be able to do and on the other it presents a necessity to transform our systems of education away from outcome-based learning to make space for learner transformation.

With the risk of leaving the reader hanging by not diving deeper into this conflict, we here summarize the various discourses with the help of Stephen Sterling's seminal work disentangling the discussion around ESD literature and practice. Sterling (2014) outlines three main 'levels' in the discussion: (1) education *about* sustainable development (ESD

I), (2) education *for* sustainable development (ESD II) and (3) education *as* sustainable development (ESD III). Respectively, each level might be equated with first, second and third-order learning as the emphasis shifts from knowledge acquisition to critical questioning to epistemic change. In this way, the three levels reflect a model of progressive engagement with and deeper learning for sustainable development. Across all levels value-change is acknowledged, with varying degrees of sense-making in relation to the worldviews one holds and how those might change in relation to addressing sustainable development.

Initially these were understood as parallel tracks, and so alternative (complementary) approaches to implementation. More recent literature however points to the urgent need to transform systems of education (ESD III) to address ESD as envisioned by UNESCO, and that working on ESD I and II may be perpetuating a competing agenda. MacIntyre, Tilbury & Wals (2024) track these narratives about education and learning across the last five decades, showing how education *as* sustainable development (ESD III) has come more to the foreground of educational developments in relation to sustainability. Yet it is crucial to note that this does not spread evenly, and educational context in location, culture and level of practice (primary, secondary or tertiary) greatly influences the understanding of ESD and how it is predominantly being translated to practice. Even within an EU project such as EduSTA, the differences in context and understanding of ESD have raised a design dilemma in how to develop badges that support reaching ESD ambitions, while being applicable to all consortium partner contexts.

DESIGN PROCESS SIMULATION

The workshop (1.5 hours) aimed to evoke participant learning about educational design dilemmas when developing digital open badges for sustainability education by experiencing a simulation of the EduSTA consortium design process. Various elements of this design process were mimicked in the workshop consisting of three brief design sprints, including:

- creating diversity in badge teams, per both country of practice or origin and level of experience and knowledge of ESD;
- time pressure;
- shifting badge team members;
- and predetermined design contours for competence-based digital open badges.

To scope the level of complexity the participants were provided with an overview of the EduSTA badge constellation, as depicted in figure 1, to highlight the distinction between micro badges and overarching milestone badge areas. Setting the stage for the design process included a brief introduction to the EduSTA project, the consortium, project aims and key concepts including competence-based learning and digital open badges. Participants were divided into two diverse groups (group of 4 and 5) based on travel time from home to the conference location, and affinity with (theory or practice of) sustainability education. Countries represented by the participants were Luxembourg, Belgium, the Netherlands, Germany and Finland. Throughout the workshop it became

clear that the participants are also working in various educational contexts, such as teacher-education for primary and secondary education, ICT education and professional identity and development.

Both groups received their unique badge to work on: 1.1. *Knowledgeable Problem Articulator*, or 3.1. *Active Collaborator*. Based on the identified key themes in navigating the design (Asikainen et al., in press) and the EduSTA badge template, the design simulation workshop was structured according to three design sprint phases. After each phase participants were asked to reflect on aspects of the process specific to that phase, to write their answers on a card and share highlights plenary. To supplement participant reflection with overall reflection, at least one dedicated workshop host observed each group and took notes on key matters either in the content of the discussion or in the process of coming to a shared understanding of the badges.

Phase 1: Sense making

Phase 1 asked the participants to focus on the badge title, description and competence objectives in a collective sense-making process. They were instructed to, in their group, come to a collective understanding of what the badge is about based on the title, description and competence objectives formulated by the EduSTA consortium. After ten minutes the sense making process was halted and the groups were presented with two reflection questions:

- Did you arrive at a collective understanding?
- How did you arrive at this collective understanding?

Process and outcomes phase 1

Both groups started by reading the description of the assigned micro badge. The group working on badge 1. *Knowledgeable Problem Articulato*r (hereafter group KPA) set out questioning and discussing the target group of the badge (constellation), the concept of sustainable teaching and the kind of understanding of ESD the badge builds upon. The group also agreed that a shared definition of ESD is needed to arrive at a collective understanding of what the badge is about. Also questions like which level of knowledge is needed and how to integrate knowledge with teaching were discussed. One of the workshop hosts intervened to provide the answer on who the badges are designed for.

The group working on badge 3.1 *Active Collaborator* (hereafter group AC) started with exchanging ideas and an example from their own context. Expressions like: "I think that …." were used, which formed the basis of a shared understanding on the basis of examples. There wasn't much discussion on the overall understanding of what the badge is about, and discussion stayed on a rather general level.

Reflection on sense making phase by participants

Group KPA (n=5) report that they did not arrive at a collective understanding of the badge but tried to do so, by sharing about experiences and differences in interpretations. The participants also mention that they first needed to discuss the connection between ESD and Sustainable Development Goals (SDGs), and their common definition of ESD. The members of group AC (n=4) are positive about reaching a collective understanding. Overall sharing thoughts, opinions and experiences, and connecting these to the badge description was helpful in reaching common understanding. Thinking out loud, wondering and finding examples to substantiate thoughts and looking at the overarching categories also helped to make sense.

Phase 2: Bargaining

Phase 2 shifted the focus from understanding to formulating new ideas. Participants were asked to engage in a process of negotiation to come to a collective agreement on what assessment criteria would support evaluating whether a badge applicant had reached the competence objectives. The agreed upon assessment criteria were written on the badge template. Reflection questions for phase 2 were:

- What did you have to let go of to come to a decision?
- What was non-negotiable for you?

Process and outcomes phase 2

The aim of the second phase was to find ways to assess the competence, most of the discussion in both groups revolved around what should be assessed and what kind of assessment criteria would be suitable. Yet, both groups were rather cautious and hesitant to arrive at a conclusion. The participants used their own experiences to make sense of what it might mean to be a knowledgeable problem articulator or an active collaborator in their context and tried to derive the assessment criteria this way. At this stage, it was necessary to look at the whole constellation to give guidelines on where the distinctions are between the badges. In group KPA it helped to distinguish demonstrating how to apply knowledge on SDGs in education from finding suited pedagogies to address the knowledge. In group AC, looking at the other badges caused confusion as the group discovered how interrelated all badges really are.

Reflection on negotiating/bargaining phase by participants

One of the members of group KPA reports that she had to let go of the idea that although it is an important component of being a successful ESD teacher, intrinsic motivation is not an eligible criterion for this badge. Otherwise, the group held similar ideas on the non-negotiable criterion for assessment: the level of content knowledge on ESD and SDGs is essential. Deep knowledge and understanding on each of the SDGs and their interconnectedness is needed to connect content to pedagogy and educational practice needs to be underpinned from a theoretical perspective.

In group AC the participants did not feel they had to let go of aspects concerning the assessment criteria. They were clear on what are non-negotiable assessment criteria for

their badge: communication and interaction through (building) relationship with stakeholders. However, one participant from group AC raised the question about the possibility of interviewing applicants to be able to capture their learning process more effectively, indicating the challenge of reducing such complex competences to concrete criteria.

After phase 2 reflection participants were invited to switch design groups voluntarily, simulating shifting badge design teams in the EduSTA design process due to interest and availability of project team members. Two participants swapped from each group.

Phase 3: Refining

Phase 3 placed emphasis on refining the badge design with the competence demonstration. Participants were asked how applications could demonstrate their competence, and what product might be associated with this. Reflection questions for phase 3 were:

- What are you proud of in your design?
- What challenged you in the design process?

Process and outcomes phase 3

The aim of this phase was to find suitable demonstration for the competence. The arrival of new people, after four participants switched groups, restarted the sense-making process. Not knowing what has been discussed before presented a challenge to collective understanding. Asking questions was a tool used in both groups to add a critical tone to the conversation and reiterate why certain decisions had been made. In group AC the result was a hesitant and prudent discussion that stayed on a general level, where resistance seemed to come from feeling non-expert on the relevant topics. In group KPA a solid suggestion for competence demonstration was produced quite easily, to which the group-changers' questions introduced a critical thinking process. These questions were more concrete than in group AC by relating teacher competences to the SDGs and their interconnectedness. The discussion also pointed out that the SDGs (as a form of content knowledge) will most probably change over time and that would cause a need to change the demonstration if it were depending on the SDGs too heavily. One of the workshop hosts directed the group to use the dimensions of sustainable development instead of the SDGs as the conceptual framework to overcome the problem.

Reflection on refining phase by participants

Both groups noted that having a new member in the group posed a challenge to design, as what had become collective understanding tacitly now had to be made explicit. Given the time restraints it was not possible to come to a new common definition, so the responses were to either stay on the general side (AC) or use the opportunity to have the new member be a critical sparring partner (KPA). Participants in group KPA also noted how the complexity of the underlying knowledge needed for KPA made it difficult to quickly introduce to a new member. While the designs were not seen as ready, or

anywhere close to being completed, participants did feel there was a logical connection made between the various badge components and that the competence demonstration were a concrete reflection of the discussions had during the design phases. Questions were posed regarding how assessing these badges would happen. As the competences are diverse and complex, they may warrant a reflective conversation between assessor and applicant.

Reflection on the overall design process by participants

To round off the design participants were asked to reflect on the overall design process by rating how satisfied they are with the outcomes of the design process on a scale of (low) 1 – 10 (high satisfaction) and explain why.

The process was generally rated quite positively, where most reflections acknowledged that due to the time constraint this was only the start of a (design) process. Simultaneously various participants mentioned their pride in the design they came up with in such a short time, even though it was incomplete. The quality of the group discussions and conversations are mentioned as a valuable component to the process while limitations were felt in a lack of time and expertise.

REFLEXIVE PRAXICE

The EduSTA badges are intended to act as an impulse for educators to reflect on the teacher's practice in relation to ESD. The workshop 'Navigating dilemmas....' at EAPRIL 2024 served as a mirror for our own learning and experiences during the EduSTA design. Participants went through a learning process with similarities to the process in the EduSTA badge teams, exposing their own perspectives and understanding on the three key themes in designing EduSTA badges: competence-based learning, ESD and transformative learning. While there were several limitations to reaching deep discussion on these themes, notably the timeline of the workshop and only two of the badges tested, we recognized highlights from conversations that eluded to our own discussions in the EduSTA consortium.

Collective processes like sensemaking, bargaining and refining are all rooted in the perceptions and understandings that the members of the collective bring with them. Everyone has a reference point for understanding based on what they experience and the types of conversations they hold. Each participant started to make sense of the competence from their own context and using their experiences. This is only natural and fits well with Weick's (1995) theory of how organisations make sense of new phenomena. Discussions on badge KPA showcased this in relation to sustainability discourses and the varying interpretations of how knowledge (of the SDGs and sustainability) can or should be used. The density of knowledge-laden concepts in the framing of KPA makes it a suitable starting point for teachers to develop their understanding of ESD and SDGs. Therefore using the badge as impulse to start a conversation about what ESD and the SDGs means, strengthened the participants (or

outside of the workshop context: educational designer) awareness of their own frames of references regarding ESD and SDGs. Similar processes unfolded for AC but rooted in examples of sustainability practices. Simultaneously, there is a risk in staying on abstract level when there is a need to make decisions or define something as a collective. Therefore, the urge to define concepts together is both part of the learning process and part of the design itself. The richness of a cross-cultural consortium, participant group, or educational design group is in bringing together examples from different contexts that broaden and deepen our understanding of what ESD might look like in our own lives.

Open digital badges provide a well demarcated tool to bring competences to educational practice, yet their plainness also presented challenges for the diverse, open-ended and complex competences central to the ESD discussion. Workshop participants exemplified this intuitively by questioning the borders between the various badges and the approach to assessment. Notable was the discussion raised on assessment for such competences warranting a reflective conversation between assessor and applicant. Similar discussions were held within EduSTA discussing for several badge areas, for instance in relation to badge *Learning Ecosystem Design* where a distinction should be made between how teachers design ESD and the efficacy of student learning on ESD. Likewise for badge *Enabling Action* where the outcomes of the initiated action, or how engaged the stakeholders were says very little about the learning process the teacher has gone through in initiating or facilitating action on ESD. The interest in capturing the learning process is well aligned with the way transformative learning is conceptualised within ESD (UNESCO, 2017) and highlights the importance of continuing to emphasise process when designing ESD. We recognize the participants' hesitation therefore to concretise assessment criteria.

And still, open digital badges present an avenue to make ESD, with all its interpretations, bite size for the teacher needing an accessible road into developing sustainability competence. As with any educational design process, it is essential to decide what discourse you are operating in. In the case of ESD, the levels I-III can function as a reference to make decisions regarding how the competence should be demonstrated, and how it will be assessed. The varying discourses on ESD do not however help to further the ESD agenda if they are working against one another, which the conflict between outcome-based model of education and transformative learning does hint to. At the same time, working on tools such as digital open badges exposes the tensions in bringing ESD to educational practice. While we were not able to explore these design tensions in great depth during the workshop, the workshop reinforced the necessity of deep knowledge and understanding on the SDGs, their interconnectedness, and how to connect content to pedagogy and educational practice for ESD. Developing collective understandings on this front is about as simple as designing ESD itself and calls for patience in the face of challenging discourse and divergent perspectives and experiences. Embracing imperfect tools is part of that process, wherein we, educational designers, *embrace complexity* while *critically developing* ESD practice.

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RELIGIOUS EDUCATION TEACHERS AND THEIR PERCEPTION OF NON-DENOMINATIONALISM IN RE LESSONS

Daniela Zahneisen

PhD candidate and research assistant (Protestant Theology/Religious Education), RPTU Kaiserslautern-Landau, Fortstr. 7, 76829 Landau (Germany), zahneisen@uni-landau.de

ABSTRACT

With regard to the desideratum concerning the question of how non-denominationalism are perceived and addressed by religious education teachers in religious education lessons, the central research question of my PhD thesis is as follows: What attitudes do religious education teachers have towards non-denominationalism as a dimension of religious-ideological diversity and what religious didactic ideas do they associate with this dimension? This research question will be clarified with the help of a qualitative-empirical approach. For this purpose, the use of in-depth interviews including case vignettes and in-depth questions is planned to explore the attitudes and behaviour of religious education teachers regarding non-denominationalism.

The present study is contextualised in Germany and focuses on this specific religious education setting. It is based on the concept of non-denominationalism, which can be located as "a perspective – also diverse in itself – in the interplay of religious and ideological plurality" (Woppowa, 2022, p. 309). This perspective includes several phenomena such as non-denominationalism, non-religiosity and religious indifference and must be taken into account in religious education in order to design future-proof religious education.

RESEARCH CONTEXT: RELIGIOUS EDUCATION IN GERMANY

The school system in Germany is a matter for the federal states, i.e. each federal state draws up its own curricula and decides on the organisational form of religious education. Overall, a denominational form of religious education prevails (alongside the subject of ethics/philosophy), which means that there are mainly Protestant and Catholic religious education lessons and, in some cases, also Islamic, Jewish and Christian Orthodox religious education programmes (see further for example Schröder, 2021). However,

denominational-cooperative and interreligious models of religious education have been steadily increasing in recent years, which is a consequence of increasing religious and ideological plurality (Baumert & Teschmer, 2024). In 2023, around 46% of the population in Germany do not belong to any religious denomination (in 2018, non-denominational people made up nearly 38%, which means a currently increase of solid 12%). 24% are Catholic, 22% Protestant and Muslims make up 4% of the population, while 2% each are Christian Orthodox or belong to another religious community (fowid, 2024). Religious education is therefore the largest area in terms of numbers for which the churches are jointly responsible and which provides young people with "space for religious learning and religion-related reflection" (Dechow et al, 2024, p. 333). At the same time, religious education is currently under pressure to legitimise (Domsgen & Witten, 2022), because fewer and fewer people belong to any church. In the face of increasing religious and ideological plurality, the question arises of how religious education can be organised so that pupils can find relevance in it regardless of their religious and ideological position. In the light of the steady increase in non-denominational people, this facet of religious and ideological diversity forms the focus of the following remarks.

Non-denominationalism and religious education

Non-denominationalism: A definition

Non-denominationalism basically describes non-affiliation to a religious community (i.e. people who have not been baptised or left a church). In this context, nothing is said about individual religiosity, as there can be both non-religious church members and 'religious non-denominationals (Käbisch, 2021, p. 1). Being distant from the church or even turning away from it does mean automatically the rejection of everything religious (Käbisch, 2021, p. 4). Basically, the term 'non-denominational' actually falls short because it is neither neutral nor does it include all facets of religiosity. The present study is based on a broad concept of non-denominationalism, which is to be located as "a perspective – also diverse in itself – in the interplay of religious and ideological plurality" (Woppowa 2022, p. 309). So I lean on the common use of the term in educational contexts, where a broad "tendency concept" of non-denominationalism dominates, which covers all those developments "that are described with the terms irrelevance, speechlessness and indifference with regard to Christian-religious patterns of interpretation and life practices" (Domsgen, 2018a, p. 4).

Non-Denominationalism as a challenge in RE lessons

Perceiving non-denominationalism is of great didactic relevance as non-denominational pupils are already part of the learning and target group of religious education – and the trend is rising (Schambeck & Kropač, 2022), at least in the German context. There is a growing demand to take non-denominational pupils seriously and to adapt the topics and didactic approaches to them as well (Evangelische Kirche in Deutschland, 2020). In the

words of Michael Domsgen (2014), religious education ultimately faces the challenge of making plausible what does not seem plausible to non-denominational students, because religious education must be able to clarify what potential for meaning is inherent in religion and religions, what they contribute to personality development and to what extent they can be a resource for shaping a meaningful life. The phenomenon of non-denominationalism in religious education settings has been increasingly investigated in recent years and has also been incorporated into religious didactic considerations.

First religious didactic approaches for learning groups with non-denominational pupils

Usually, Religious education theories do not focus on non-denominationalism as a missionary challenge (Pemsel-Maier, 2021, p. 191), but as a challenge to convey religious content as possibility for reflection and education. Three particularly prominent religious didactic approaches and principles are briefly outlined below, although elaborated concepts are not available yet.

According to David Käbisch (2021), a distinction can be made between three paradigms for educational work with non-denominational pupils: The first paradigm focuses on how the Gospel can be incorporated into lessons in such a way that non-denominational students also recognise its relevance and that they can be part of the communication. Authentic encounters with representatives of the religion are central (Domsgen, 2018b; Grethlein, 2012). The second paradigm centres on the question of implicit religion, in other words "the religious dimension of basic existential experiences, everyday symbols, community-building rituals and meaningful narratives" should be discovered, understood and transferred to one's own life (Käbisch, 2021, p. 7, quoted from Rosenow, 2016; Kumlehn, 2014; Meyer-Blanck, 2014). The third paradigm aims at a process of mutual exploration of religious and non-religious life orientations and perspectives on the world. Pupils should be able to switch between different perspectives and reflect on their own points of view in relation to other, unfamiliar positions (Käbisch, 2014).

For all these paradigms, it must be emphasised that they do not aim at leading pupils towards a particular religion or even converting or evangelising them. At this point, particular reference should be made to the so-called "Koblenz Consensus", which sets out important guidelines for religious education in Germany. It ensures that no pupil should be religiously proselytised: "In Protestant and Catholic religious education lessons, the aim is to communicate respectfully with other people, including about differing positions. This applies to the interaction between teachers and learners, the interaction between learners and the respectful treatment of religious testimonies and positions in the subjects taught. In this way, respectful communication is to be practised as a basic discursive attitude and its effects are to be dealt with." (Koblenzer Konsent, 2024)

Non-denominationalism as a challenge for RE teachers

RE teachers and non-denominationalism: a desideratum

In general, the task of planning and organising religious teaching and learning processes in such a way that they are suitable for all pupils is a challenge for religious education teachers and their competence in dealing with religious and ideological diversity (Woppowa, 2022), which is why actor research focussing on religious education teachers is an essential subject of religious education research.

So far, not much is known about how religious education teachers perceive non-denominationalism. This phenomenon is only marginally researched when it comes to religious-ideological studies in general (e.g. Riegel et al., 2023). In a nutshell: Studies on attitudes towards the organisational form of religious education (Feige et al., 2000; Kuld et al., 2009; Rothgangel et al., 2017; Pirner, 2022) come to the conclusion that religious education teachers "have a positive attitude towards opening up denominational religious education" and that denominational-cooperative religious education is generally viewed positively, although the principle of confessionality is still upheld (Hermisson, 2020, p. 134). The objectives of religious education teachers are being researched both in German-speaking countries and in Europe (Rothgangel et al., 2017; European comparative studies: PeTeR (Perspectives on Teaching Religion), Ziebertz & Riegel, 2009 and as part of the REDCo project (van der Want et al., 2009)). Religious diversity is perceived particularly differently by teachers (Pohl-Patalong et al., 2016). For example, they do not make a clear distinction between a lack of formal religious affiliation and a non-religious attitude. For teachers, church affiliation plays less of a role than the juxtaposition of religious and non-religious attitudes and, in general, an indifferent attitude towards religious topics is often perceived. However, this perspective represents a desideratum in religious education research, although there are isolated studies dealing with the perspective of religious education teachers (mostly quantitative in nature). On the one hand, there is a research gap with regard to the attitudes and behaviour of religious education teachers towards non-denominationalism in religious education (Finkenstein, 2022, p. 11; Eisenhardt, 2014, p. 45; Woppowa, 2022, pp. 312-313.) and, on the other hand, from a religious education didactic perspective, the question remains how non-denominationalism can be addressed in religious education in order to create an accessible RE for all learners (e.g. Domsgen, 2020, 212; Schwarz, 2019).

Non-denominationalism in the context of professional theoretical reflection

Religious education research on religious education teachers is mostly professionally orientated work that deals with the question of the role and professionalism of religious education teachers. In the German context, two approaches dominate when analysing the professionalism of (religious) teachers: competence theory and structural theory approaches (Klein, 2010, pp. 19-20). In the following, only the competence-theoretical

approach will be presented briefly because it is of particular interest for my study. From a structural theory perspective, the focus is on the negotiation processes that characterise religious education; from a competence-oriented perspective, "the attitudes, convictions and competences [...] that enable the teacher to provide good (religious) education" (Riegel, 2021, p. 135). The professionalisation of religious education teachers from the beginning of the 19th century "can be seen as a major motivation for the emergence of scientific religious education" (Rothgangel, 2019, cited in Wermke, 2008, pp. 258-261); conversely, "religious education teachers have long been a major focus of religious education research, both theoretically and empirically" (Rothgangel, 2019, p. 1).

In the context of competence-theoretical approaches, the COACTIV model (Cognitive Activation in the Classroom: The Orchestration of Learning Opportunities for the Enhancement of Insightful Learning in Mathematics) according to Jürgen Baumert and Mareike Kunter is a very fundamental approach to supplement expertise research on the teaching profession and research on teachers' beliefs with the concept of competence. The aim of the COACTIV study is to "identify the individual characteristics that teachers need to successfully master their professional tasks" (Baumert & Kunter, 2011, p. 31. COACTIV assumes that the professional knowledge of teachers is made up of three areas, which in turn are differentiated into their own areas of competence: 1) beliefs, values and goals, 2) motivations, 3) self-regulation. (see further: Baumert & Kunter, 2011, see also Figure 1). Particularly with regard to the aspect of beliefs and values, COACTIV is compatible with religious education considerations, because the profession of religious education teachers is more strongly characterised by personal attitudes and convictions as well as questions about their own personality than teachers of other subjects (Pirner, 2022, p. 24). My study belongs to this context, because the attitude research of religious education teachers is of central importance. Konstantin Lindner (2023, p. 65) demands, that "religious education teachers must [...] distinguish between religion-related observer and participant perspectives and be able to make this difference accessible to meta-reflection in the classroom." At this point, the competence in religious education, which can also be found in the further development of the COACTIV model in religious education, goes further: it emphasises the perceptual or diagnostic and pedagogical competence, the "feeling for the needs of the learners" (Riegel, 2021, p. 140) and, above all, the competence in religious education reflection as the ability to distance oneself from one's own religiosity (and one's professional role and actions) (Evangelische Kirche in Deutschland, 2014, pp. 7, 33).
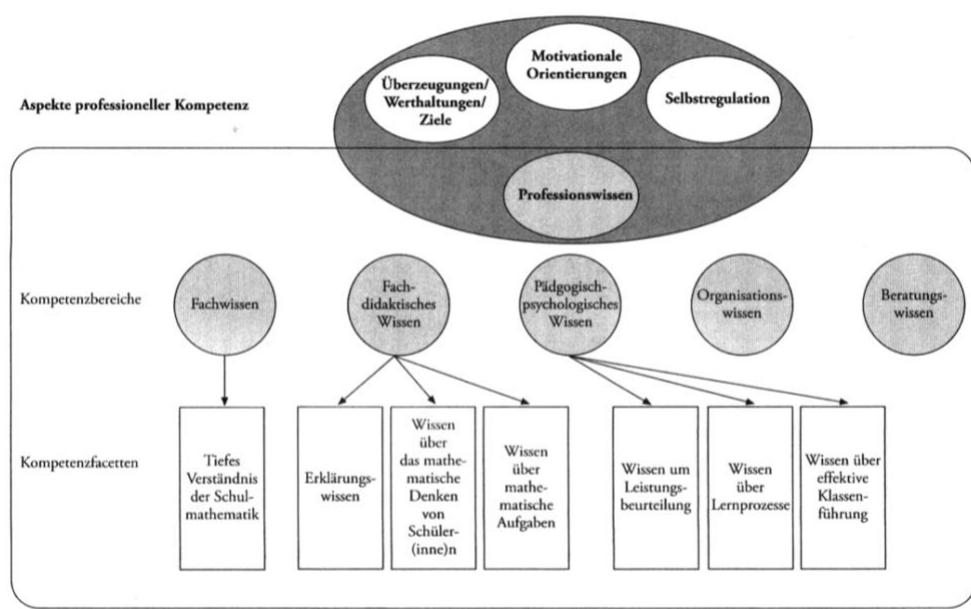
Figure 3: COACTIV model (Baumert & Kunter, 2011, p. 32)

PROJECT DESIGN

As my project is not finished yet, the following details are partly provisional. The interviews with religious education teachers have not been analysed yet.

Research question(s)

As described above, the perspective of religious education teachers on non-denominationalism in religious education represents a research gap. I would like to close this desideratum by basing my research on the following question: Which attitudes do religious education teachers have towards non-denominationalism in contexts of religious education and what religious didactic ideas do they associate with this dimension?

This implies further questions regarding the social and (religious) didactic level:

- How do religious education teachers perceive non-denominationalism as a dimension of religious-ideological diversity in society?
- What attitudes and approaches do religious education teachers take to the task of dealing with non-denominationalism as a dimension of religious-ideological diversity in religious education?
- Closely related to this is the following third question: What religious didactic ideas guide religious education teachers in dealing with non-denominationalism

in religious education (e.g. in relation to planning the teaching process, dealing with pupils, topics, methods)?

- And finally, a facet focussing on the professionalism of religious education teachers: What demands are placed on religious education teachers in the face of religious and ideological diversity in religious education, particularly due to the increase in non-denominational pupils?

Qualitative-empirical approach

Survey and evaluation method

The research questions are to be clarified through a qualitative-empirical approach, i.e. individual interviews, which include case vignettes and in-depth questions with 12 religious education teachers, and the evaluation by application of grounded theory and objective hermeneutics. In this way, the subjective views and constructions of meaning of religious education teachers can be recorded, which requires communicative structures in order to uncover "superficially concealed structures of meaning (not visible in normal conversation), interdependencies or deep-seated motivational structures through the use of explorative questioning techniques" (Kirchmair, 2022, p. 57).

Case vignettes offer a realistic introduction to the interview that comes from the everyday world of religious education teachers and thus provide a potential for identification that encourages them to talk about their perception of non-denominationalism in the most natural way as possible. This creates a stimulating initial situation that is intended to encourage the interviewees to make intuitive judgements or to take further action (Stiehler et al., 2012). The vignette is a classic form of elicitation that contains a narrative-generating impulse with a situational character. In this way, judgement behaviour in everyday life can be reconstructed (Miko-Schefzig, 2022, p. 13). In the interview, a hypothetical situation is used as a stimulus and the interviewee is asked to judge the situation and/or indicate a course of action appropriate to the situation and to justify this (Schnurr, 2003). By investigating patterns of thought and behaviour, latent meaning structures such as attitudes or motivation(s) can be ascertained (Miko-Schefzig, 2022), which is why this approach is suitable for ascertaining the attitudes of religious education teachers with regard to non-denominationalism.

Grounded theory (Strübing, 2022) makes it possible to structure and analyse the data material regarding the types of different attitudes/beliefs/convictions of religious education teachers in relation to religious and ideological plurality with the focus on non-denominationalism in religious education. In addition, the various sequencing methods of objective hermeneutics have the added value that latent structures of meaning can be uncovered (Oevermann, 2000).

Case vignettes used in the interview

The interviews contain a total of three case vignettes, which are presented to the religious education teachers being interviewed. The interview partners are asked to put themselves in the shoes of the situation described and to express their reactions. Subsequently, in-depth questions are used to elicit the attitudes and behaviour in relation to my research interest.

1) Imagine that today is an open day at your school. Each subject has its own information stand with illustrative material and introduces itself to interested visitors. As a religion teacher, you are representing the subject of Protestant Religious Education and get talking to a mother. The mother considers whether her child would be in good hands in the subject of religion during the transition from primary school to secondary school. She asks: 'We're not church members and don't know much about church. Will my child even fit into religious education?' How would you respond to this question?

2) Please consider yourself in the following situation: You teach at a small school. There are generally few teachers and therefore also few religion and ethics teachers. Unfortunately, one ethics teacher is now on long-term sick leave. The existing ethics groups are therefore to be divided up among the existing religion groups with the parents' consent. As a result, five more pupils with no religious affiliation are taking part in your religious education lessons. What do you think of this and what consequences does this change have for you and your religious education classes?

3) Now imagine that a trainee teacher for Protestant religious education would like to debrief a religious education lesson with you. She has just had the topic of resurrection in a ninth grade class. The pupils are very diverse in their prior knowledge and religious attitudes. Two pupils vehemently stated that they did not want to believe in such 'fairytale nonsense' as the resurrection. Nor could they understand why others believe in it. At first, the trainee teacher was overwhelmed and didn't know how to respond to the objections. At first, she ignored the pupils' comments. However, she would like to take up the situation again in the next religion lesson. She therefore asks how you would deal with this in her place?

Other colleagues join the conversation. One colleague emphasises how important it is that all pupils recognise the relevance of the Christian message. In his opinion, every religion teacher must be able to speak authentically about their faith. This would enable pupils to better understand what it means to belong to a particular religion. A second colleague tries to incorporate as much of the pupils' everyday lives as possible into the religious education lessons. She emphasises, for example, that religious symbols in everyday life can be used to build a connection to religion. In this way, all pupils could transfer religious

meanings to their own lives. A third colleague favours switching between different religious and non-religious viewpoints in religious education lessons. For example, she works with different - also religious - actions in her religious education lessons. This makes religion tangible and understandable, she says. After the interview, the trainee teacher turns to you again and wants to know what you think about the three ways of organising religious education lessons mentioned above. How would you plan the next lesson?

The aim of my research is to contribute to reflections on religious education that is fair to all its pupils by taking everyone into account. In terms of subject-orientation, those pupils who no longer see themselves as part of the churches must also be recognised and taken seriously. In order to start here, the perspective and attitudes of those who decisively determine the lessons are crucial: the religious education teachers.

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NEPALESE UNIVERSITY TEACHERS' EXPERIENCES OF CO-CREATION IN DEVELOPING NEW COURSES TO INTEGRATE 21ST CENTURY SKILLS

Dr Eila Burns*, **Dr Usha Acharya **, Mr Krishna Prasad Adhikari,*** and Ms Nirmala Subedi ******

*Senior Researcher, Jamk University of Applied Sciences, Rajakatu 35, FI-40200 Jyväskylä, Finland, eila.burns@jamk.fi, ** Lecturer, Nepal Open University, Manbhawan, Lalitpur, Nepal, usha.acharya@nou.edu.np, *** Assistant Professor, Central Department of Education, Tribhuvan University, Nepal, krishna.adhikari@cded.tu.edu.np**** Asst. Lecturer, Nepal Open University, Manbhawan, Lalitpur, Nepal, nirmala.subedi@nou.edu.np.

ABSTRACT

This research was conducted in Nepal, a country that despite facing significant poverty and numerous cultural, ethical, social, political, and economic challenges, aims to improve pedagogical quality in higher education and equip learners with essential future skills. Our study aims to explore the experiences of Nepalese university teachers on collaborative co-creation approach in developing courses that integrate 21st century skills through national and international partnerships.

Co-creation has emerged as a vital strategy for fostering collaboration among stakeholders in education. Co-creation process facilitates increased interaction, ultimately enhancing educational quality.

Employing a qualitative research design, this study utilises semi-structured interviews with 14 Nepalese academics to investigate their experiences with co-creation. Findings reveal key benefits, including enhanced interaction and collaboration, professional development, and cultural exchange. However, challenges persist, such as differing work cultures, resistance to digital practices, and the struggle to manage time constraints amid heavy workloads.

The research concludes that the co-creation process has been transformative for Nepalese university teachers. The involvement of international experts and a focus on cultural exchanges have significantly improved curriculum development and teaching methodologies, contributing to the broader goal of enhancing educational systems globally, particularly in developing countries.

INTRODUCTION

Teacher professionalism and teacher quality have been recognised as some of the key factors in improving the quality of education. This phenomenon is evident globally as seen in publications by Organisation for Economic Co-operation and Development (OECD), which provide definitions and breakdown of policies that promote teacher quality (Schleicher, 2015). Thus, we can postulate that teachers can be real changemakers in the process of improving students' skills, knowledge, attitudes and values needed to tackle the changes in their environment and daily lives. Such changemakers are particularly needed in developing countries like in Nepal, where teachers tackle enormous ethical, social and economic challenges daily.

Additionally, discussions in education and the world of work have emphasised the importance of acquiring generic skills (also known as transferable skills, core competences or 21st-century skills) to increase employability (Tight, 2021). These skills encompass knowledge, skills, attitudes and values are needed, not only by students but also by teachers to meet the unknown challenges of the 21st century, transform society, and shape the future for better lives (Tight, 2021). However, integrating 21st-century skills into existing education programmes is a new practice in Nepal. One of the core generic skills in education is collaboration, not only between individuals and but also between organisations, which is also a new concept in the relatively short history of Nepalese higher education.

Supporting the development of these competences in developing countries like Nepal is aided by different international governments. Our research is based on funding from Finland's Ministry for Foreign Affairs through the Higher Education Institutions Institutional Cooperation Instrument (HEI-ICI) for the project "Developing Pedagogy for 21st century skills in Nepal". Its overarching aim was to increase the capacity of Nepalese higher education teachers', particularly to enhance their 21st-century skills and digital competencies. To offer authentic experiences in developing these skills, the current study explores the process of co-creation. It integrates organisational resources and encourages exchange and interaction between the co-creators to aim for higher quality pedagogical practices and innovations (Dollinger, Lodge & Coates, 2018). In this article, we focus on the experiences of Nepalese university teachers as they co-created online courses with international and national experts and integrated 21st-century skills into these courses.

HIGHER EDUCATION IN NEPAL

Some researchers such as Simkhada and Teijlingen (2010) and Upadhyay (2018) have noted that while the history of higher education in Nepal is short, it has experienced significant growth since the emergence of democracy in the 1950s. Tri Chandra College, the first higher education institution in Nepal, was established in 1918, initially affiliated with Calcutta University and later with Patna University in India. The collapse of the Rana regime in 1951 created a favourable climate for the growth of higher education. At

that time, higher education at Tri Chandra College was accessible to individuals who completed the School Leaving Certificate exams, with minimal fees, thus providing educational opportunities to all who sought them. However, students who completed their bachelor's degrees had to travel to India to pursue their master's degrees. The establishment of Tribhuvan University in 1959 marked the institutionalisation of higher education in Nepal. Following the restoration of democracy in 1990, various public and private universities were established, expanding the range of programmes courses and modalities available in higher education.

In the context of reforming Nepal's higher education system, Upadhyay (2018) argued that to establish a robust foundation for higher education, education planners must adopt a multidimensional and dynamic approach. The higher education system should be flexible and offer formal and nonformal, full-time and part-time, as well as online-based courses that cater to diverse needs. On the other hand, Kunwar et al. (2020) identified several challenges in implementing online education, particularly issues related to students, teachers, and the curriculum. Additional challenges included technology, student guidance and support, equity, pedagogy, access, time, and attitudes. To address these challenges, the government, universities, and relevant institutions should focus on infrastructural development and provide technical and other support to students, faculty members, and staff by ensuring access to electronic equipment, devices, and digital resources.

Furthermore, Upadhyay (2018) suggested that faculty development programmes should aim to enhance the quality of faculty members, infrastructure should be improved, evaluations should be timely and maintain standards, and the curriculum should be regularly updated to include relevant issues. Pedagogical approaches should be changed timely and effective collaboration between institutions and employers should be maintained. The government should formulate policies to invest in higher education, where the current allocation of approximately 7 percent of public expenditures in education seems very low.

In this regard, Simkhada and Teijlingen (2010) stated that Nepal's education system is a product of its century-long authoritarian and feudalistic political history, which has created socioeconomic inequities among citizens. Higher education is influenced by these inequalities, with the wealthiest 20% of the population receiving nearly half of all public education resources, while the poorest 20% receive very little. Vocational courses such as engineering and medicine, which often lead to well-paid jobs and high status, are generally accessible only to the rich and upper-middle classes.

21st Century Skills in Nepalese Context

The essence of 21st-century education is to prepare the citizens who can contribute to and work the society. Over the last decades, numerous models and frameworks for 21st-century education have been developed (e.g. Binkley et al., 2012; Van Laar et al., 2017). Although there are some different focus points and areas of emphasis within the frameworks exist, they are largely consistent in terms of what 21st-century competences are. In general, the different frameworks have highlighted, skills such as collaboration,

communication, ICT literacy, intercultural skills, citizenship, creativity, problem solving and learning to learn as integral skills for a 21st-century citizen.

At the onset of the project funded by the Finnish Ministry for Foreign Affairs a baseline study was conducted in 2020 to map out how Nepalese HEI teachers integrate 21st century skills into their teaching in online environments. The baseline study focused on analysing the 21st-century skills within four main themes: 1) *Ways of thinking* (critical thinking, problem-solving skills, innovation and creativity, learning to learn and metacognition), 2) *Ways of working* (collaboration and communication skills), 3) *Tools for working* (ICT literacy, information management), and 4) *Living in the world* (social and cross-cultural skills, global citizenship skills). We discovered that many of Nepalese HEI teachers (n=358) did not have a comprehensive understanding of the of 21st- century skills, nor were these skills actively applied in teaching. Devkota et al. (2021) highlighted by that COVID-19 pandemic truly highlighted the necessity of digitalization and collaboration between and within the institutions in Nepal. And the Developing Pedagogy for 21st-century skills in Nepal project launched during the pandemic period, demonstrated how such digitalization and collaboration could be achieved. This awareness prompted us to focus on fostering a culture of collaboration among and within the universities and launch the co-creation process in developing new educational courses.

CO-CREATION PROCESS

Concepts such as co-creation of curricula and integration of 21st-century skills in education are on a high agenda in the discussion about the future of learning. Constantly changing operating environments in the educational sector challenge both organisations and individuals to renew their methods of development and collaboration. The digitalisation of education, multi-location work, and businesses requiring new future skills from their employees are only some of the challenges faced in 21st-century education. The fundamental changes in the job market and the era of innovations calling for collaboration and diverse perspectives have prompted research on future skills (Ehlers & Kellermann, 2019) and highlighted the process of co-creation.

Co-creation, originally a business concept for value creation through company-customer interaction (Galvagno & Dalli, 2014), has been increasingly adopted in education. Based on a constructivist view of knowledge creation, co-creation has been used to enhance complex processes such as curriculum development and assessment design (Lubicz-Nawrocka & Bovill, 2021). Previous research on involving students in the curriculum co-creation (Bovill, 2020; Lubicz-Nawrocka & Bovill, 2021) has found benefits such as improved students' enjoyment, engagement, and feelings of a mutually benefit between teachers and students (Tsui, et al., 2024). Co-creation process has been found to be effective way to develop the skills and positive attitudes in communication, collaboration, and conflict management (Cook-Sather et al., 2014). It also has been found to help develop a respectful and safe environment within institutions (Hill et al. 2019), and to build rapport among the stakeholders (Riva et al., 2022).

As the use and value of co-creation in higher education is still new, not many conceptual models of the process yet exist. In our study, we utilised an indicative model of co-creation for the higher education developed by Dollinger and his colleagues. Their dual model includes two distinct yet complementary dimensions: co-production and value-in-use, highlighting the indicators and benefits of the co-creation process as shown in Figure 1 (Dollinger et al., 2018).
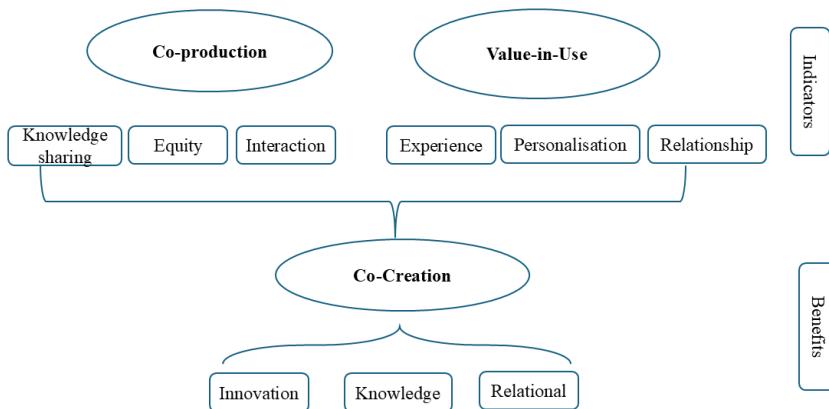
Figure 1: Indicative model of co-creation in higher education

According to the model, co-production dimension can be indicated through three indicators: knowledge sharing, promoting equity, and mutual interaction. In our study, this included staff members from Nepalese and Finnish universities sharing their expertise, exchanging ideas and information related to the development of courses and 21st-century skills, and creating balanced relationships and equal access i.e. equity to the developed material. Interaction was continuous and utilised both digital environments and face-to-face contexts.

The second part of the model, value-in-use, also has three indicators: experience, personalisation and relationship. In our study, this included acknowledging how the Nepalese university teachers utilised the information gained in their own work. The experience indicator referred to the teachers' views on how the jointly created courses would be perceived by their students, whereas personalisation included Nepalese teachers' own cultural preferences they wanted to include to the courses. The third construct, relationships, complemented the previous indicators by considering teachers' relationships with their own organisation i.e. whether they had positive or negative views of their organisation. The dual model also outlines the anticipated benefits of the co-creation process, both for staff members and higher education institutions. These

benefits for staff members could include valuable and expanded interactions, work satisfaction, and for institutions, staff loyalty and an improved university image.

As discussed before, little is known about how and if the concept of co-creation can support academics in developing courses that integrate 21st-century skills and adopt student-centred pedagogies in a tradition-laden society in Nepal. The aim of our research is to explore Nepalese university teachers' experiences of the co-creation process in developing such courses.

The research questions were formulated as follows:
- Which practices did Nepalese university teachers perceived as enhancing and hindering their co-creation work?
- How the existing co-creation process can be improved?

METHODOLOGICAL APPROACH

Our qualitative study is anchored in semi-structured interviews conducted with university teachers from Tribhuvan University and Nepal Open University. This choice is grounded in the assertion that semi-structured interviews offer a flexible yet focused means for exploring complex phenomena that co-creation is (Roulston & Choi, 2018). This approach enabled us to delve deeply into the subjective experiences and perceptions of the participants. A purposive sample of 14 university teachers was utilised, selecting faculty members who were involved in the co-creation process to develop courses for the curriculum "Master of Educational Science in Digital Pedagogy".

The sampling process aimed to ensure equal gender parity, but this was not achieved as out of 14 teachers, four were female and the rest were male. Participation was voluntary and the participants were informed that the data would be processed anonymously. All participants gave their informed consent to take part in the study. The interviews were conducted from June to August 2024 by Nepalese researchers. Each interview lasted approximately one hour, during which participants were asked to use the Nepali language to facilitate a space where teachers could articulate their insights and experiences with maximal clarity and authenticity. Semi-structured interview questions were used to explore the practices employed in the co-creation process; the benefits and difficulties experienced, and how the co-creation process could be improved.

Data Analysis

This study applied Braun and Clark's (2006) thematic analysis, a commonly used method for identifying and interpreting data patterns in qualitative research. Defined as a systematic approach to uncovering themes across a dataset (Braun & Clark, 2006), this method aligns well with investigating Nepalese academics' experiences of co-creation process. Its flexibility, noted by Kiger & Varpio (2020), enabled an in-depth exploration of participants perspectives, making it suitable across diverse pedagogical contexts.

Following Braun and Clarke's (2006) guidelines, the analysis underwent detailed phases. The process began with transcribing and translating audio to text in English and during this process, all identifiable information was moved to ensure confidentiality. The transcribed data were read and re-read by the authors for reflection and familiarisation purposes. After data familiarisation, initial coding followed, capturing key meanings and patterns, and organising the data systematically to identify meaningful patterns (Braun & Clarke, 2006). Codes were then reviewed and grouped, marking a crucial phase where broader themes began to surface. Through iterative refinement, these themes were sharpened, and finally defined and named. Consequently, the dataset was systematically categorised into the initial themes of benefits, challenges and ways forward, and further refined into final three themes: 1) collaboration and interaction, 2) professional development and empowerment, and 3) cultural and contextual practices. Participants also indicate several actions for improving co-creation practices.

FINDINGS

The data obtained from the interviews with Nepalese university teachers revealed several themes highlighting how the co-creation process can be both beneficial and challenging. The findings emphasise the importance of collaboration, professional development, empowerment, and cultural exchange while also addressing the obstacles that need to be managed and providing suggestions to improve co-creation practices.

Professional Development and Empowerment

Participants reported notable improvements in their course design process through the co-creation process. Their skills shifted from content-heavy, theoretical approaches to more practical, student-centred course design. This transformation was achieved through by adopting new strategies and discarding outdated practices. University teachers learned how to design courses with less contents and more activities to support learning. Using action verbs to define learning objectives and outcomes was one of the major beneficial skills acquired during this process. One participant shared, *"based on this collaborative working culture, and sharing and hearing the inputs from both national and Finnish experts we were able to make manageable content and more productive courses."*

The participating teachers also revealed developed their 21st-century skills during the process. They discovered how to unlearn outdated practices and relearn newly approaches, building a transformative attitude and confidence to implement newly acquired knowledge in their own settings. *"I unlearned many traditional practices in creating a course, and I relearned a new approach to course development through the process of co-creation"*. Teachers acknowledged co-creation as a learning opportunity, as this approach was a new in the Nepalese context. *"The co-creation process was a learning experience, where we gained new perspectives and skills from international collaboration"* and *"This co-creation process was a completely new perspective for us*

in the Nepalese context, requiring us to adapt traditional methods to fit the new approach". The co-creation process not only built up a level of confidence and expertise on the course development process but also transformed teachers' professional practices. In this regard one participant shared, "*this co-creation process has helped to transform my teaching and learning activities into a more engaged and interactive classroom*". Teachers also developed their technological skills, as one participant shared, "*the course 21st-century skills was developed by me and my colleague. We gained ICT based knowledge and digital skills while developing the course. We learnt about the 21st-century skills through the interaction with different experts."*

Importance of Collaboration and Interaction

Understanding the importance of collaboration was one of the benefits experienced by participants, supporting both intra- and inter-institutional work. Respondents noted that multiple rounds of discussions, feedback exchanges, and consultations with external experts being useful and supportive. This collaborative approach was experienced crucial in integrating new skills and perspectives into course design. The collaborative culture enabled participants to refine their ideas and significantly improve course design. The collective brainstorming approach, described as "more heads are far better than one," allowed for the development of more comprehensive and practice-oriented courses. One of the participants highlighted that *"in collaboration with Tribhuvan University and the Finnish experts we developed the course 'Perspectives on Education' that helped us to make it more practical."* Working collaboratively with different university specialists built a team-sharing culture, beneficial not only for content development but also for transforming course structures into more practical and student-centred formats. One participant noted, *"we learnt to design less content, add more activities, to build a more focused course".* Working in a mixed team offered university teachers opportunities to expand their interaction and communication skills as expressed by one participant, *"I got a chance to work collaboratively with national and international experts. While developing the course, I learned different skills of using action verbs to make objectives and outcomes".* Communication and interactions were mainly conducted online, offering a flexible channel for co-creation. However, problems with internet access, electricity cuts and varied learning platforms hindered communication and collaboration in Nepal. One teacher mentioned, *"I had technological challenges due to electricity and internet fluctuation. Also, different interfaces of MOODLE created confusion among us and students. It was changed many times that affected our work."*

Different Communication Styles as a Challenge

Although participants understood the importance of effective communication for the co-creation process, they experienced difficulties due to a lack of timely information sharing as well as personal and organisational time management issues. These challenges were caused by differences in working cultures, levels of adaptability and different negotiation skills. One participant shared, *"I felt that limited information sharing caused confusion. The work was delayed, because we didn't get proper information"*.

Different institutional practices and focuses on interaction and collaboration between the universities created obstacles in achieving uniformity in course development, as noted by one teacher: *"Working with different universities helped us to create more practical-oriented curriculum, but it also caused some confusions as the practices were so different."* Initially, participants had difficulties discussing their issues and uncertainties with other experts. This was evident in one course creation where the plan was to jointly create one course for both Nepalese universities. However, this did not work out due to many institutional differences that were not highlighted at the beginning of the joint work. Nepal Open University focused on school education, while Tribhuvan University focused on higher education, leading to difficulties in developing a uniform course. In this regard participant shared, *"I worked with other university friends, and we discussed 2-3 times, and eventually during one discussion an issue was raised of different student populations. We noticed we are different, and for that reason our collaboration could not run smoothly."*

The findings noted difference in communication styles between European and Asian cultures. Generally, European communication style tends to be direct and explicit, whereas Asian style relies on high-context communication, maintaining harmony and avoiding confrontations (Hofstede, 2015). This was evident on the comments made by one of the teachers *"I faced many challenges on incorporating feedback due to different thoughts and opinions of experts. Sometimes they said work together, or reduce content and make it more practicable, but then I got different opinions from my Nepalese experts."*

Cultural and Contextual Practices Seen as Benefits and Challenges

The co-creation process also contributed to social and cultural aspects. The exchange of cultural practices between experts from different universities strengthened bilateral relationships and enhanced understanding of indigenous cultures. This cultural exchange was seen as a valuable outcome, fostering harmonious relationships and enriching the overall co-creation experience. While not a primary focus, economic benefits were also mentioned as a result of knowledge sharing. Participants noted that the skills and experiences gained through the co-creation process opened opportunities to develop similar courses at other institutions, potentially leading to economic advantages.

Cultural and contextual constraints also created difficulties. Respondents noted that 'fixed mindset´ rooted in traditional and theoretical approaches hindered the

incorporation of feedback from international partners. They also noted tension between local practices and feedback from Finnish experts. One participant elaborated, *"I faced many challenges due to different thoughts and opinions of experts as we are used to make theory loaded courses. It was difficult to reduce content and make it more practical "*.

Resistance to digital adoption within traditional academic environments posed additional challenges. Participants reported reluctance from authorities to introduce digital course programmes. Designing courses in a modular structure, which was a new practice for many participants, also proved challenging. In this regard, one of the participants shared. *"I had difficulties in course evaluation as authorities asked to use the traditional evaluation system"*. Integration of technology in the courses faced financial constraints in Nepalese universities, leading to reliance on pirated software, further complicating the course development process.

The workload and time constraints were perceived as obstructing the co-creation process and creating significant challenges. Participants found it difficult to balance this new type of collaborative work with their existing academic responsibilities. Teachers with heavy workloads involved in the co-creation work were not sufficiently compensated compared to administrative personnel, further exacerbated these challenges. Bureaucratic and administrative hurdles in approving the developed courses added to the difficulties. Such a bureaucratic system required negotiation at multiple levels within the university, delaying the co-creation process.

Enhancing Co-Creation Practices

To enhance co-creation activities, teachers from both Nepalese universities provided several suggestions. Participants emphasised the necessity of frequent meetings and timely and appropriate information sharing before starting any work tasks. This was evident in one of the responses, *"we need to have meeting frequently, information circulation in time is needed to know what is going on as well as it is better to provide the whole information in advance or before starting the work"*. Information of learners' needs was deemed essential, along with clear coordination among course developers, subject committees, academic councils, and policy-level personnel. Involving policy and authority-level individuals in course design and co-creation was one of the suggestions to facilitate monitoring in any future implementation. Additionally, participants highlighted the importance of in-depth knowledge sharing among academics to bridge gaps in different competences. One participant as noted, *"it is better to have an in-depth level of academic sharing to reduce the gaps in the work"*. The participant further recommended post-semester discussions with students to address difficulties and revise courses accordingly.

Further opinions and suggestions included the value of co-creation as a collaborative philosophy, promoting group ownership and the integration of multiple perspectives. Participants stressed the importance of equal understanding and collaboration among team members, clear work division, and effective budgeting. One teacher noted, *"co-*

creation team members need to have the same level of understanding and collaboration, there should be work division in team, high bonding with members as well as proper budgeting".

Eliminating hierarchical distinctions, *"sense of superiority and juniority needs be to be eliminated in co-creation" and* ensuring timely idea sharing were also highlighted. Some participants found that the co-creation period was enjoyable and educational, advocating for a feeling of belonging among teachers involved as shared with one participant*, "The concept of co-creation is good, whoever is involved, as they share common feelings. It was enjoyable for me".* Respondents suggested that overcoming institutional rigidity and embracing digital practices would be crucial steps to enhance co-creation. Continuity of collaborative practices and regularity of meetings among co-creators, as well as institutional support and infrastructure improvements to support digital collaboration, were emphasised.

DISCUSSION AND CONCLUSION

Our study on Nepalese university teachers' experiences with the co-creation process in developing new courses, indicates that although beneficial the process did not proceed without challenges. The co-creation process, involving significant collaboration among various stakeholders, both within and outside one's educational organisation, revealed being as a complex and multi-faceted journey.

As depicted in the model by Dollinger et al. (2018), successful co-creation requires both co-production in terms of knowledge sharing, equity and mutual interaction, and value-in-use through experiences, personalisation and relationship. In our study, participants from national and international universities shared experiences and skills to enrich the co-creation efforts. The process fostered a collaborative culture among Nepali professionals, which was previously lacking. This new culture of collaboration is seen as a significant positive outcome. These cultural and inter-university exchanges can be viewed as a value dimension in Dollinger's (2018) co-creation model, enriching the experiences of the participants and contributing to the overall success of the tasks.

Moreover, the co-creation process has been beneficial for the professional development of the participants. Teachers have engaged in unlearning and relearning their implementation practices, which has allowed them to adopt new approaches to course development in higher education. This process has empowered teachers, boosted their confidence, and enhanced their capabilities, leading to a transformation in their teaching and learning methods as discussed also by Cook-Sather et al. (2014).

Despite the benefits of the co-creation process, several challenges persist, stemming from institutional differences, cultural practices, communication barriers, technological limitations, bureaucratic hurdles, and work-life balance. Our findings suggest that while co-creation holds significant potential for innovation in course development, it necessitates adaptability to mitigate these challenges. The analysis of respondents' feedback reveals several key aspects that could enhance the co-creation process. Firstly, better alignment and adaptation among collaborating institutions are essential to address

challenges arising from institutional practices and cultural differences. Effective co-creation requires a common understanding of time schedules for co-working, meetings, seminars, and workshops. Secondly, maintaining consistent team composition can improve understanding and collaboration among group members. It was highlighted that the subject-specific experts should be emphasised over the hierarchical positions within team compositions. This would support the continuation of collaborative practices and adaptation of technological challenges.

In summary, the co-creation process has been a transformative experience for Nepalese teachers, characterised by the development of collaborative culture and professional growth. Our small-scale research contributes to the existing body of knowledge on the co-creation methodology in the development of higher education. The results indicate that co-creation is a valid methodology for enhancing the quality of higher education programmes. However, we recommend careful introduction and implementation, with a particular emphasis on ensuring that all partners fully comprehend the underlying principles of collaboration to achieve the anticipated outcomes.

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RESULTS FROM THE EAPRIL ROUNDTABLE TO PRETEST THE USE OF THE CRITICAL INCIDENT TECHNIQUE TO ANALYSE MISCOMMUNICATION IN GROUP MENTORING PROGRAMS FOR EXPERTS

Tom De Schryver*, **Zenobia Homan**** , **Rebecca Eliahoo *****

*Associate Professor at the Netherlands Defence Academy, Faculty of Military Sciences, Breda, The Netherlands, t.d.schryver@mindef.nl **Research Fellow and Project Coordinator (CBRN Security) at King's College London, Department of War Studies, Centre for Science & Security Studies (CSSS), London, United Kingdom, zenobia.homan@kcl.ac.uk, *** Lecturer at Workers' Educational Association (WEA), United Kingdom

ABSTRACT

Miscommunication in group mentoring programs often occurs. Both mentors and mentees might not be able or willing to exchange information required for meaningful interaction. They may not have the freedom to fully express themselves or they may not be willing to listen to a different point of view. These behavioural responses require priority in the instructional design of mentoring programs. In order to give practical advice to mentors on how to improve communication in functional group mentoring programs, we have conducted a literature review and developed a research proposal. In our research proposal, the use of Critical Incident Technique (CIT) is central. We describe the results of pretesting CIT at the EAPRIL conference where educational experts helped to fine-tune our research proposal.

Mentoring can be defined as a process for the informal transmission of knowledge, social capital, and psychosocial support from a mentor to a mentee. Mentoring entails dedicated communication between a mentor and a mentee — usually face-to-face and during a

sustained period of time (Bozeman & Feeney, 2007, p. 731). Group mentoring involves a program that includes multiple mentees (and mentors) in order to stimulate diversity of thinking, practice and understanding. In group mentoring, mentor(s) are no longer the wise trusted advisors only. They also act as facilitators for group dynamics. They encourage mentees to share experiences and problems and steward them based on the mentor's experience. The relationships between mentors and mentees in group mentoring are less hierarchical than in traditional mentoring, as mentors and mentees help each other within the framework of a functional mentoring program. Thus, the mentoring activity becomes a shared, distributed and complex responsibility in which everybody can take on the role of trusted advisor (e.g. Kram & Isabella, 1985).

Despite these benefits, mentoring in general brings about communication challenges (e.g. Feldman, 1999, Finkelstein et al., 2003, Tinoco-Giraldo, 2022). The risk is present that participants do not feel safe or confident to take on advice or trust the words that have been said. Hence, instead of connecting, catalysing or stewarding mentees, group mentoring programs can lead to debate and polarization among participants. In practice, program managers of mentoring programs should navigate around these persistent communication boundaries. They should acknowledge that not everybody can share private information. They also have to assume that some people may be unwilling to listen or receive feedback (e.g. Van Werven et al., 2023).

Moreover - and relevant for our working context (see Homan and De Schryver, 2024) - adults and experienced people do not always find it easy to take on a mentee role (e.g. Finkelstein et al., 2003; Feldman,1999). In the design of a functional mentoring program for professionals that already have a long history of experience and even a track record, there will be power and information asymmetries. It is therefore important to take the affiliation and the agenda of participants into account. The ultimate goals of experienced mentees can be situated outside the mentoring project. They are likely to stick to their agenda. Their role is to gain or to strengthen the support from other stakeholders that are not immediately visible or present while the communication is taking place. Communication in such a context may become a game of reinforcing "us versus them" thinking; even though "you and me" are only physically present in the mentoring program. The goals of these mentees are stronger than the desire of a program manager to find common ground in a temporary group mentoring context. In sum, a focus on the external persisting pressures on participants in a mentoring context helps to understand why it will be extremely difficult to find transformative solutions for program managers. Alternatively, when mentoring programs insufficiently consider the external pressures, the communication in a mentoring program will serve to fuel identities and will lead to reiteration of a participant's own position. Then little learning and knowledge exchange will occur. Instead, communication then serves to fortify existing positions.

In dysfunctional mentoring relations miscommunication piles up to a stage where participants might become defensive or protective when encountering new information. We therefore advocate for a more structured examination of miscommunication. We draw on the model of polarisation by Brandsma (2017) for two reasons. First, Brandsma has introduced more stakeholders than the ones who do the talking. In this model there are "pushers," "joiners," "silent people," and "bridge builders." Pushers generally tend to talk but do not listen. Joiners tend to listen to pushers and agree. The silent and bridge builders remain agnostic or see both sides. In the context of functional mentoring, we acknowledge that any mentee or mentor can play each role. We speculate that this model can help to explain dysfunctional communication in group mentoring contexts better.

Second, Brandsma (2017) has identified productive and counterproductive strategies to deal with communication boundaries. If we adopt his recommendations to the mentoring context then mentors should not take on the role of bridgebuilder on their own. Trying to solve communication boundaries between people is a high-risk strategy as long as the underlying reasons are not clearly understood. Instead, mentors should try to create conditions so that the mentees are willing to connect. It is up to them to receive and to make use of the input from within the mentoring program. Brandsma (2017) has identified three successful options to counter miscommunication. The first option is to restrict the conversations in the mentoring program to topics that are not sensitive. The second option is to restrict the participation in the mentoring program to more agnostic people (the "silent"). A final option is to invest heavily in the mentoring relationships, so that sensitive topics and persons become less sensitive. Indeed, the importance of early communication efforts to create trust at the start of a mentoring program has only recently started to receive attention (van Werven et al., 2023)

While these options might increase the likelihood of meaningful interaction, none of them are without risk. First, we think that restricting the conversation to nonsensitive information risks not getting to the bottom of the problem. Communication can remain superficial and learning is superfluous (see also Feldman, 1999). Second, when only the silent in the Brandsma model are enrolled in the mentoring program, we may ignore the voice of the pushers, who can be powerful and overrule the silent. Finally creating rapport in a functional mentoring program can never be fully achieved - because differences are not always at the personal level.

Accordingly, applying the Brandsma model to the context of mentoring programs, is in our views promising; but it also raises more questions than answers at this stage. We have therefore decided to use an inductive approach where we aim to find clues about successful and detrimental communication strategies from what experienced mentors and mentees recall. Therefore, we would like to use the Critical Incident Technique (CIT) (e.g. Bott & Tourish, 2016). A critical or revelatory incident can be defined as *"any observable human activity that is sufficiently complete in itself to permit inferences*

and predictions to be made about the person performing the act. To be critical, an incident must occur in a situation where the purpose or intent of the act seems fairly clear to the observer and where its consequences are sufficiently definite to leave little doubt concerning its effect'' (Flanagan, 1954, p. 327).

This ties well into mentoring research, as functional mentoring programs have specific goals (Thorndyke et al., 2008), which can or cannot be met due to miscommunication. Not surprisingly, CIT has been used in research on mentoring context (e.g. Cain, 1981; Orland-Barak & Yinon, 2005, Eliahoo, 2016, Buydens, 2016). Moreover, similar approaches, like turning point analysis, are also common in the study of relations between mentors and mentees (e.g. Bullis & Bach, 1989; Hagenauer et al. 2023). In turning point analysis, multiple critical incidents are identified and analysed as a sequence. It favours breadth over depth. We argue that turning point analysis can be considered in a follow up study after that we have gained some insights from the analysis of individual revelatory incidents in functional group mentoring contexts.

All previous empirical studies using CIT primarily focussed on critical incidents in traditional dyadic mentoring practices between one mentor and one mentee. They also mainly focussed on escalating incidents between mentors and mentees, leading to dysfunctional relationships. Our approach is different in two ways. First, we would like to extend this method to group mentoring - where the respondents can recall any incident in the group. It does not matter if the respondents were involved in the actual communication. It is acceptable if the informants only *observed* the miscommunication while participating in the mentoring program. If respondents are able to recall the incident, it must have had an impact on them personally. The mere fact that a respondent recalled an incident is an indication that it has triggered a learning process in the mind of the respondent: the incident has had a transformative value for the respondent. We aim to turn this personal value into general knowledge that helps to find productive solutions to miscommunication in group mentoring programs.

The second difference with previous mentoring research is that we would like to define critical incidents in a more neutral manner. We understand that mentoring in a security context is a contested space and that hence miscommunication happens all the time. We believe that some of the miscommunication can be dealt with in a constructive way – but others in a destructive manner. Instead of only focussing on incidents that lead to escalation, we would like to compare incidents which were successfully resolved to incidents that were not.

Bott & Tourish (2016) argue that CIT enables greater focus on practical context. They say it offers thick descriptions, and that it is a great method for inductive theorising if the researcher is open to be surprised. In terms of data collection, the advantage of CIT is that it can provide thick descriptions of actual events that were considered important for the respondent.

These advantages only materialise with good preparation. Essentially, CIT implies that we see our respondents as informants and use research methods accordingly to transfer thick descriptions to paper (e.g. Petinsteva et al., 2019). Qualitative researchers must make an effort to reconstruct events as accurately as possible. Practically, the data collection therefore consists of two phases. In the first phase of the data collection process, the informants are urged to think of two critical incidents during a mentoring process. In a second phase, the incidents are being validated and enriched in order to paint a full picture.

Because the informants have to provide a lot of information, two factors in the data collection are considered to take precedence. First, it is important to ensure the informants feel safe to report on these events. Therefore, the researchers need to guarantee the confidentiality and privacy of the informants. The researchers will ensure informed consent, and enough time for respondent validation. Second, some of the probing questions may require the informant to look things up because they might have forgotten certain details. As a result, they may need additional time to respond and revisit specific points.

Step 1: a survey to collect responses

This phase consists of a written survey - because it is considered good practice to allow informants some time to think about a relevant incident (Bott & Tourish, 2016). The starting point is to provide helpful directions on what is understood as a critical or revelatory incident in the group mentoring context. This research focusses on creating conditions for meaningful communication in a mentoring project. The informant will be required to describe two situations.

"Please describe a significant communication problem during your time as a mentor/mentee which was adequately solved in the group mentoring program. Focus on a situation where participants did not feel safe and hence were reluctant to share information in the group meeting or were unwilling to listen to other perspectives. It should be a situation in which some participants in the program – not necessarily you – have become defensive or protective when encountering information that is inconsistent with their view. It can be an idea, issue, situation, or experience that challenges underlying assumptions and has raised anxiety, stress or anger in the group. However, these feelings were successfully resolved."

"Please describe another communication problem during your time as a mentor/ mentee. The only difference is that now you felt it was not adequately addressed in the mentoring program and the issue lingered. It should be a situation in which some participants in the program – not necessarily you – have become defensive or protective when encountering information that is inconsistent with their view. It can be an idea, issue, situation, or

experience that challenges underlying assumptions and has raised anxiety, stress or anger in the group. In this case, the problem was not resolved in the mentoring program."

The survey shall end with some basic closed-ended biographic questions and questions about mentoring and professional experience (see e.g. Feldman, 1999; Finkelstein et al., 2003).

Step 2: follow-up questions

In the next phase, each incident needs to be enriched by the qualitative researchers by means of follow-up questions. This step is necessary to make the description of the incidents as thick as possible. Aspects that are evident to the informant but ignored in the survey need to be brought to light. Therefore, all informants need to be willing to answer a set of probing questions from the research team. We suggest conducting several in-depth interviews, which will, with explicit permission, be recorded, transcribed and verified with the informant. A final step consists of comparing factual elements of the transcripts with data from the first step and factual records from the mentoring program, about data such as place, time and presence.

In this phase, the choice is whether we continue to follow an open and inductive approach – or whether we make use of the Brandsma model and employ more specific questions is still open. By means of a pretest, we hope to get some more insights.

METHODOLOGY

The European Association for Practitioner Research on Improving Learning (EAPRIL) is an excellent platform to pretest this part of our research proposal. The annual 3-day EAPRIL conference attracts many experts in the field of educational science from all over the world. It is especially popular among educational professionals from Belgium, The Netherlands and Finland. In 2024, EAPRIL celebrated its 15th anniversary at the Hogeschool Professionals & Excellence (PXL) in Hasselt, Belgium. One of the unique selling points of the EAPRIL conference are the different presentation formats, which create enough time and space for knowledge exchange. Conference participants like to discuss the latest developments in the field in a peer-to-peer setting. One of these presentation formats that allows extensive interactive exchange among experts is the "roundtable". In this format, only two research projects are scheduled in a timeslot of 90 minutes. Each presenter of a research project has 15 minutes to outline the main ideas of their project, as well as an opportunity to propose questions for discussion. This introduction by the researchers is followed by a 30-minute discussion.

Our "roundtable" session was scheduled on the first day of the conference, just after the plenary opening session and the first keynote speech. Conference participants could

choose to join one of thirteen sessions (mostly in the roundtable format) that were scheduled in parallel. Our session attracted five experts; three working in Belgium and two working in The Netherlands. One expert had English as a native language, the others spoke Dutch. Three participants identified as female, and two as male. Since only conference participants could join our session and only participants interested in this subject joined, our sample is a convenience sample. This selection bias may limit the transferability of our findings; but it is a limitation that we accept since our aim is to pretest our research methodology.

We started the session by asking the participants why they joined this "roundtable" and what their experience was with group mentoring. Then, we introduced our research project and the goals we had in mind for the session. We briefly explained that we had conducted a literature review on the topic of miscommunication in mentoring contexts. We explained that we found that CIT had been used to study communication problems in traditional mentoring settings and that we would like to discuss if this technique could also be applied in the study of functional group mentoring. We mentioned our interest in the polarisation model of Brandsma (2017) as a possible explanatory framework for communication problems, without fully explaining how we would use it. We then distributed to each of the participants a transcript of a critical incident in a mentoring context as reported in Eliahoo (2016). This critical incident was collected as an assignment set as part of a post grad mentoring course.

Table 1: Transcript of a reported critical incident

A mentee was teaching an Afghan couple with differing levels of English competence. The mentee arranged for the husband to receive extra tuition from a white British female teaching assistant. When his wife was informed, she objected to the intervention on the grounds that it was "against their culture" for a man to be taught, especially on a one-to-one basis, by a woman.

The mentee requested from her mentor an organisational stance on the matter.

She personally felt immigrants ought to conform and embrace British culture, especially if they were to become economically active and responsible citizens. On the other hand, she feared being branded a "racist" by the learner's wife or members of her class. With limited resources, the organisation was unable to engage the services of a male tutor immediately.

The mentee had a valid point. She had identified an urgent need and had attempted to meet it. She had acted on behalf of the department in the name of equality. The

learner's wife's voice, however, was a claim for diversity. Emotions were also intertwined. Was there a hint of jealousy or fear of losing her husband to another woman?

The mentor was a **BME** male teacher who, whilst he believed strongly in the need for immigrant communities to integrate into wider society, wanted to achieve this without alienating the parties involved. He and his mentee apologised for "their lack of respect for their culture" and offered them time to return with any ideas they might have, given that all parties were keen to see the learner develop.

A meeting was scheduled: Our learner and his wife conceded that it was also against their culture to see women (like his wife) being so dedicated to her study. They explained that the husband had been a victim of constant abuse and ridicule within their local community and yet could see the advantages of education, and the need to make trade-offs to achieve this. They both agreed to proceed with the original plan and expressed appreciation for the support.

Source: Eliahoo (2016, p. 313)

The selected incident, as presented in Table 1, illustrates communication challenges in mentoring programs, particularly how differing cultural norms and values can impact the effectiveness of information exchange. It underscores issues related to cultural sensitivity, power dynamics, and gender norms that can create barriers to meaningful interaction. These factors can complicate mentoring relationships and affect the willingness and ability of individuals to engage fully in the program. The reason why this particular critical incident was chosen for the pretest, is because the described incident takes place in an international context where multiple interests and cultural influences are at play. At the same time, it describes a context that is recognisable for anyone without prior knowledge of international politics and security studies. This particular prior knowledge cannot be assumed for the EAPRIL community. In our view, the incident struck a balance between simplicity and complexity - making it an ideal choice for facilitating expert discussion without causing confusion.

The educational experts were given about 10 minutes to read the critical incident. Subsequently, participants were asked if anything was unclear. One of the participants asked more information about "BME" (used to indicate Black, Minority, Ethnic). The question was actually a good manipulation check: the participants had read and absorbed the transcript.

Next, the researchers started presenting extra questions to the experts about the critical incident. The interview guide consisted of a mix of introducing and probing questions. To further test the usefulness of CIT, the introducing questions invited participants to recall what happened. This allowed us to distinguish between what was understood, and what requires further clarification. The probing questions focused on the relationship between mentee and mentor.

In order to stimulate exchange with the educational experts, it was decided not to record the conversations. Recording is also not standard practice at the EAPRIL conference. Instead, the researchers used the whiteboard to create a storyline of what was being said. In order not to delay the brainstorming process only keywords, highlighting the experts' voices, were written down. The session was ended by thanking the participants for their input and we gave the participants the opportunity to share any recommendations or raise other questions related to the roundtable session.

Immediately after the session, the researchers annotated the storyline and transformed it into minutes of the session. Accordingly, the minutes might contain filtering bias from the researchers. It would have been helpful to present the minutes to the experts – but we decided not to trouble the conference participants and let them enjoy other parts of the EAPRIL program. While it would have been useful from a methodological point of view, we felt that it was socially inappropriate to stretch the commitment of the workshop participants further. Hence, no respondent validation has been applied. This is one limitation of using the EAPIL roundtable format for pretesting.

LESSONS FROM THE EAPRIL ROUNDTABLE

The researchers invited the experts to express what the critical incident was about. The discussion among the experts in the roundtable initially focussed on the tension between the female mentee and the migrant wife. Thus, the focus of the discussion was not initially on the role of the mentor. The experts quickly pointed out the different cultural backgrounds of both the mentee and the immigrant wife. It was also acknowledged that it is normal to experience emotions in a sudden stressful situation. The experts concentrated on the difficult position of the migrant wife. It was clearly not easy for her to let her husband be tutored by a female coach. Overall, the experts expressed an understanding of the circumstances surrounding this dispute. While it would have been helpful to regulate emotions, it is often difficult to take a step back and to reflect on the norms and values that one has acquired or that one stands for. The educational experts acknowledged that it is easier said than done to ignore these feelings in the moment. Not only was there recognition of the position of the two protagonists - there was also speculation and rationalisation for the behaviour of the migrant woman. Specifically,

assumptions were made that the migrant woman might having been protecting her husband in light of past setbacks.

It is important to mention that the educational experts made a clear reservation due to a lack of information. The experts ultimately expressed that it would have been interesting from a research perspective to find out more about the migrant woman's motives. This call for more information was reinforced when a (male) expert stated that the migrant man had remained noticeably quiet. The feedback from the experts made it clear to us that it would be valuable to have more in-depth discussions with all stakeholders. This kind of triangulation of the incident would have resulted in thicker description and possibly a deeper understanding. A first important methodological lesson was retained.

Lesson 1: From an interpretative research perspective, it is important to look at critical incidents through the eyes of all persons involved. A thick description of a critical incident requires that all persons involved can bring their perspective to the table.

Because the ultimate focus of this research is to improve understanding of the relationship between mentor and mentee, and because the role of the mentor had not been explicitly raised during the session with the experts, the researchers subsequently asked the experts how they viewed the role of the mentor. There was consensus that the mentor had an important mediation role to play. He could have helped to end the dispute by reiterating the goals of the educational program and by deemphasising or deescalating emotions. There was consensus among the experts on the way forward, but views on who should lead this process differed. First, they indicated it was important to change the conversation to a more professional, neutral tone. Shifting the focus from cultural identities, and highlighting the aims of the educational program, was considered paramount to solving the issue. This shift is only possible if the objectives of the educational program have already been clearly communicated prior to the occurrence of the critical incident. It was deemed essential to highlight the educational goal of the program, namely, improving English language proficiency. There needs to be clear expectations about what can be done in the program, and what is outside of the program scope. The mentor indeed underlined this, by repeating to all parties involved what the intention of the collaboration was.

Some experts wondered why the mentor directly intervened in the relationship between his mentee and the migrant wife. Would it not have been better for the mentor to provide more coaching and support to let the mentee change the tone of the conversation? Instead of leading the change, he could have been more active behind the scenes? Again, requests for additional information about the scenario arose. Specifically, there was a desire among the experts to learn more about the tenure and the experience of the mentor. We provided some further context, about the research of Eliahoo (2016). Overall, the discussion in the roundtable focussed on the objectives of the educational program and not on the mentoring relationship. There was insufficient time to turn the conversation

back to mentorship. Nevertheless, the second part of the roundtable resulted in another interesting lesson.

Lesson 2: Critical incidents give insight into any area of concern of the respondent (the mentee) and studying them requires a longitudinal approach.

In a trusting mentoring relationship, we can expect that the critical incident raised by the mentee will not initially concern the mentor, nor the mentor-mentee relationship. In the critical incident in Table 1, the relationship between the mentor and the mentee was not considered problematic by the educational experts. However, the way these incidents are handled may change the relationship between mentors and mentees over time. In order to gain a deeper understanding of the role of the mentor, stronger guidance will be needed in our research project on mentoring relations. We argue that it is essential to follow up the critical incident by posing questions about the impact of the mentor's interventions on the mentee and on the relationship between them. This lesson of having follow up conversations is especially important for the preparation of the second stage in the data collection phase.

During the closing of the workshop, an expert asked how Brandsma's model fitted into this research. We explained that we could transpose the roundtable expert discussion onto the Brandsma model and drew Figure 1 on the whiteboard. We indicated that the protagonists could have been motivated by their cultural backgrounds and that this was how the discussion arose. In addition, both the silence of the migrant man, and the bridge-building of the mentor could be placed into the framework. We pointed out that, according to Brandsma, bridge building is a risky strategy in a polarised world. It is only possible if the bridge-builder has sufficient credit and respect from both sides. Within the confines of the information in Table 1, we therefore speculated that since the mentor was male and guided in the mentee's studies, it may well be that these two contingencies may have facilitated acceptance of the direct approach. However, it could have been more challenging if the mentor were not male or did not have a formal authority relationship with the student. The main purpose of this research pa In these cases, the mentor should have adopted a more coaching role. Again, it is important to have more rounds of data gathering, to validate these claims. Moreover, we would like to emphasize that the principal aim of this research project is to better understand the underlying communication mechanisms in group mentoring programs. The culture and gender divide is not our primary focus but we take the complex relationships between these constructs and communication patterns into account (see also e.g. Kochan, 2013)

Figure 1 : Brandsma model applied to group mentoring
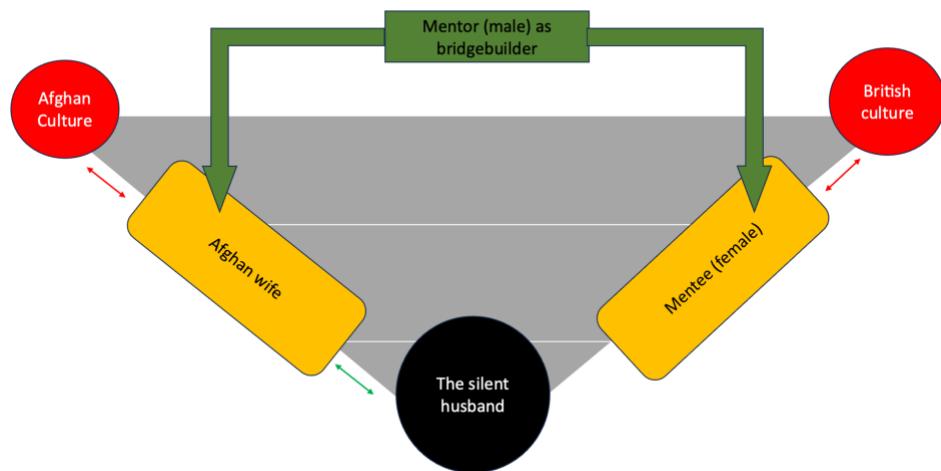
NEXT STEPS

In sum, this pretest revealed that CIT is, as already described in the literature, a useful exercise to learn about the respondent's practices. Because the initial choice of incident by the respondent is so decisive for the next steps in the research, we propose to include critical incidents of both the mentor and the mentee in the analysis. This is a research innovation because it is unclear whether they choose the same critical moments or different ones. Choosing to analyse critical incidents provided by both the mentor and the mentee decreases bias and it will create a more complete picture of the communication challenges in a mentoring context.

Hence, we conclude that this technique can be used further if some methodological adjustments are made. The most important takeaways from the EAPRIL discussion were about the proposed methodology. The session with the experts led to different interpretations as to why the husband remained silent, why the wife acted the way she did (protecting her husband? versus protecting her cultural identity?) and how effective the strategy of the mentor was. As a result, a suggestion here is to dedicate more time to collecting additional information. It is important to describe the critical incidents in as much detail as possible, and to analyse them from the point of view of both mentor and mentee.

The lessons that we learned from this roundtable were valuable. We admit that these lessons are coloured by the choice of the specific incident. Given the time allocated to

the EAPRIL "roundtable", it was decided to analyse only one critical incident in sufficient depth. We do not know how the interaction would have progressed if we had presented another critical incident to the same educational experts.

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COMPARATIVE JUDGEMENTS AS LEARNING ACTIVITIES: A THREE-TOOL TRIAL

Marie Hoffelinck*, Pascal Detroz**, Dominique Verpoorten***

*Assistant, IFRES, University of Liege, Traverse des Architectes 5B, 4000 Liège, Belgium, marie.hoffelinck@uliege.be **Professor, IFRES, University of Liege, Traverse des Architectes 5B, 4000 Liège, Belgium, p.detroz@uliege.be *** Professor, IFRES, University of Liege, Traverse des Architectes 5B, 4000 Liège, Belgium, dverpoorten@uliege.be

ABSTRACT

In the context of a specialised MA in Higher Education pedagogy, students took part in six activities in which they assessed previous cohorts' work using three Comparative Judgement platforms (RM Compare, Comproved and No More Marking). Results reveal Comparative Judgement sessions hold a potential as learning activities, provided the tools are designed with a stronger emphasis on learning rather than solely on assessment reliability. Based on instructor's experience and users' perception, suggestions are offered to strengthen this orientation.

INTRODUCTION

Comparative Judgement (CJ) is an assessment method grounded on Thurstone's (1927) *Law of Comparative Judgement*. It relies on the idea that humans are better at making decisions when presented a pair of analogous items than at making absolute judgements (i.e. without any explicit comparator) (Laming, 2004). Concretely, in CJ sessions, assessors are presented with successive pairs of items from which they must decide which is the best. Based on the series of successive decisions made by the judge(s), items are ordered in ranks, established from their relative attributed quality.

Over the past decade, CJ digital tools have been developed, widening the use of CJ as an assessment method in education (see for example: Bisson et al., 2016; Bramley, 2015; Coertjens et al., 2021; Marshall et al., 2020; Pollitt, 2012). Even more recently, CJ tools use has extended beyond their primary area of development (i.e. assessment) to learning (Barber, 2018; Bartholomew & Jones, 2022; Dewit et al., 2021; Potter et al., 2017; Rhind et al., 2017; Strimel et al., 2021). These novel practices are supported by studies demonstrating CJ platforms' potential as tools to implement peer feedback activities (Barber, 2018; Demonacos et al., 2019; Dewit et al., 2021; Potter et al., 2017; Topping

et al., 2023) and by the recent coining of the concept of *Learning by evaluating* (Bartholomew et al., 2022; Mentzer et al., 2023; Thorne et al., 2024).

However, the potential of CJ as a learning tool is still understudied (Hartell & Buckley, 2021). For instance, differences between currently available digital tools are not addressed in the scientific literature; contrariwise to some other educational technologies (Machado & Tao, 2007). Nevertheless, the question of which platform to choose will cross the mind of any educator envisioning the use of CJ. This paper intends to contribute to filling this gap by giving a detailed account of a three-tool practical trial implemented during the fall semester of 2023 in the context of a specialised MA in Higher Education pedagogy (*CAPAES*, n.d.; *Formasup*, n.d.). Three major platforms—No More Marking (NMM), Comproved and RM Compare—were practically put to test. The study evaluates the tools through two perspectives: (a) a critical analysis of their features based on instructors' experiences and (b) an assessment of student reception through participation, performance, and perception (Verpoorten et al., 2017).

METHOD

Context

The CJ activities were implemented into the course "Framing and analysing teaching and evaluation practices", part of a specialised MA in Higher Education pedagogy in a Belgian French-speaking university. Participants were all active Higher Education instructors. By engaging them in CJ activities, the instructors had three pedagogical objectives:

a) To probe CJ's pedagogical potential as a learning activity;
b) To expose participants to innovative, technology-enhanced learning tools aligned with contemporary teacher development needs;
c) To use CJ as a as a reflection amplifier (Verpoorten, 2012) about constituents of quality for the final output of the course.

CJ Activities

Concretely, after each class dedicated to a topic corresponding to one section of the final essay, students were requested to perform a CJ activity as a homework comparing excerpts written by students of previous cohorts. These excerpts were chosen by the teaching team to reflect different nuances and levels of quality and were roughly 200-to-800-word long. Additionally, students were requested to comment on the quality of the items they were presented with, building on the idea that writing feedback is source of learning (Cho & MacArthur, 2011). During the following class, global results from the CJ session were discussed and confronted to the teaching team's appraisal of past productions.

CJ platforms

Three main CJ tools are currently available: No More Marking (NMM), Comproved, and RM Compare. These platforms stem from diverse backgrounds and pursue different overarching goals, as briefly described below.

No More Marking

NMM is a British private company that was founded with the intention of developing a functional inter-school assessment tool in the United Kingdom (UK) that would allow evaluation of school performance at national scale (C. Wheadon, personal communication, 12 March 2024). Its main area of focus being writing skills for pupils in primary and secondary schools, NMM organises national CJ sessions for schools to compare their pupils' levels to national performances. Beside this, the website offers a free "custom task" option that allows for individuals to use basic features of the digital tool (*No More Marking*, 2022). The algorithm constituting the pairs shown to judges in NMM is designed in such a way to ensure that items are seen an equal number of times and that judges are not presented the same items too many times. Previous decisions made on an item do not impact the future comparators it is going to face later (C. Wheadon, personal communication, 12 March 2024).

Comproved

As for Comproved, it stemmed out of a research project, called D-PAC, funded by a public Flemish agency, investigating CJ as a means to increase inter-rater reliability in the context of assessment. When funding for the research project ended, it was turned into a private company to maintain and further develop the tool that emerged from the research project (M. Goossens, personal communication, 28 February 2024). The algorithm that selects pairs in Comproved is mostly based on randomness, even though it ensures that each item is compared an equal number of times (Comproved, n.d).

RM Compare

The technology RM Compare is based on was developed by Alistair Pollitt and Declan Lynch. The company they created, formerly called "CompareAssess" was bought in 2019 by a broader educational technology provider, RM PLC, based in the UK (M. House, personal communication, 28 February 2024). RM Compare uses a slightly different process than NMM and Comproved, called "*Adaptive* Comparative Judgement" (ACJ): its *adaptivity* is designed to limit the number of judgements needed to reach an acceptable reliability (Pollitt, 2012). When in "traditional CJ", pair allocation is mostly based on randomness, in the ACJ model, only the first round of comparisons is truly random. From the 2nd to the 6th one the pairs are assigned according to the "Swiss tournament method". This method is based on the pairing of items that have an equal

number of "wins": in round 2, items who have won the first round will be paired together, and so on (Pollitt, 2012). This is supposed to permit to reach a higher level of reliability with less judgements made, hence lightening the assessment process for judges[1].

Data Collection

In this study, four different data types were used:
- the functioning of the CJ platforms was apprehended through the first author's experience. On the one hand, the first author acted as an instructor setting up the tasks. On the other hand, the first author also took part in the sessions as a judge to document how the activities unfolded from the students' perspective.
- participation data was collected through the CJ paltforms (number of judgements, comments written and time spent on task). N.B. data generated by the first author's participation as a judge was removed from the final data set.
- the final assignments' results were used as performance data.
- perception data was collected by documenting class interactions during the sessions' debriefings and via a questionnaire that was submitted electronically using Qualtrics (*Qualtrics*, n.d.) during the last class of the semester (19 December 2023).

FINDINGS

Three different online tools were used to practically implement six similar CJ sessions. This section outlines variations in the activities as they unfolded.

Task set-up

No More Marking

In NMM, instructors upload the documents to be assessed. The platform generates a unique URL that can be shared with potential participants, enabling them to self-register using their email addresses. During the setup CJ session, the platform requires instructors to specify the number of judgements per assessor. This is calculated using a straightforward formula that considers the number of items to be assessed, the desired number of judgements per item (defaulted to 10 but adjustable), and the anticipated number of judges. However, NMM does not provide a built-in feature for collecting

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[1] This has been critiqued by some (see notably Bramley, 2015) and the method has then been refined further by Rangel-Smith & Lynch (2018). Even though the question does not seem to yield unequivocal unanimity (Benton & Gallacher, 2018; Verhavert et al., 2019) some studies that have tested the reliability of adaptive comparative judgements for assessment draw positive conclusions (Bartholomew & Jones, 2022). Nevertheless, in the case of CJ *learning* activities, the impact of adaptivity on reliability is not of primary concern as the focus is on the act of making judgements rather than on the actual results of the session.

feedback from judges about their decisions or the items reviewed. Therefore, students were instructed—via the university's Learning Management System—to include feedback comments in the platform while completing their CJ tasks.

Comproved

In Comproved, instructors upload a list of judges (which can be done using a CSV file) and the items to be assessed. On the scheduled date and time, participants receive an email invitation to create an account and begin the CJ task. The instructor determines the number of judgements each judge must complete. Regarding feedback, the platform allows instructors to specify the number of comparisons for which feedback on the items will be requested. This number can be set to match or be lower than the total number of comparisons assigned to each judge.

RM Compare

In RM Compare, administrators upload both the items and the list of judges (which can be done using a CSV file). Judges are first invited to register for the session via an initial email and then receive a second email inviting them to participate in the task. Unlike other platforms, RM Compare does not allow for a fixed number of judgements per judge. Instead, the number of *rounds*[2] is defined, and a built-in calculator helps estimate the required number of judgements based on the number of items, judges, and rounds. For feedback, RM Compare offers flexible options: judges can be asked to provide comments on comparisons or individual items. Additionally, the platform allows feedback to be made mandatory. In such cases, judges cannot proceed to the next judgement without submitting the required comments.

For the trial reported here, table 1 details the options that were selected.

Final essay section title	No. of items	Platform used	Judgements/ judge	Options chosen
(1) Teaching philosophy	5	No More Marking	7	"Custom tasks"; separate instructions requesting students to add a note on each item
(2) Learning objectives	6	Comproved	7	"Instructor adds all products"; feedback on 4 comparisons, pre-structured as strengths/ Weaknesses, after judgement
(3) Course description	6	RM Compare	15 *rounds*	Feedback mandatory on all items
(4) Methods	5	No More Marking	7	"Custom tasks"; separate instructions requesting students to add a note on each item
(5) Pedagogical alignment	6	Comproved	7	"Instructor adds all products"; feedback on 4 comparisons, pre-structured as different criteria, after judgement
(6) Assessment	6	RM Compare	automatic	4 mandatory comments on comparison + mandatory feedback on individual items

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[2] In the context of ACJ, a round is an occurrence of pairing in which all items are seen once, at least at the beginning of the session; later, when adaptivity kicks in, this may not be the case anymore (Pollitt, 2012).

Session process

No More Marking

While NMM does not offer a dedicated feature for requesting feedback from judges, the platform does allow judges to add comments about items by clicking on the central panel where the "judge question" is displayed. This action opens a pop-up window where a written comment can be inserted. During this trial, students found this process somewhat cumbersome. As they shared in class, once they had selected the better item in a pair, they were unable to go back and add a comment if they had forgotten to do so beforehand.

Comproved

In Comproved, feedback is requested to judges the specified number of times, at different moments during the session. From the participants' account, it seems to have been generally requested towards the end of the session, however this is not consistent. Students generally appreciated this timing, as it gave them an opportunity to familiarize themselves with the task before being prompted to write comments. As one student shared: "The fact that comments didn't come right way, it was good. We had time to figure out what was expected before starting to write" (Linda[3], 24 October 2023, after the "learning objectives session").

RM Compare

In RM Compare, the feedback process begins at the start of the session, with the set number requested for the first few pairs of items. Once a comment is submitted, it remains attached to the corresponding item and can be amended later if the same item reappears during the session.

Following the first RM Compare session, some students expressed disappointment that they had not seen all the items included in the task. Instead, they encountered certain items multiple times while missing others entirely. This issue, as evidenced in the session reports, was unique to RM Compare and did not occur with the other platforms (see table 2). The problem arose from two factors: the adaptive nature of the RM Compare algorithm and the impossibility to fix the exact number of judgements per judge. In this trial, students were assigned fewer judgements than expected—four in the first session and five in the second—which reduced their chances of seeing all items. Additionally, for judges who completed their tasks later in the session, the algorithm paired items with

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[3] All names are pseudonyms and verbatim accounts have been translated from French by the first author.

similar scores more frequently. This further increased the likelihood of repeated items while excluding others entirely.

Session and Platform	No. of students who did not see all items/no. of students who completed their allocated no. of judgements
CJ Activity 1- NMM	0/6
CJ Activity 2 - Comproved	0/6
CJ Activity 3 - RM Compare	5/8
CJ Activity 4- NMM	0/7
CJ Activity 5 - Comproved	0/7
CJ Activity 6 – RM Compare	2/6

Table 2. Number of students who completed their assigned number of judgements and did not see all different productions

Participation

Overall, participation data denotes some form of adhesion to the activity. Indeed, most students participated to most sessions (see table 3) even though participation was not formally credited in the course context. The median time spent on judgements, compiled by the three different tools for each individual judge, ranges from 0.73 to 506 sec. The Inter Quartile Range (IQR) rule for outliers was applied to the aggregated data from all sessions and no formal lower bound outlier was identified. However, it was considered that the lowest value was too short a time to make a valid judgement and was therefore considered as non-participation. The next following values in increasing order (i.e. 29.37, 40.90, 48.50, …) however small, did not seem incoherent, they were thus considered as effective.

Student ID	CJ activity 1 NMM	CJ activity 2 Comproved	CJ activity 3 RM	CJ activity 4 NMM	CJ activity 5 Comproved	CJ activity 6 RM
1	✔ Yes	✔ Yes	✔ Yes	✔ Yes	✔ Yes	✔ Yes
2	✘ No	✔ Yes	✔ Yes	✘ No	✘ No	✔ Yes
3	✘ No	✔ Yes	✔ Yes	✔ Yes	✔ Yes	✔ Yes
4	✔ Yes	✔ Yes	✔ Yes	✔ Yes	✔ Yes	✔ Yes
5	✔ Yes	✘ No	✔ Yes	✔ Yes	✔ Yes	✔ Yes
6	✔ Yes	✔ Yes	✔ Yes	✔ Yes	✔ Yes	✘ No
7	✔ Yes	✔ Yes	✔ Yes	✔ Yes	✔ Yes	✔ Yes
8	✔ Yes	✘ No	✔ Yes	✔ Yes	✘ No	✘ No

Table 3. Students' participation to the 6 CJ activities

Another way to assess participation is to look at the number of comments participants wrote for each session. As shown in table 4, there are more discrepancies between the different platforms: there is more variation when NMM is concerned than in RM Compare and Comproved. This can be explained by the way the different platforms work. In NMM, the website did not formally request comments from judges, they had to pro-actively think about adding a comment. This explains why some students completely omitted doing so during the session. On the opposite, some wrote comments

on all items within each pair they were presented with and then ended up commenting on the same items more than once, thus explaining a higher number of comments than of items included in the session. In RM Compare and Comproved, such a situation could not happen, as the platform requests comments for items on which the judge has not commented yet. In Comproved, as the feedback comment is not mandatory to continue in the session, some students have disregarded comment writing, this is why the number of comments is not constant. In RM Compare, comments were mandatory. Variation is therefore due to the adaptivity of the algorithm: some students did not see all items (see above). All comments were qualitatively assessed, and none was found to be deliberate nonsense (which would have been interpreted as an indicator of non-participation).

Student ID	CJ activity 1 NMM	CJ activity 2 Comproved	CJ activity 3 RM	CJ activity 4 NMM	CJ activity 5 Comproved	CJ activity 6 RM
1	2	6	5	4	6	6
2	NA	6	5	NA	NA	6
3	NA	6	5	0	6	5
4	0	6	6	0	6	6
5	7	NA	6	6	4	5
6	8	6	5	11	6	NA
7	10	6	5	8	6	6
8	5	NA	6	8	NA	NA

Table 4. Number of comments written per student in each CJ session.

Perception

General perception of the CJ learning activities

The first question of the questionnaire aimed at assessing the students' overall perception of the recourse to CJ for learning. Globally, their perception is rather positive (see fig. 1). The question was followed by an open question asking them why this was the case. The main pedagogical function of the exercise as perceived by students seemed to be related to the possibility to see exemplars (mentioned in 4/6 answers received). One student also brought up the opportunity to see criteria that were important to take into account when writing their final assignment.
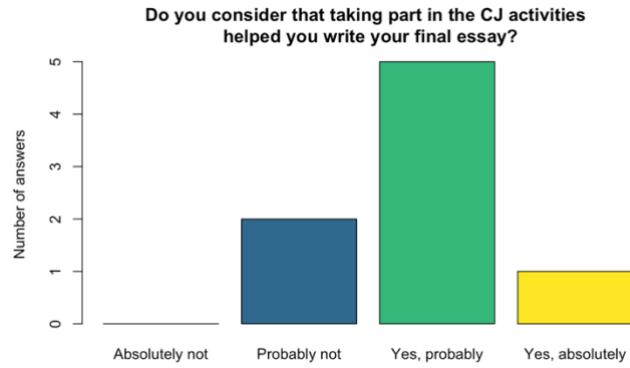
Figure 1. Students' general perception of CJ learning activities

Moreover, in class, some students commented about what they thought of the CJ activities. For example, Arthur found it "quite easy" (10 October 2023, after the first CJ session). On the same day, Angela reflected further: "At the beginning, judgements are really based on intuition. But after seeing more items, judgements become more refined. Especially when we have two items that are very similar: we have no choice but to think more deeply". On another day, Angela also shared her doubts (24 October 2023): "writing feedback is quite long. If we were to use it with our students, I fear they would not do it thoroughly".

Different tools perception

In the questionnaire, students were also asked to assess their relative appreciation of the three different platforms. The graphs below represent the repartition of their answers for each platform (see fig. 2, 3 and 4).
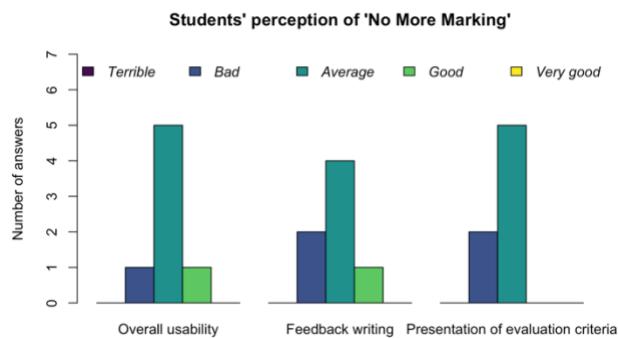
Figure 2. Students' perception of "No More Marking".
One student did not complete any activity using NMM, for this reason, N=7.
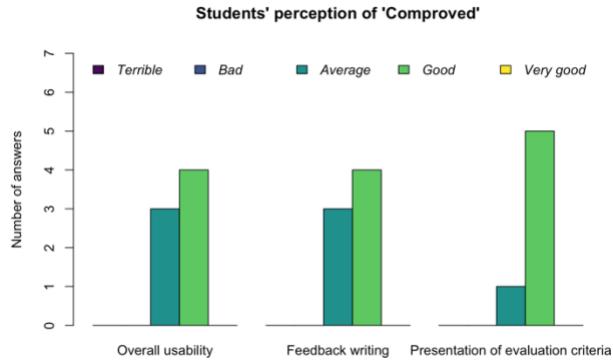
Figure 3. Students' perception of "Comproved".
One student skipped the question about Comproved, this is why N=7. Another student skipped only the section 'presentation of evaluation criteria', this is why N=6.
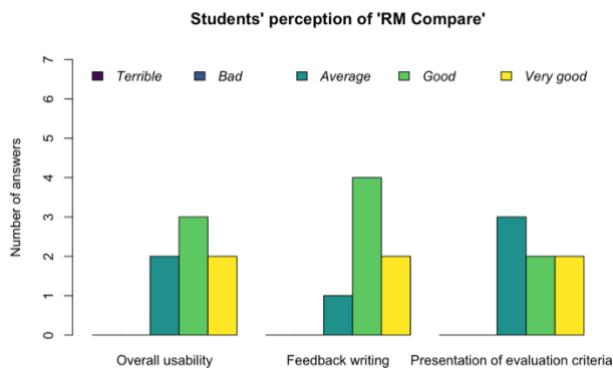
Figure 4. Students' perception of "RM Compare".
One student skipped the question about RM, this is why N=7.

As shown by the graphs, globally, students reported having had a better experience using RM Compare, without much difference regarding the different criteria (overall usability, feedback writing and presentation of evaluation criteria).

Performance

Performance was assessed through the final exam success rate. The final assignment consisted of a "course plan" mainly constituted by the 6 sections that were evaluated through the CJ activities. The final requirements for course completion as well as the teaching team have been the same for the past five years. The success rate (rather than an average of the final scores for instance) has been chosen as an indicator of performance because part of the students enrolled in the class are registered in the CAPAES programme (*Certificat d'Aptitude Pédagogique Approprié à l'Enseignement Supérieur à l'Université de Liège*, n.d.), for which no grade is attributed. Numbered scores data were therefore not accessible for all students. Finally, students who were formally enrolled but did not submit their final essay were not included in the analysis. Indeed, on the year of the trial, it appeared that these individuals did not participate in

any of the pedagogical activities and therefore their performance does not reflect any impact that the participation to CJ activities may have. These profiles were thus removed for all years presented in table 5.

Year	Pass	Fail	Total	Success Rate (%)
2020	12	2	14	85.71
2021	4	1	5	80.00
2022	17	4	21	80.95
2023	15	4	19	78.95
2024	7	1	8	87.50

Table 5. Success rate at final assignment 2020-2024

Data shows that success rate in 2024 was higher than previous years (see table 5). Fisher's Exact Tests were conducted to examine the association of success rate with academic years. Across all comparisons, no association between the academic year and the success rate was found ($p = 1$, for all pairwise comparisons), thus rejecting the hypothesis that the success rate was significantly higher in 2024.

DISCUSSION

The three-tool trial recounted here sheds light on some features that do not function the same way in the different CJ digital tools available and that instructors should pay attention to when designing CJ learning activities as they entice different learning experiences for students.

Pair selection and judgements

When performing a CJ learning activity, the reliability of the assessment is of minor interest. If adaptivity may or may not (see above) be an effective way to boost reliability, it is of no interest when the focus is put on the judge experience of making judgements rather than on the output of the session. Moreover, similarly, it is not so much the number of rounds that are globally performed that matters in the case of CJ as learning activities but the number of judgements that a judge makes. The fact that this cannot be set up as such in RM Compare prevents from firmly determining the number of judgements a judge will be requested to make. Indeed, the calculator featured in the editing tool allows the task administrator to approximate the number, but the latter is finally only determined when the session is officially started and depends on the number of judges who have accepted to pre-register for the session. This fact makes sense when it comes to generating reliable assessment session but is not well-suited for learning activities. In our case, the combined impact of adaptivity and the impossibility to set the number of judgements judges must make even seems to have impeded the learning process. Indeed, in the third and sixth activities, it caused some students not to see all the essay sections that had been deemed interesting by the teaching team. This hindered the following discussions in class.

In the context of CJ as learning activities, ACJ does not have any advantage over CJ and, in some cases, it may even disrupt the learning process. It seems therefore better to favour the use of CJ or, if ACJ is used, it is important to correctly assess the number of students who are going to perform the activity to set an appropriate number of rounds.

Feedback

Another element that plays a great role in the learning experience that is offered to students concerns feedback writing. First, having the platform formally request comments is important as when it is not the case, some students disregard this part of the exercise. Moreover, making them mandatory to go further in the session ensures that this component of the activity is thoroughly completed. Secondly, students noted having preferred being requested for feedback towards the end of the session. This gives them time to familiarise themselves first with the tool, the items and the criteria before engaging more deeply in a more complex analysis, intrinsically needed for writing comments. This is generally the case in Comproved, however not constantly as there is a random component in the way feedback is requested. As for RM compare, comments were always requested the first time an item was presented to judges, however the fact that the comment is "attached" to the item for the rest of the session allows judges to amend them if new elements come to light in the rest of the session. Finally, RM Compare permits to make comments on comparisons rather than on individual items. Even though this was not directly targeted in this trial, it seems a good option to rationalise the time spent on task for students—who tend to find comment writing lengthy—given that comments are not communicated to the items' authors as feedback.

Judge registration

Concerning judge registration, NMM offers a simpler way to enrol judges in a session. The platform generates a link that can be distributed to whomever. Beyond the fact that this relieves the task administrator from computing and uploading a list of judges on the platform, it also offers convenient flexibility to accommodate for students who are not administratively registered for example. Moreover, it also eases the process for students as they do not have to set up an account to participate to the CJ session.

Globally, RM Compare was perceived better by students. However, a critical analysis of the different options offered by the three main platforms balances this finding with other pedagogical concerns. Indeed, the above analysis allows the identification of some features that are better suited for CJ learning activities. These, as well as their availability in the three tools tried, are identified in table 6. No digital tool appears to be the perfect fit for CJ learning activities and instructors willing to implement such pedagogical tasks should make a choice informed by their educational context and prioritise features that are consistent within it.

Number of judgements per judge set by instructor	✔ Yes	✔ Yes	✘ No
No-adaptivity for pair selection	✔ Yes	✔ Yes	✘ No
Mandatory feedback	✘ No	✘ No	✔ Yes
Comments on comparisons	Possible, but not formally requested	✘ No	✔ Yes
Request for comments towards the end of session	✘ No	✔ Yes , but not consistently	✘ No
Judges' self-registration	✔ Yes	✘ No	✘ No

Table 6. Most suitable features of CJ platforms for learning activities and their availability

CONCLUSIONS

Overall, the recourse to CJ as learning activities yielded positive outcomes. On the students' part, participation was high, perception was positive and performance was higher than previous years for the same course. Students particularly appreciated the opportunity to see exemplars of previous productions and to engage with the course assessment criteria. If conclusions about the pertinence of CJ activities for learning purposes are limited due to the small number of participants and the design of the experiment (without pre/post test evaluations) this three-tool experiment allows us to draw interesting conclusions about their usability in this context, and areas for further developments for these tools to better support this kind of activity. Indeed, the currently available online tools—that were all primarily designed for assessment practice—still lack some features that are crucial to refined learning activities: unsurprisingly, when the instructor's intention is not generating a reliable ranking of items and the emphasis is put on the writing of feedback rather than on its reception, the instructional designers' needs are different.

Finally, it is to be noted that some elements pinpointed here warrant further research to assess their impact on the learning opportunities for students: (1) the position of feedback requests in the series of judgements. Indeed, if the participants' to this trial expressed having preferred receiving them towards the end of the session, the question of the potential positive cognitive impact remains unclear and (2) the pertinence of requesting feedback on judgements rather than on individual items. If it a priori seems more time-efficient to request only one written comment to students, there may be some value to having them focus on one item at a time.

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EDUCATIONAL ASSESSMENTS FOR LEARNING IN TEACHER TRAINING FRENCH PRIMARY EDUCATION IN FLANDERS

Karen Reekmans*

*Teacher trainer – researcher, University of Applied Sciences & Arts PXL, Vildersstraat 5 in BE-3500 Hasselt, karen.reekmans@PXL.be.

ABSTRACT

In this case study, we discuss innovative ways of teaching, incorporating technology enhanced learning, need-supported teaching and retrieval practice in meaningful and varied ways. Our aim was to explore if continuous assessments for learning in an online learning platform offered realistic and achievable support to pre-service teachers to become well qualified teachers of French in a primary school. Data was collected from a cohort of students of the Educational Bachelor Primary Education at the University of Applied Sciences and Arts PXL in Hasselt (Belgium), who attended the course of French didactics in the second year of the Educational Bachelor Primary Education during the period 2017-2024. This case study resulted in a positive evolution of the number of successful students. The innovative approach ensured deep learning and had a positive impact on the learning outcome.

CONTEXT

French is the first foreign language young children learn at school in Flanders, the Dutch-speaking northern region of Belgium. It is therefore crucial that future primary school teachers have a good command of French. That's why students have to take a language proficiency test French before starting their Educational Bachelor Primary Education. Where an average of 80% succeeded this language proficiency test French in 2017, barely 20% succeeded in 2024. The poor results of the test show that the gap between the desired level of language proficiency determined by Flemish decree and the entry level measured cannot be bridged with the available study load hours in the curriculum, more specifically 7 out of 180 credits as defined in the European Credit Transfer and Accumulation System (ECTS). That's why we explored methods to offer students additional support outside the curriculum to overcome this proficiency gap.

Due to the large teacher shortage, there are more and more initiatives to motivate secondary school students (generation students) to become teachers. They subscribe to daytime education. In addition, (temporarily unemployed) workers are strongly encouraged to retrain as teachers during their careers. They opt for education in day or evening track. In the day track, there are 10 interactive sessions of 3 hours each of which 9 sessions are face-to-face on campus and 1 online, dividing them into groups of an average of 30 students who take lessons from the same teacher. In the evening track, there are 4 interactive sessions of 3 hours each, 3 of which are on campus and 1 online.

Many students take the course in evening classes in combination with a family and a job, which inevitably has an impact on their study results. In addition, once this group of students have passed a first successful traineeship, schools encourage them to give up their jobs to go straight into the classroom with the aim of addressing the teacher shortage. Students in teacher training who respond to this, experience a lot of additional workload, as preparing for classes in primary school requires a lot of effort from them, not least because they have not yet acquired the required knowledge of content and teaching strategies. This makes some of them overtired in the evenings or unable to attend teacher training classes at all. This situation requires great flexibility and effort from both the student and the teacher educator.

To ensure that students in the Educational Bachelor of Primary Education at PXL Hasselt can be confident in proficiently teaching French in primary schools, the question addressed for this case study was as follows: "Does continuous assessment in an online learning platform offer realistic and achievable support to pre-service teachers to become well qualified teachers of French in primary education?"

METHODOLOGY

To address these challenges, we designed an online learning platform that included the knowledge and skills needed to succeed in the course. In a first phase, we implemented a digital pathway blended learning, an educational approach that combines traditional face-to-face teaching and online activities via Blackboard Learn. This is a very structured learning management system that gives students easy access to all essential information and other resources to pass the course. We implemented online assessments blended learning for vocabulary and grammar training, reading and listening skills at a B-level of the Common European Framework of Reference for Languages (CEFL). In a second phase, we expanded the scope to MIXed Learning, an educational model for authentic and inclusive education with ICT as a key driver. The MIXed Learning Model combines preparatory exercises online in Blackboard Ultra, face-to-face workshops on campus and practice in a primary school context. The new Blackboard Ultra Experience improved workflows with a clearer, personalized interface and intuitive tools to support teaching and learning. Specifically for the course French in the Educational Bachelor

Primary Education, the weekly assessments provided first insights into the required prior knowledge for foreign language teaching discussed in the face-to-face workshop on campus that same week, but were not mandatory for passing the course. The learning analytics helped the teacher trainer to monitor students' performance and knowledge retention.

EDUCATIONAL ASSESSMENT FOR LEARNING

Teaching pedagogy focusing on student-centred learning has never been more challenging as fewer credit hours are required for degree completion (Robinson, Eck & Cole, 2023). Developing a continuum of low-stakes assessments improves students' active roles within learning processes and facilitates students' learning maximally (Schellekens, Bok, de Jong, van der Schaaf, Kremer & van der Vleuten, 2021), when designing self-paced and asynchronous assessments with immediate feedback on the product and the process. Additionally, the teacher trainer acts as a guide providing future-oriented feedforward based on the standards defined in the curriculum (Schellekens et al, 2021). This way, students learn through doing and making mistakes, repeating the online activities as often as needed (Behnen, Themmen, Harmsen, van Terwisga & van Aalst, 2024). At the end of the process of assessment for learning, students do a formal, summative assessment of learning to certify their competences and obtain a credit for the course.

Thoughtful digitalisation

We enabled student-centered online learning based on the framework for digital competences of lecturers in higher education (Tondeur, Howard, Zanten, Uerz, Nackaerts, Kral, Gorissen & Neut, 2022). The PXL Centre of digital learning trained the full staff to be digitally literate for MIXed Learning with ICT as key driver via Blackboard Ultra (macro). The planning, organisation and structure of the course – agreed upon with the teacher training team of the Educational Bachelor of Primary Education - were communicated in the study guidelines and linked to the objectives, content and evaluation of the course (meso). To align the needs of students with the teaching objectives, we created our learning resources tailored to the target group (micro): listening, reading and didactic tutorials with videos of good practices in the classrooms were linked to low-stakes assessments for flipped classroom. To close the gap between the required language proficiency level French and the results obtained for the entry level test, we designed online activities for language proficiency French, also supported by short tutorials.
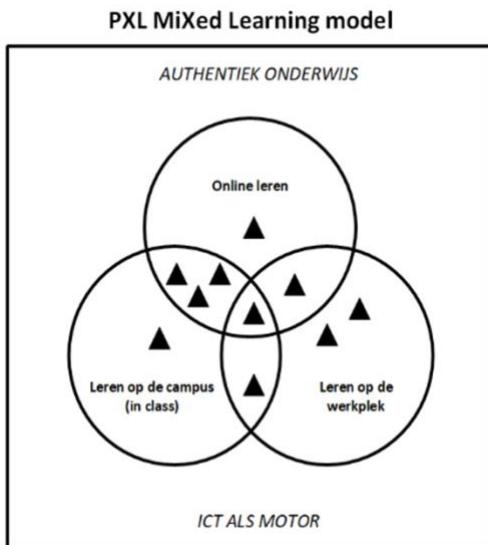
Figure 1: PXL MIXed Learning Model authentic education with ICT as key driver

Figure 1 visualizes the MIXed Learning Model authentic education (authentiek onderwijs) with ICT as motor (ICT als motor), including three pillars: learning online (online leren), learning on campus (leren op de campus) and work-based learning (leren op de werkplek). For the course French – and most other courses of the curriculum of primary education, we applied type 4 of the MIXed Learning Model. The vocabulary and grammar assessment matched with the learning material used for the new teaching didactics discussed on campus that same week. The content of the listening and reading exercises and the ten minute tutorials exemplified how the didactic strategies for teaching practice were applied in a primary school. Similar didactic models were discussed during a face-to-face session on campus that same week. As the low-stakes assessments were linked to lower order of thinking of Bloom's Taxonomy and short-term retention of new content, this kind of preteaching enabled to accelerate our use of the higher order of thinking of Bloom's taxonomy when focussing on future practice, critical thinking and reflection during the face-to-face sessions on campus. To improve students' learning outcomes we created multiple ways to have students formulate clear learning objectives, critically analyse existing learning materials, eventually enrich them with additional learning materials they created themselves and share their learning via Blackboard Ultra discussion fora. As the preparatory exercises were functionally embedded in a meaningful learning pathway, more time could be spent on reflection upon teaching effectiveness. Although the preparatory exercises were not mandatory for passing the course, the students' efforts were monitored. In addition, students could participate in a course remedial teaching, either online via an asynchronous learning pathway we co-created in near collaboration with teacher trainers French primary education in Flanders, thanks to a project launched by the Council of Flemish

Universities of Applied Sciences and Arts, or during interactive face-to-face sessions guided by the teacher trainer on campus at PXL Hasselt.

Need-supported learning

To nurture motivation & performance, we applied the need-supportive teaching model (Vansteenkiste, 2014), focusing on autonomy, relatedness and competence. A weekly planning helped students to prepare the face-to-face sessions self-paced via an asynchronous online pathway. They chose when, at what pace and order and how often they made the assessments. The preparatory exercises were linked to the learning objectives from the study guide and clearly displayed in a thematic digital folder. Because the students had already gone through the contents a first time before coming to class, we were able to zoom in deeper on the application and critical analysis of effective didactics for foreign language teaching in a safe learning environment. Realistic intermediate targets helped students to meet the high standards of the programme.

For example, the didactics of interactive reading are taught and practised during the first year of their educational bachelor primary education and refreshed during the first week of the second year, both via an online learning path as discussed above and during a practice-based workshop on campus. This learning path included a ten minute tutorial with video recordings about interactive reading in a primary school as well as a reading and listening exercise on the benefits of a good storytelling approach. In addition, an article in the school language Dutch was made available. During the same period, students could participate in remedial lessons on the question word and the adjective, two grammatical contents they need to master fluently for interactive storytelling. Three weeks later they took a practical oral exam on this topic and six weeks later they tested their activities with primary school children in the authentic class of our teacher training programme. For each intermediate learning step, students obtained interim feedback to improve their approach in preparation for their traineeship.

Clear feed-up, feedback and feedforward are essential for student success (Hattie, 2014). Feed-up is linked to the study guidelines and evaluation criteria. The weekly short online tutorials and the automated grading of the continuous assessment resulted in immediate feedback on the correct answers and feedforward for the learning process clarifying why it is the correct answer. The automated feedback function of Blackboard Ultra reduced instructor workload. The teacher trainer added additional individual feedforward via Blackboard Ultra to improve students' metacognition on the mastery of language proficiency and didactics for foreign language teaching. Feedback was provided for example by clarifying in case of a misconception or by referring to the place where they found more explanation of a spelling rule, a language strategy or a didactic concept. Additionally feedback and feedforward were given every face-to-face session. Students learnt how to look at the learning process through pupils' eyes and how to broadly

evaluate pupils' learning in order to adapt their own teaching methods accordingly. Creating a safe learning environment where making mistakes is allowed requires that teachers and teacher educators consciously realise which of their teaching strategies work and which do not.

Retrieval practice

At the start of every face-to-face workshop, students were invited to recall the knowledge from the prior session and the online learning pathway. Calling information to mind to enhance and boost learning is an important learning strategy of retrieval practice (Agarwall, 2020). Didactic models for teaching practice were explained reflecting upon a demonstration by the teacher trainer, a critical analysis of the activities presented in manuals and a video observation of interactions between primary school pupils learning French. In a next step, the students created lesson plans in group that were subsequently tested in an authentic educational context in week 7 of that semester. Language proficiency in French was meaningfully practised when elaborating a lesson preparation. Each lesson was concluded by the question: "What did you learn today that will help you for traineeship?" According to research on retrieval practice, this kind of challenging and effortful retrieval leads to long-term learning and better understanding of practicing skills in new situations.

For example, the didactics of creative writing were taught and practised in week 4. During the previous weeks of that semester, effective didactics for vocabulary and grammar teaching and for oral interaction French in primary education were explored. At the start of the lesson, students recalled what they remembered of the teaching strategies for oral interaction, as they are similar to those of creative writing. They then shared with the group which strategies for creative writing were discussed in the online learning pathway, more specifically in the reading and listening assessments and in the tutorial including classroom activities. This introduction was valuable input for the demonstration of a creative writing lesson on campus by the teacher educator, in which students assumed the role of primary school pupils, and was followed by a reflection on effective strategies for creative writing. The introduction to this face-to-face session was linked to activities according to Bloom's Taxonomy's lower order of thinking: remember, understand, apply. We then zoomed in on the higher order of thinking of Bloom's taxonomy: analyse, evaluate, create. The exercises in the primary school textbook were critically discussed. Students analysed the extent to which the learning materials were in line with the predetermined writing objectives and - when necessary - enriched in terms of differentiated guidance according to the heterogeneous class group. In addition, students elaborated a lesson plan based on semi-authentic documents in preparation for peer teaching. This lesson plan was tested in an authentic educational context in week 7 of that semester.

Figure 2: Blackboard Ultra learning pathway creative writing French in primary education

SUCCESS FACTORS

In order to involve students more in their learning process, we focused on constructive alignment between learning objectives, learning activities and assessments online via Blackboard Ultra and during face-to-face sessions on campus. The integrated approach of the MIXed Learning Model was enhanced with the research insights for thoughtful digitalisation of technology enhanced learning, need-supported teaching and retrieval practice.

Critically defining which knowledge, skills and attitudes were essential for primary school teachers based on our own experience and several consultations with other teacher educators ensured optimal use of the learning time. The weekly tutorials and the automated grading of the continuous assessments generated immediate feedback for the student and reduced the instructor's workload. Besides that, we updated the online assessments annually recycling previous summative exams. Adding individual feedback improved students' metacognition on the mastery of language proficiency and didactics. Setting high and realistic expectations seemed achievable with the necessary support in small intermediate steps.

The ten minute tutorials of each didactic model were enriched with recordings of a lesson exemplifying how the theory about early foreign language teaching was applied in class with primary school pupils. Good practices in schools were animated by a student in coteaching with me, the teacher trainer. The didactic models demonstrated, practiced and discussed both online and in class according to the six levels of Bloom's Taxonomy helped students understand how to apply these teaching methods during traineeship.

As this model focuses on retrieval practice in and outside the classroom, there was much more time for in depth learning and retrospection on students' personal growth. This is also very decisive for teacher style. Designing digital learning pathways as an additional strategy for retrieval practice had a positive impact on students' final summative learning outcomes. Late assignments did not relate to poor results. The findings demonstrate significant advantages of implementing continuous assessment for student performance and knowledge retention.

To evaluate the impact, I polled students' experiences and needs in an interview and an online survey at the end of each semester. Students consider the learning materials functional and felt better prepared for the exam. They appreciated the unlimited replay of the tutorials and online assessments at a time of their choice. They also valued the extensive feedback and feedforward, as it provided them with insights into their misconceptions. Recalling prior knowledge according to the principles of effective retrieval practice and practicing what they know, reduced anxiety, made them more confident and better prepared for traineeship in primary schools. The meaningful learning activities had a positive impact on students' engagement and knowledge retention.

For quality control I consulted partners from other institutes of higher education in Europe. The consultation was given more weight thanks to my experience as a developer for an online remedial platform that helps Flemish students to practise French as a foreign language. Moreover, to gain a better idea of the efforts students need to make to bridge the learning gap for language proficiency skills, I took an online preparation course myself to passed the DALF C1 English test, in order to do a traineeship of one week in coteaching with an experienced CLIL-teacher English in a primary school for 10-year-old children growing up in a predominantly French-speaking environment in the southern region of Belgium.

CHALLENGES

The time and energy it costs to implement the design and provide weekly feedback and feedforward must be in reasonable proportion to the effects it achieves. Artificial intelligence could provide future solutions to practice speaking and writing skills with immediate feedback produced by the chatbot. Unfortunately, some students tend to deploy AI tools as a compensation strategy when submitting tasks for listening and reading assessments French. This sometimes complicated a proper interpretation of learning analytics to assess students' learning processes correctly and modify teaching practice.

Not all students that already master the desired language proficiency level, are motivated to do the online learning pathway or impulsively submit assessments without reflecting

on their approach, while the content of these tests are a preparation towards the didactic model discussed in the subsequent lesson. Even though they considered the goals, planning and structure of the course very clear, they did not always schedule the assessments in time in combination with their (student) job, hobby, family or remedial courses due to deficits for other entry level tests. Moreover, for students who do not meet the required language proficiency levels, it is not always realistic to practice French on their own. Barely 20% of students attend remedial classes French online or on campus.

The choice of technology-enhanced learning seemed a tailor-made solution for students in evening track, who combined evening courses with a family and a job, but scored better for students in daytime education, as the latter group was more closely monitored. The overall pass rates were better for students in day track, because the this group was guided during 10 weekly sessions instead of 4 sessions in a full semester for students who subscribed for the evening track. The teaching staff started a program for students to focus more on self-regulation skills in order to have them take action to upscale their level of proficiency for all courses of teacher training.

For policymakers, the challenge is to make the job of teacher more attractive so that we attract stronger profiles. Qualitative, high-level teaching requires a solid basic education and ongoing professionalisation where we should pursue rigorous standards, even in times of teacher shortage.

CONCLUSION

This case study demonstrates significant advantages of implementing continuous assessment for student performance and knowledge retention. Designing digital learning pathways as an additional strategy for retrieval practice and need-supportive learning created more time for in depth learning and reflection on campus. Although more focus on self-regulation skills are required, educational assessments for learning had a positive impact on students' final pass rates. Policymakers face the big challenge of attracting strong entrants and continuing to enforce high standards at graduation, even in times of teacher shortage.

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HOW TO CAPTURE STUDENT LEARNING IN CHALLENGE-BASED LEARNING – A PROPOSAL FOR A LONGITUDINAL STUDY

<u>Kerstin Helker*</u>, Isabelle Reymen, Miguel Bruns***, Jan D. Vermunt****

*Postdoctoral Researcher, innovation Space, Eindhoven University of Technology, Eindhoven, The Netherlands, k.helker@tue.nl, **Scientific Director, innovation Space, Eindhoven University of Technology, Eindhoven, The Netherlands, i.m.m.j.reymen@tue.nl, ***Professor, Industrial Design, Eindhoven University of Technology, Eindhoven, The Netherlands, mbruns@tue.nl, ****Professor emeritus, Eindhoven School of Education, Eindhoven University of Technology, Eindhoven, The Netherlands, j.d.h.m.vermunt@tue.nl.

ABSTRACT

Recent years have seen increasing calls for a more modern and flexible university education that prepares students for an increasingly complex and ambiguous world. As an educational concept responding to such calls, Challenge-Based Learning (CBL) has been implemented by an increasing number of higher education institutions. CBL puts students in the lead of their own learning, working on authentic and real-life challenges, collaborating with other learners and stakeholders to define learning and working goals. Research systematically exploring student learning processes in CBL and specifically student learning outcomes however remains scarce. In a pilot study, we therefore explored the learning gains CBL alumni reported to have taken away from a CBL learning experience. Participants reported many advantages of CBL and having acquired a broad number of personal and professional skills, but also named disadvantages of CBL learning processes. Therefore, we present a proposal for a longitudinal study of student learning in CBL in the second part of the paper. This longitudinal study should follow students on their path through higher education, capturing their learning process, perceptions of the CBL learning environment, and learning gains during each CBL course they encounter. This would allow us to get a better understanding of how CBL learning experiences affect student learning in other (both CBL and non-CBL) courses and foster the development of most beneficial conceptions of learning as well as processing and regulation strategies.

INTRODUCTION

Over the last years, Challenge-Based Learning (CBL) has gained popularity with higher education institutions looking to implement more authentic, real-life, and future-proof education. Since then, much research has emerged aiming to capture the different forms and definitions of CBL and student learning experiences in CBL. Research systematically exploring student learning processes in CBL and specifically student learning outcomes however remains scarce. This is a specifically pressing issue as one of the main points of evaluation of innovative educational concepts such as CBL is whether students truly acquire as much or more content knowledge as students in more traditional classrooms.

In this paper, we present the outcomes of a pilot study of learning outcomes of CBL alumni. Based on this, we make a suggestion for a larger longitudinal study of student learning processes and outcomes in CBL and present some methodological considerations.

THEORETICAL BACKGROUND

Recent years have seen increasing calls for more modern and flexible university education that prepares students for an increasingly complex and ambiguous world. This is specifically true for engineering education. Already in 2018, Graham explored "The global state of the art in engineering education" and identified a trend "to move towards socially-relevant and outward-facing engineering curricula" that "emphasise student choice, multidisciplinary learning and societal impact, coupled with a breadth of student experience outside the classroom, outside traditional engineering disciplines and across the world." (p. iii). This is not only crucial for students to be able to make sense of their learning and see the future usefulness of learning contents, but also to enable students to respond to future challenges that are not even known to them yet.

In a response to the above needs, Challenge-Based Learning (CBL) has been implemented in several educational contexts around the world, being most popular as an innovative educational concept for higher education (for a review, see Gallagher & Savage, 2020) and even more so in higher engineering education (for a review, see Doulougeri et al., 2024). Although its wide and various implementation has yielded many different forms and definitions of what CBL is, van den Beemt et al. (2020) define CBL in higher engineering education as

> "an interdisciplinary experience where learning takes place through identification, analysis, and collaborative design of a sustainable and responsive solution to a sociotechnical problem of which both the problem and outcomes are open. CBL at least involves (1) open ended problems from real world practice that require working in interdisciplinary teams, (2) entrepreneurial acting and design thinking, (3) combining disciplines, and (4) linking curricular and extracurricular activities.

CBL both deepens disciplinary knowledge and stimulates 21st century skills such as self-awareness, self-leadership, teamwork, and an entrepreneurial mindset." (p. 62)

While CBL has strong conceptual links to other approaches of creative and interdisciplinary learning, it however allows students to dive into the full technical complexity of the respective challenge they are working on and the resulting social and technological problems (Malmqvist et al., 2015). Prior research on CBL has shown student learning gains regarding industry networking, improving technical skills, applications of skills in a real-world environment, training in multidisciplinary teamwork, improving problem solving skills, and achieving a deeper understanding of knowledge (see Gallagher & Savage, 2020 for a review).

Despite the obvious advantages of students working on authentic, real-life challenges, the question remains what learning processes students realize in CBL and how learning outcomes can be described. Therefore, Helker et al. (2024a) developed a framework of student learning in CBL, where student learning patterns and learning gains are assumed to be affected not only by students' personal factors (such as personal background, educational experience, age, gender, and also experience with CBL and interdisciplinary work) but also contextual factors. These contextual factors are conceptualised as multilevel (micro, meso-, exo- and macrolevel) and comprising distinct types of (physical, social, and formal) content.

LEARNING GAINS IN CHALLENGE-BASED LEARNING

Learning gains in higher education have been defined as "students' change in knowledge, skills, attitudes, and values that may occur during higher education across disciplines" (Vermunt et al., 2018, p. 272). This change is conceptualized to consist of a cognitive, metacognitive, affective, and socio-communicative component. Prior CBL research has analysed student and academic feedback and indeed found benefits for students in industry networking, improving technical skills, applications of skills in a real-world environment, training in multidisciplinary teamwork, improving problem solving skills, and achieving a deeper understanding of knowledge (see Gallagher & Savage 2020 for a review – referring to Cheung et al., 2011; Conde et al., 2017; Gama et al., 2019; Membrillo-Hernandez et al., 2019; Rådberg et al., 2020). In a recent review of the literature, Perna and colleagues (2023) found that CBL "enhances students' sense of meaning in their education (Bernard et al., 2016; Gallagher & Savage, 2020), promotes student reflective practice, self-regulation and metacognition (Bohm et al., 2020; Doulougeri et al., 2022; Tang & Chow, 2020) and is effective in increasing student engagement, motivation and participation, all elements that are considered of paramount importance by contemporary educational institutions." (p. 17)." Further learning gains in CBL compared to traditional lecture-based education regarding interdisciplinary thinking, self-directed learning, collaboration skills and engagement as well as

disciplinary knowledge and skills have also been studied and findings suggest positive learning effects of CBL on students critical thinking, problem-solving skills, creativity, and communication (e.g., Ardiansyah & Asikin, 2020; Colombelli et al., 2022; Johnson et al., 2009; Martin et al., 2007) as well as content mastery (e.g., Bohori et al., 2022; Membrillo-Hernández et al., 2019).

PILOT STUDY – CBL ALUMNI LEARNING GAINS

The data in these studies on student learning outcomes in CBL have however often been collected during or right after students' CBL experience which does not allow for inferences on whether these learning outcomes and described effects of studying through the CBL approach are lasting. Therefore, Helker et al. (2024b) invited all students at a particular university of technology who had ever participated in a CBL course at their institution before to take part in an online survey exploring various aspects of their CBL learning experience, starting off with questions about the course they attended, what motivated them to take this course and what they felt were the advantages and disadvantages of CBL. To capture their personal learning gains, participants could indicate to what extent they saw added value of their CBL experience in their academic life, professional life and career, and their personal life. If participants saw at least some value, they were asked to further comment on how they had benefitted or were still benefitting from their CBL experience and what key learnings they had taken away.

20 CBL alumni participated in the study (8 female, 10 male, 2 not identifying; age: M = 24.8, SD = 7.09). By the time of responding, nine participants had finished university education, five were continuing at the same and another five at another university.

The survey results showed that students name a range of reasons why they had followed CBL courses. Among these, the courses' interdisciplinary set-up, the variety of interesting projects (e.g., *"I liked the diverse set of challenges and the fact that you worked with others in a group."* #5) and the perspective to be able and apply knowledge and skills to real-life problems (e.g., *"I liked the applied research aspect of it, as well as the possibility to work together with other people and improve my soft skills along the way."* (#7); *"It seemed more interesting than a regular Bachelor End Project as there was group work involved"* (#17)). Furthermore, several students mentioned that the course had been recommended to them.

The likelihood of students recommending CBL courses to other students ranged from 20 to 90% (M=69.07; *"I would highly recommend it, but not every student would fit this kind of work."* (#5); *"I learned more from my course than any other course at the university."* (#8)) with students describing a large variety of advantages and disadvantages of CBL:

Advantages of CBL that were described were the interdisciplinary nature of the CBL courses, opportunities for applying their knowledge and skills to a real-life problem (e.g., "*I think it resembles the 'real world' more. So I think you learn a lot of skills that are really valuable for the future. I also think that projects can feel more relevant because they are based in a challenge.*" #11), collaboration with other students and having to deal with uncertainty were described as more interesting and motivating than regular courses: e.g., "*The freedom means that you have to guide your own work, which teaches you to think, work, design and engineer without a course prescribing every step. This is more realistic compared to real engineering jobs*." (#5), "*You learn to work on a real world problem, instead of pre-defined exercises with pre-defined answers. You become more used to uncertainty*." (#18). The freedom in their learning students experienced in CBL courses were at the same time also described as a disadvantage of CBL – specifically the perceived lack of structure and supervision: e.g., "*The lack of structure can be a bit of a pitfall for students that haven't learned how to make their own structure yet (CBL for first year students is a horrendously terrible idea)*." (#7). Students furthermore mentioned the difficulty for students and teachers in CBL to capture student learning (e.g., "*There's a risk of unclear assessment because the learning is so open. This can cause confusion and unclear/misaligned expectations. In your job, you've done well when the client is happy, but that's of course not enough for Challenge-Based Learning*." (#12)) and that CBL might even "*not provide as much in-depth content knowledge as regular courses or projects.*" (#3).

Participants however described key learning outcomes such as collaboration skills, ability to deal with uncertainty, problem-solving skills, project management, communication and networking skills, and many more. One person indicated they had not taken away any learnings. When asked to indicate whether CBL had helped them develop each of a list of 13 personal and professional competences, positive responses were highest for Social Awareness, Dealing with Uncertainty, Communicating, Self-directed Learning and Pro-activity.

These outcomes support prior work emphasizing the variety of student learning outcomes of CBL, but also fuel on-going discussion in CBL research and practice on what and how much guidance is needed and how learning outcomes can best be assessed.

A CALL FOR FUTURE RESEARCH

The above findings call for a more overarching study of CBL in higher education. Up to today, however, the above framework of CBL (Helker et al., 2024a) and the numerous assumptions on the advantages of CBL, including student learning gains, have not been put to the test in large-scale empirical research with students in Challenge-Based Learning environments. Such a study, however, becomes more urgent the more higher education institutions re-design their courses and programs to CBL teaching and learning settings.

Based on the above, we argue for a study that explores the following research questions:

1) How is Challenge-Based Learning (CBL) as an educational concept implemented in different Bachelor programs and courses?
2) What are students' learning patterns in CBL?
3) What are students' learning outcomes in CBL?
4) How do student motivation and educational background influence learning patterns and outcomes in CBL courses?

STUDY PROPOSAL

Context and setting

Following Graham's (2018) statement that innovations in engineering education are likely to be successful if they can be integrated at scale to large cohorts and under constrained budget (p. 45), Eindhoven University of Technology (TU/e) decided to place CBL at the core of their educational vision 2030, by establishing a CBL curricular line across the Bachelor College. This means that every Bachelor programme offers a certain number of courses in a CBL format with an increasing interdisciplinarity, complexity and open-endedness, so that students at the end of the second year are proficient in CBL working and learning formats, and that they can successfully participate in a multidisciplinary CBL course. The agreed essential CBL characteristics include that (a) challenges are real-life and authentic, (b) learning activities create a rigorous treatment of fundamental engineering knowledge and skills, and (c) challenges stimulate the combination of deep understanding and broader view (Van den Beemt et al., 2023).

Despite this standardisation, the specific set-up of each of the courses of the CBL curriculum line and how they are being implemented in the programme varies per Bachelor programme. Some of the departments have over the last years already gathered more experience with CBL re-design and implementation than others, who are doing their first steps now. TU/e has developed some structures to support this process. Nevertheless, up until now, no studies have been conducted that have compared student learning in differently set-up CBL courses on such a large scale.

Research Methodology

In order to answer the above research questions, we suggest recruiting students from all CBL courses of all Bachelor programmes, i.e. all courses that are part of the CBL curriculum line. In order to capture the general considerations of the specific programmes for their students' learning processes and outcomes, we suggest conducting interviews with programme directors or program managers. In these interviews we also

hope to understand the general philosophy of the programme and why certain courses were chosen to be re-designed to CBL.

For each of the specific CBL courses, we are planning to conduct interviews with teachers, starting off with a number of practical questions on the course (How many students are enrolled, educational background of students, student-to-teacher-ratio, (dis)advantages of CBL in general and in this specific set-up). The first part will be focusing on the implementation of the course, guided by the CBL compass (Van den Beemt et al., 2023). Teachers will be asked to rate on a 4-point scale (from 1="not implemented" to 4="fully implemented"), several items on the real-life and open nature of the challenges in their course, their collaboration with stakeholders, education of T-shaped engineers, self-directed learning, collaborative learning, interdisciplinarity, learning technology, and assessment.

At the core of the study, we are planning several occasions at which we collect data from students: (1) at the beginning of their studies, during the first week of university, (2) at the beginning of each CBL course, (3) in the middle of each CBL course, and (4) every six months. The contents of each of these data collection points will in the following be described in more detail:

(1)   At the beginning of their studies, students will be asked to respond to a number of questions on their educational background (e.g., prior degrees, secondary education), professional background (e.g., prior employment), and experience with interdisciplinary, challenge-based, and/or collaborative teamwork. Furthermore, we include a scale to capture student grit (Duckworth & Quinn, 2009, 8 items, e.g., "New ideas and projects sometimes distract me from previous ones." scale: 1= "strongly disagree" – 6= "strongly agree") and students' overall study motivation (Vallerand et al., 1992, 28, items, e.g., Why are you taking up university studies? "…because I experience pleasure and satisfaction while learning new things." scale: 1= "strongly disagree" – 6= "strongly agree") including the subscales intrinsic motivation – to know, intrinsic motivation – experience stimulation, intrinsic motivation – accomplishment, extrinsic motivation – introjection, extrinsic motivation – external, and amotivation.

(2)   At the beginning of each CBL course, we will capture student course motivation (Kosovich et al. 2015; 9 items, e.g., "I believe that I can be successful in this course." scale: 1= "strongly disagree" - 6= "strongly agree").

(3)   During each course, students will respond to survey questions aiming to understand their learning patterns and perception of the learning environment. Student learning patterns will be captured with an instrument developed by Vermunt, Ilie, and Vignoles (2018), with subscales capturing students' relating and structuring (7 items, e.g., "I try to relate new subject matter to knowledge I already have about the topic."), critical processing (4 items, e.g.," I draw my own conclusions on the basis of data that are presented."), concrete processing (5 items, e.g., "I use what I learn from a course in

my activities outside my studies."), self-regulation (6 items, e.g., "I also pursue learning goals that have not been set by the lecturers but by myself."), lack of regulation (5 items, e.g., "The study directions which are given are not very clear to me.") as well as self-management (7 items, e.g., "I'm very good at making time to study."). Social engagement (6 items, e.g., "I try to help others who are struggling.") and emotional engagement (5 items, e.g., "I look forward to this course."). These subscales will be measured with the instruments developed by Fredricks, Wang, et al. (2016) and Wang, Fredricks, Ye, Hofkens, & Linn (2016).

Students' perceptions of the learning environment will be explored using Könings and colleagues' (2014) instrument, with subscales to capture students' perception of fascinating contents (8 items, e.g., "Most of what I learn is interesting."), integration (4 items, e.g., "Most sessions of this course are focused on practice."), student autonomy (9 items, e.g., "Students are free to choose the way in which they learn the content."), differentiation (4 items, e.g., "All students in the course do the same work at the same time.") and clarity of goals (2 items, e.g., "Students know what to expect at tests and exams."). All items are responded to on a 5-point Likert scale.

(4)   In order to capture student learning outcomes, we have decided not to collect data after each of the CBL courses but every six months. This way, student reports on learning outcomes will not be tainted by their experiences of the learning process (post-group euphoria, e.g., Marsh et al. 1986). In these surveys, we will present the overall learning goals of the specific Bachelor programme and ask students to self-assess their competence level for each of these learning goals. Furthermore, we will ask students in an open-ended question which activities they attribute the development of the respective competence to, and expect students to either name curricular or extracurricular activities at university or even activities independent of their studies. Furthermore, students will be presented 14 personal and professional competences (e.g., communicating, collaborating, planning & organizing, dealing with scientific information, taking responsibility, dealing with uncertainty) and will be asked on a four point scale, to which extent they would like this respective competence to describe them in the future and to what extent they feel they have already developed this competence.

Methodological Considerations

There are some limitations of the study plan that should be addressed in all clarity. First of all, in this study setup, no data will be collected in non-CBL courses. This decision was made in order not to overload students with surveys, also considering that the data would not provide more beneficial information. Of course, studies researching the effectiveness of CBL would benefit from the comparison of a CBL experiment with a control group of students that study the same learning contents in a traditional learning context. This, however, is rather impossible given that in CBL, teachers cannot plan for

the contents students study as the students often define the problem and learning goals as part of their autonomous working process on the challenge.

Another limitation of this study is, that students' learning outcomes cannot be clearly linked to the individual CBL courses as data on student learning gains will be collected every six months irrespective of whether and how much students have studied in CBL environments in the proceeding time period. Until there is an opportunity to conduct similar six-monthly data collection on student learning gains at a university with a more traditional educational concept aiming at the same learning contents, the current study will only provide insights on student learning outcome development over time. It may well be that the CBL courses have focused on knowledge application whereas the more traditionally set-up courses such as lectures served knowledge acquisition. Only students' self-reported data on which study activities they attribute the learning gain to, will serve as an indicator for now. Nevertheless, we will refrain from using student exam results as indicators of student learning. Not all courses that will be researched in this study include exams in their assessment plans and if they do, exams can only capture student learning gains anticipated by the teacher when designing the course.

CONCLUSIONS

While there is an increasing amount of research trying to capture student learning processes and outcomes in Challenge-Based Learning, it has mostly focused on students' application of previously acquired content knowledge and development of personal and professional skills. Many teachers argue that learning outcomes in CBL may only be fully visible a while after the CBL experience when students move on to other educational or professional contexts. Own prior research has yielded some insights into the learning outcomes of CBL alumni, but we argue for a thorough longitudinal study following students on their path through higher education. This would allow us to get a better understanding of how CBL learning experiences affect student learning in other (non-)CBL courses and foster the development of most beneficial conceptions of learning as well as processing and regulation strategies.

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VALUE-BASED MATHEMATICS EDUCATION FOR SOCIALIZATION

Jeroen van Rumpt*, Janneke Buikema**, Willemien Eikelboom***, Michiel Veldhuis****, Ronald Keijzer*****,

*Researcher/educator, Driestar Christian University of Teacher Education, Gouda, j.j.g.vanrumpt@driestar-educatief.nl, **Researcher/board member, NVORWO, penningmeester@nvorwo.nl, ***Researcher/educator, KPZ University of Applied Sciences, Zwolle, w.eikelboom@kpz.nl, **** Associate professor, IPABO University of Applied Sciences, Amsterdam, m.veldhuis@ipabo.nl, ***** Professor, IPABO University of Applied Sciences, Amsterdam, r.keijzer@ipabo.nl.

ABSTRACT

In this paper we describe values in mathematics education in the Netherlands, in a context where both government and teachers are merely focused on test results. At the same time, newly proposed core goals emphasise mathematics education's socializing function. These new core goals also focus on mathematical attitudes and relating mathematics and the world outside school. This paper describes an exploration to come to a model that can be used to both clarify the role of values in mathematics education and can be used to design education that aligns with this value-oriented character. We present the development of this model as it evolved in discussions with experts such as teacher educators, mathematics specialists, and primary school teachers. It developed from a linear model, via an adapted version making it too complex, to a model that is more focused on the relation between the main elements. The final model represents relations between 'mathematics', 'values', and 'the world' and names the connections between these aspects 'mathematical literacy', 'citizenship', and 'value-based mathematics'. By developing this model, we experienced that its use shifted from a descriptive model, via a model that helps communicating about value based mathematics to a mental model. The final model can be used for future design research, where the first step will be establishing the present status of values in mathematics education.

INTRODUCTION

Mathematics education in The Netherlands is developing in a political and societal context where test results, for example in international comparing studies like TIMSS or

PISA (Mullis, et al., 2020; OECD, 2023) are valued (Ministery of Education, 2022). However, new core goals for mathematics in Dutch primary education express that mathematics education is crucial for citizenship education and, more generally, to participate in an open democratic society (Prenger et al., 2023).

Further, mathematics is generally recognized as the human activity of mathematizing one's world (Freudenthal, 1991). Mathematizing means using and developing mathematical tools and insights in interaction with the context (within or outside mathematics) one is participating in. It can thus be a way to learn mathematics which can be used when needed in daily life. Being a result of interaction, mathematizing implies mathematics construction can be different for each learner. Moreover, mathematizing as central activity in mathematics learning is related to mathematics as cultural artifact, where one's culture constitutes one's mathematics learning (D'Ambrosio, 2015). Since mankind is living in a diverse cultural world, the specific nature of mathematics for a learner is implicitly determined by (educational) habits and culture. There is a need for recognizing that mathematics can constitute crises in a sense that it is central to the dynamics of present-day crises (Skovsmose, 2021; Wolfmeyer, Lupinacci, & Chesky, 2017). Mathematics learning can also act as a means for recognizing and valuing patterns and relations between unquantifiable variables, such as empathy, beauty, and kindness (Renert, 2011). These values are gaining importance, as they are a means for critical mathematics education, where controversial issues are discussed (Ödmo, Boistrup, & Chronaki, 2023). More generally, values in relation to mathematics education link mathematics teaching to social, political, and ecological issues.

Values can be recognized in actions and decisions during teaching, learning, and doing mathematics, and therefore have an important place in research in mathematics education (Carr, 2019). Nonetheless many mathematics teachers consider mathematics as a value-free space (Clarkson, Seah, & Pang, 2019). They might see mathematics as culture-free; mathematical ideas can be discussed separate from language and space, and therefore culture-free and value-free. Another reason could be that mathematics teaching is mainly focused on skills, technique-oriented, and gaining good test results (Bishop, Seah, & Chin, 2003; Clarkson, Seah, & Pang, 2019). Values become visible in one's choices in mathematics education. However, mathematics education in the Netherlands is generally textbook driven (Van Zanten, 2020). This obviously influences the scope for teachers making educational choices and the extent they are able to connect to the specific social-ecological context. Moreover, this connection is also difficult because mathematics is often invisible and not obviously present (Gravemeijer, 2001).

In this article we will describe the background of value-based mathematics education. After presenting the research question and method we will describe the research process that led to the different stages of the developed model and the changing role of this model. We will then present the state of art and explain the developed model for value-based mathematics education. Finally we will look ahead to future design research and the role of the developed model in it.

BACKGROUND

Value based education emphasizes that education is not a neutral, open field of possible relationships between action and consequences, but a normative, directed activity starting with the question of purpose and desirability of intended goals (Biesta, 2010b). It is difficult to get a proper widely accepted definition of values, among others because concepts such as morals, ideals, beliefs, and ethics are synonyms or overlapping in meaning (Clarkson, Seah, & Pang, 2019; Murre, 2017). If one approaches the concept value broadly, it turns out to be difficult to arrive at a workable list of values. In the Dutch context there are lists found with 1300 different values (Murre, 2017).

Together with emotions, beliefs, and attitudes, values form the affective domain of mathematics (Debellis & Goldin, 2006). Because values become visible through our choices, guide them, and have to be made in social and ecological issues, space for choices in mathematics education, both for teachers and students, is essential (Carr, 2019; Clarkson, 2019). We define values as part of one's normative framework, providing direction in choices that need to be made, and show what someone considers important and good. Values are shaped by one's worldview or religion and their social and ecological environment.

Particular values might also be developed by doing mathematics, like endurance, openness of spirit, trust in reason, or independent thinking (Su, 2020). In 1988, Alan Bishop introduced three couples of complementary mathematical values (Bishop, 1988). The first couple concerns the societal values of *control* and *progress*. Control gives you assurance in using mathematics to solve (social) problems, progress is more focused on growth and change. Secondly there are the cultural values of *openness* and *mystery*. Openness emphasizes transparency in arguing and criticizing it, mystery is more about curiosity and wondering. Thirdly there are the symbolic or ideological values of *rationalism* and *objectivism*. Rationalism is about arguing, logical thinking, and deductive reasoning, objectivism is more focused on representing and the interaction between form and object (Gravemeijer, 2005). The values rationalism, control, and openness are most commonly acknowledged, with most emphasis on rationalism. Some values seem to be incompatible, but rationalism, for example can deepen mystery (Clarkson, 2019).

In addition to values focused on mathematics, one can identify values focused on mathematics *education* (Kacerja & Julie, 2023). Values in mathematics education have been identified as continua between: ability and effort, wellbeing and hardship, process and product, application and computation, facts and ideas, exposition and exploration, recalling and creating, ICT and pen-and-paper (Kacerja & Julie, 2023).

Focusing on values is an opportunity for mathematics education to achieve a better balance between the domains of qualification, socialization, and subjectification (Biesta, 2010a; Onderwijsraad, 2016). When this is realized, students can be better prepared to

functionally use mathematics in our present-day society. Focusing on values is also important, because the values mentioned above can be positive and negative. And teachers do teach them in mathematics, although they do it unconsciously and uncritically (Bishop, 1988).

RESEARCH QUESTION

Developing value-oriented mathematics education to connect mathematics with citizenship and to approach the subject more broadly than merely from a qualifying perspective requires a new way of looking at the subject. In mathematics education, values that are both consciously and unconsciously embedded shape how the subject is taught and learned. To better understand how mathematics education contributes to the development of citizenship, it is essential to explore the interplay between mathematics and values. Such an approach requires a model that makes these connections visible. This model must show how mathematics can be connected to values and how these connections contribute to education that aligns with the value-oriented nature of the subject. Using a model provides not only insight but also supports the design of this type of education.

The central question to be answered is:
How can the connection between values and mathematics education be modelled in a model that clarifies what value-oriented mathematics education is?

METHOD

The development of this model for value-oriented mathematics education followed a cyclical approach, as shown in figure 1.
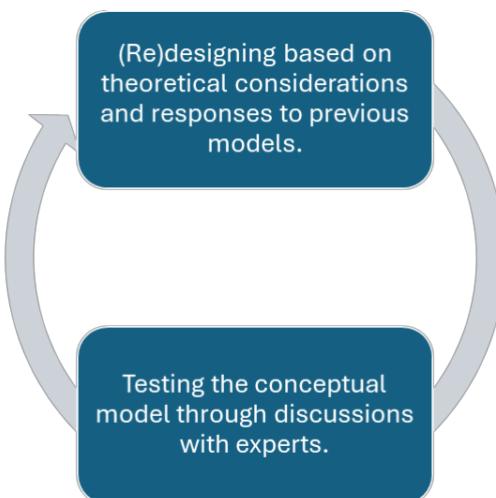
Figure 1. Cyclical approach of development process

During the development process, the model was initially designed based on aspects found in our literature review. This model was validated from various perspectives. It was discussed during meetings of a research group and during interviews with several mathematics experts. Feedback from mathematics experts has also been collected during a workshop at a national conference for mathematics education. Additionally, the model was presented at two conferences for mathematics specialists, where the values within mathematics were explored in combination with mathematics in the real world. The position of the model was also explored in response to the question: 'Why do we teach mathematics in primary education?' Furthermore, the model was examined at a conference for teacher educators, where it was tested from a broad perspective to determine whether it serves as a functional model to raise awareness of the various elements within education. These activities did not take place in the order described above, as we had to account for scheduled conferences. The most important activities can be found in table 1.

Date	Activity	Group
October 2023 – June 2024	Monthly meetings	Researchers of mathematics education
March 2024	Conference	Mathematics specialists
March 2024	Conference	Teacher educators
April 2024	Conference	Teacher educators Mathematics experts Mathematics specialists
May 2024	Conference	Teacher educators Mathematics experts
June 2024	Meeting	Mathematics experts

Table 1. Feedback activities

A similar approach was used during the development of the Dutch Association for the Development of Mathematics Education (NVORWO) research agenda for mathematics education (Keijzer & Veldhuis, 2020). The refinement of the model continued until all relevant groups of experts, as mentioned above, had shared their insights.

RESEARCH PROCESS

At first we explored lists of values as a means defining values in mathematics. That proved to be difficult, as the lists we found contained many values of various nature. Therefore an initial linear model was developed to gain a clearer understanding of the research field of the socializing function of mathematics education and the place of values in it. This first model (fig. 2) consists of key elements: mathematics education, value-based education, normative educational practice and mathematics in the world.

The model shows that there are two way to approach the research field. The first one is to get a good insight of what value-based education is. Value-based education is, as mentioned before, based on the idea that education is not a neutral field of actions, but a normative practice. In this approach we have to filter out what is specific for mathematics in value-based education. The second approach is to research what kind of values are in charge when we look to the role of mathematics in our society. From this, we can determine which values should be prioritized in our mathematics education.
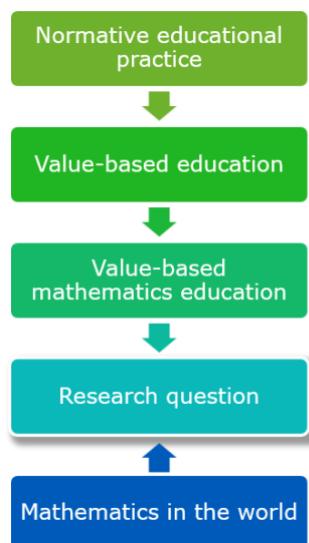
Figure 2. Initial model of value-based mathematics education

In successive meetings with critical friends we discussed the linear character of the model and its elements and emphasized the relationship between the key elements. In these meetings the role of the model was changing from a model to get grip on the research field to a descriptive model to clarify what value-based mathematics education is.

Redesigning the model resulted in a Venn diagram combined with a triangle (fig. 3). We defined the relationships between the key elements and made a connection with the didactic triangle. Key elements are still mathematics in the world, value based education and mathematics education. But combining them this way, more relations became visible and it shows for example the role mathematics can play in citizenship education. By adding the didactic triangle not only the values by doing mathematics are part of the model (Bishop, 1988), but also values of teaching mathematics (Kacerja & Julie, 2023). Aforementioned values in the continua like ability and effort, wellbeing and hardship, process and product are visible in choices that are made in the triangle between teachers, students en the mathematical content.
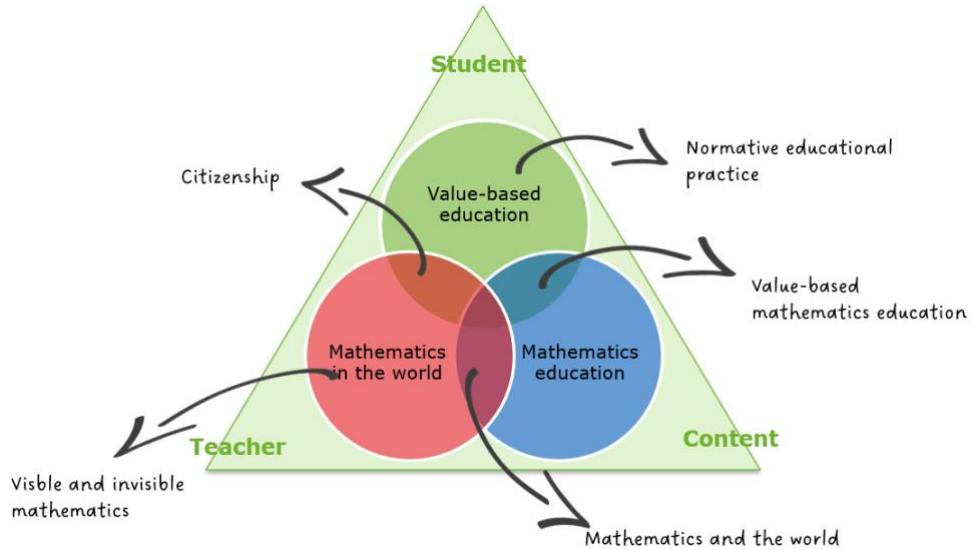
Figure 3. Second model of value-based mathematics education

We discussed this model in meetings with several experts and we discussed it in a research group with critical friends. We also discussed the model with teacher educators, teachers and mathematics experts. At last we used the model in conversations at learning networks of mathematics specialists. At this point two aspects became clear.

Firstly, the model appeared to be too complex for this subject and the subject too complex for a model. By combining two models, it was difficult to define where connections make sense. In that way the model appeared to complex to use for design research. But the research field is more complex than this model suggests, too. For example, values take place at different levels, both in education and in society.

Secondly, the inner part of the model appeared to be a good model for discussing the role of values in mathematics education with teachers and mathematics specialists. By using this part of the model, teachers and mathematics specialists became more aware of the presence of values in mathematics education and the opportunities of it.
These two aspects pointed out that the model will function more and more as a model supporting conversation on values in mathematics, rather than a descriptive model.

The aforementioned arguments resulted in redefining the key elements and relationships. The two models (Venn-diagram and didactic triangle) are no longer combined. The current model (fig. 4), that is presented in the next paragraph, functions not only as a conversation model, but also as a mental model for further research and design.

STATE OF THE ART

This current model illustrates the socializing role of mathematics education. It offers teachers a tool for reflecting on how values can be incorporated into mathematics education and how this can contribute to broader goals, such as active citizenship. The model helps mathematics education move beyond technical skills by connecting to students' personal growth and societal involvement, making the subject more meaningful.`

The model consists of three main components: 'mathematics', 'values', and the 'world'. Together, these elements form a framework to better understand the socializing function of mathematics education. Each component emphasizes an essential aspect of the role of mathematics in education.

'Mathematics' focuses on logic, abstraction, and problem-solving. Although often considered neutral, mathematics is shaped by human choices, such as which topics are included in the curriculum and how they are applied. Mathematics encompasses not only understanding and applying mathematics but also developing broader skills like critical thinking and perseverance.

'Values' are the beliefs and principles that guide behaviour and decision-making. In education, values such as fairness, collaboration, and perseverance influence teaching approaches and support students' personal and social development.

The 'world' represents the social, cultural, and ecological contexts in which students live. Mathematics offers tools to analyse and address complex global issues, such as climate change, inequality, and justice, enabling students to engage with these challenges meaningfully.
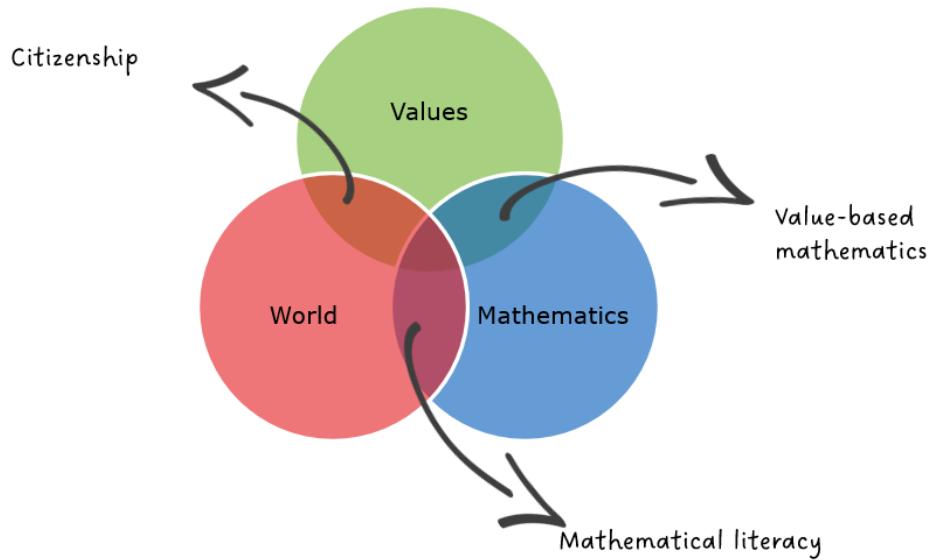
Figure 4: Final model of value-based mathematics education

By combining these three components, the model highlights how mathematics education can move beyond teaching technical skills to fostering active citizenship and critical engagement with societal issues.

The overlaps between mathematics, values, and the world reveal specific connections and opportunities for mathematics education:

- Mathematics and values: This intersection, referred to as value-based mathematics, emphasizes the typical personal traits required to solve formal mathematical problems, such as perseverance, creativity, and patience. Particular values developed by doing mathematics have primarily a place here (Bishop, 1988). By adding the world (core of the model) developed values can be applied in the society. Or the world can be used to make value-based mathematics more meaningful for students. Mathematics also inspires wonder, from exploring symmetries in nature to uncovering patterns in art and music. These connections show how mathematics supports personal growth and societal engagement.
- Mathematics and the world: This overlap, referred to as mathematical literacy, focuses on the application of mathematics in real-world contexts. Most definitions of mathematical literacy contain aspects of knowledge, skills and personal qualities which are necessary to recognize and use mathematics in the world (OECD, 2023; Ginsbrug, Manly, & Schmitt, 2006). Values developed by doing mathematics like objectism and control have also a place here (Bishop, 1988). By adding values (core of the model) students can use mathematics in daily situations to make decisions according to their worldview. For example,

statistical methods can be used to analyse climate change, or mathematical models can provide insights into economic inequality. Such applications equip students with tools to interpret and address contemporary social and ecological challenges.

- Values and the world: This overlap, referred to as citizenship, focuses on values like fairness, sustainability, and social justice. Addressing ethical questions—such as how resources are distributed or how sustainability is defined—encourages students to think critically and reflect on their role in society. By adding mathematics (core of the model) students can form and substantiate their opinions.

The model serves as both a conversation model and a mental model. It provides a structure for discussing how mathematics education can integrate values and societal engagement. At the same time, it supports educators in mentally framing their lessons to reflect broader educational goals. Rather than prescribing strict rules or fixed approaches, the model functions as a flexible tool for reflection and dialogue. Teachers can use it to explore how mathematics lessons align with educational objectives and societal needs. The dynamic nature of the model allows it to adapt to varying educational contexts and objectives. The degree of overlap between mathematics, values, and the world depends on the specific situation and needs of students.

FUTURE RESEARCH

The model, shown in figure 4, is the result of the steps taken to understand the relationship between values, the world, and mathematics. It shows how these elements are connected, both in theory and in practice. The model serves as a framework and discussion tool to raise awareness and provide insight into how values, mathematics, and the world interact in education.
We will use this model to create design criteria for future design research. In this design research we will, together with partners in primary schools, develop a prototype for value-based mathematical activities. First step will be using the mental model to describe the role of values and the relation of claimed values (ideals) and values-in-action in current mathematics education. Using the model as a conversation model we can identify what helps or hinders the connection between values and mathematics education. These insights contribute to the design research process. The model itself as a conversation model can also be part of the design while it supports teachers to connect values to mathematics education.

The model for value-based mathematics education highlights the importance of values in learning and teaching mathematics. It encourages educators to view mathematics not merely as a set of skills but as a means to connect students with the world. This integrated approach helps students develop the insight and skills to address societal and ecological challenges while fostering critical thinking and active citizenship.

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"ALL STUDENTS NEED NETWORK SUPPORT"

Judith van Driel - Noordermeer *

*Master Teacher Leader, Albeda Zorgcollege, Rosestraat 1101 3071AL Rotterdam,
j.vandriel@albeda.nl

ABSTRACT

This practical study investigated the impact of an intervention on network support of first-year nursing students at Albeda vocational education. The study focused on the relationship between educational partnership in the pedagogical triangle (school, home and student) and study-supportive behaviour at home, with the aim of increasing experiential knowledge and opinion about a study-promoting home situation.

The intervention included the provision of a general information card and a basic website for network stakeholders, followed by set meetings after 10, 20, and 40 weeks. The intervention is literature-based and was developed in collaboration with a development team (n=3) and student council (n=3), and implemented by teachers on a voluntary basis. The impact of the intervention was measured with non-validated pre- and post-measurement questionnaires among students (n=70 vs 71), student network (n=26 vs 25) and with an existing Quick Scan among teachers (n=11 vs 9).

Quantitatively, the intervention had different effects on opinions about network support. Students and teachers experienced shifts, while network showed less change. It was found that students and network valued less informal contact and more serious interlocutors, especially during crucial moments. On the role of the mentor and student consent for contact, opinions were more convergent.

Qualitatively, teachers gave positive feedback on more intensive design of the pedagogical triangle, including joint policies, time investment, communication and training. Despite limitations in voluntary participation, the intervention shows that educational partnership can contribute to a conducive home situation for study success.

Keywords: study success, educational partnership, network support

INTRODUCTION

There have been previous initiatives within our programme to increase network support. Yet these initiatives always sink into all the busyness. Also, the long development for a

parent portal (Vonk, 2020) has not contributed to a structural implementation of network support. Proximity and distance from that home situation can also be on edge in vocational education (Esch, Petit, & Smit, 2011). With this research, I aim to contribute to network support for study success. Map this involvement for nursing education and develop appropriate and feasible intervention(s) so that our students can pursue their study careers supported by their network. The following student quote captures the essence of this research, 'The idea of network support for the positive is a good idea! Not for control, from the idea that you wouldn't be able to do it'.

THEORETICAL FRAMEWORK

The reason for this practical study of network support within Albeda's nursing course is the insufficient study success, resulting in study delay or dropout. The programme experiences declining yield figures, and early school leaving in 2017-2018 was at 9%, the national average (Ministry of Education, 2019). Insufficient study success is considered a societal problem (Boogaard et al., 2019). This study focuses on network support for reducing study dropout within the nursing programme.

Early school leaving is not an immigrant problem, but a major urban and poverty problem (Winsemius et al., 2008). The problem is greatest in Rotterdam-South, with 60% overburdened youth. The complex situations of young people with limited social skills, poverty, debt, etc. makes it difficult for young people to obtain a diploma. (Eimers & Bekhuis, 2006). School dropout is seen as an end result of a long-term process, and its prevention is considered a form of study success (Lusse, 2013). Study success is viewed here not only from yield figures but also from vocational training, social engagement, and personal formation (Klatter, 2017).
Successful completion of the nursing programme means graduation within 4 years, and the qualification requirement until the age of 23 (Education
implementation Service, 2018). There are debates about the feasibility of graduation within 4 years and the possible causes of disappointing completion rates, such as above-level placement and lack of selection at entry (Inspection of education, 2018).

Social and personal background characteristics determine study success by 80% and school by 20%. The home/network is a constant factor influencing study success, with predictors including educational attainment (.38), income (.67), parents' occupation (.42), in addition motivation, background knowledge, and atmosphere at home (1.42) (Marzano, 2007). Network support is seen as all activities related to the student's career (Lusse, 2013). The three dimensions of network support are presented in order of importance, focusing on effect sizes on secondary education study outcomes:
1. Education-supportive behaviour from the network
- High realistic expectations are expressed by the network regarding results and school participation (.88).

- Time investment and participation in school activities are supervised at the network; warm interest as well as limits (.40).
- Democratic expectations about career interest are expressed by the network (.39).
- School is discussed with interest at the network (.32). The motivation to continue studying comes, to a large extent, from the norms and values transmitted to a student by his parents or network; named 'social capital'.
2. Educational partnership in an educational triangle (.36). A trusting relationship between school, student and network is a prerequisite for shaping educational supportive behaviour at the network.
3. Parent/network participation (Expertise punt LOB, MBO raad, 2020). This is unlikely to be related to study outcomes and is therefore not considered in this study.

The role of network as supportive resources for students is emphasised, especially among vulnerable young people (Lusse, 2013). The better the contact and appropriate forms of cooperation, the better young people's well-being and study results will fare (Boonk, 2021). In vocational education, by the way, the network should be seen more broadly than parents alone: all family members, partner, friends, housemates and neighbours can play a role in it. The effect of network involvement on study success decreases as students get older, while the mediating student role in network contact increases. Positive network contact is best initiated around careers and preferably in two-way traffic with one clear contact person in the school (Expertisepunt LOB, MBO raad, 2020). This is in line with Albeda's vision document: 'Optimal career reinforcement is achieved by actively involving parents/legal representative(s) as part of guidance' (Romeijnders, Louwerse, & Kooren, 2020).

One-sided contact around problems actually puts pressure on the triangular relationship and is counterproductive. It requires a sensitive, proactive attitude from school to lower the threshold for network support with a lower level of education or socio-economic background who are less agile in entering into the conversation with school (Lusse, 2013). Network support is an important aspect in education, but it is essential to address it in a balanced and thoughtful way. However, intensive homework help and rigid supervision can have negative effects on network relationships, as they limit autonomy and can cause negative emotions and sanctions (Lusse, 2013). In cases of disrupted relationships, increasing network involvement can potentially be counterproductive (Boonk, 2021). It is important to recognise that school cannot intervene directly in the network situation, but can offer information, dialogue, training or support on a voluntary basis (Marzano, 2007). The concept of voluntary basis should not be confused with non-committal; it is necessary to be clearly inviting and communicate expectations of involvement to the network (Vries & Diender, 2014).

Theme meetings organised by students, covering topics from dimension 1 (=Education-supportive behaviour), can be valuable at vocational education and increase knowledge about the importance of network support. However, the focus for intervention should be on dimension 2 (=Educational partnership in an educational triangle) (Diender, 2021).

At vocational education, specific attention is needed for network support at transition stages, such as the transition from school to school, school to internship, and other transition moments such as delays and class changes. It is also important to find the right balance between steering and letting go in vocational education, both from network and school (Vries & Diender, 2014). Creating a conscious approach around these transition moments and finding this balance can contribute to successful network support in vocational education.

METHOD

Research questions

To understand the influencing factors on network support, the main question was asked: 'How can a context sensitive intervention on network support be realized among nursing students with a view to study success and school failure?' Four sub-questions were drawn up:
1. What influencing factors of the network promote study success and reduce school dropout among nursing students?
2. What experiential knowledge about network support do students, teachers and home stakeholders have at the nursing program?
3. What design criteria are needed to develop and implement an intervention to network support?
4. What is the effect of an intervention on opinions about network support in the nursing program?

Research design

The study ran from October 2021 to July 2023 at the Albeda Rosestraat nursing course. A mixed-methods design was used with literature review and questionnaires for qualitative and quantitative data. The intervention was conducted in first-year groups, with triangulation of data analysis for reliability and validity. Results could be measured for opinions on network support and success factors for cooperation, but not for study success, as this requires a longitudinal study design (Bakker, et al., 2018). The field study was conducted with integrity and respect and care on behalf of the researcher, with the consent of all informed participants.

Intervention design

The intervention to network support for study success was conducted with first-year nursing students. The intervention was based on literature review and experiential

knowledge, developed in collaboration with a development team. Activities to increase home engagement were chosen as an innovation:

1. Video as a mandatory intake activity in career choice
2. General information card for network
3. Website for network with general information
4. Collecting contact details of network
5. Meetings with network (after 10, 20, 40 weeks)

All activities except the video were carried out. The intervention was evaluated with a non-validated questionnaire with six subscales on home involvement with students and network, and for teacher a Quickscan with three subscales on success factors for good cooperation between network and school. All based on the research of Lusse (2013).

Table 1: Data collection and analysis by sub-question:

Sub question	Data collection	respondents	Data-analysis technique
1. What influencing factors of the network promote study success and reduce school dropout among nursing students?	Literature study on network support		Narrative thematic analysis
	Expert consultation	Experts (n=3)	Summarize on relevant items
2.What experiential knowledge about network support do students, teachers and home stakeholders have at the nursing program?	Open and multiple choice questionnaire with 6 subscales about network support	Students pilot (n=60) Students (n=70)	Descriptive statistics
	Open and multiple choice questionnaire with 6 subscales about network support	Network (n=26)	Text: Summarize on relevant items Numerical: descriptive statistics
	Quick scan: open and multiple choice questionnaire with 3 sub-scales about network support	Teachers (n=10)	Text: Summarize on relevant items Numerical: descriptive statistics
3.What design criteria are needed to develop and implement an intervention to network support?	Literature review on design criteria for home involvement intervention		Narrative thematic analysis
	Design meetings	Teachers (n=3)	Summarize on relevant items
	Feedback on intervention	Teachers (n=8) Students (n=3)	
4.What is the effect of an intervention on opinions about network support in nursing program?	Open and multiple choice questionnaire with 6 subscales about network support.	Students (n= 71)	Text: Summarize on relevant items Numerical: descriptive statistics
	Quick scan: open and multiple choice questionnaire with 3 sub-scales about network support	Teachers (n=9)	Text: Summarize on relevant items Numerical: descriptive statistics
	Open and multiple choice questionnaire with 6 subscales about network support.	Network (n=25)	Summarize on relevant items

RESULTS

Baseline measurement on network support: see table 2,3,4

The student questionnaire (n=70) showed that 85% of students indicated that the (step) parent is most involved in their studies. It was notable that students clearly distinguished between pleasant attention from the network, need for that attention, and desirability of network contact with school. Contact after student consent can count on the most support among all variants (M=3.32). The network seems well informed about what is expected of them and feel competent.

The network questionnaire (n=26) showed that most respondents were (step) parents. The non-response rate was n=80, which probably means selective responses. The standard deviation is <1 on many items, so network respondents agreed on many items. The network rated contact with school as pleasant, necessary and desirable. They felt competent for study support and valued a good relationship with the teacher. They attached importance to a reciprocal relationship between network and school, with emphasis on future prospects. The network scored well above students on almost all items and remarkably higher on 'contact teacher by yourself' (M=4.22 versus 2.71). The network scored lower than students on the items 'only get information if the student wants it' (M=2.93 versus 3.32), 'the importance of tasting school atmosphere' (M=3.78 versus 3.89). In the open text, additional attention was drawn to guidance in difficult work conditions, student well-being, study support and opportunities for (digital) contact.

The teacher questionnaire (n=10) showed that there were different views on network support. The topics were rated with varying scores and this was reflected in the open text. The open-ended text emphasised, among other things, the importance of clear communication, privacy laws compliance, and the need for facilitation.

Conclusion: This study shows that both students and network value network support positive for study success. There are differences in perceptions between students and network, and these may affect the success of network involvement. Teachers have varying opinions on the level of success of network support and emphasise the need for clear communication and facilitation. These results offer starting points for improvements in policies around network support, with a special focus on the relationship between teacher, student and network, as well as the need for facilitation measures.

Effect measurement of network support: see table 2,3,4

Table 2 measurement 2 (MM2) **teachers perceptions** *of network support (n=9) on five point scale (--,-,+-, +, ++) compared to measurement 1 (MM1) with Quick Scan (Lusse)*

Category	Subcategory	MM 1	MM2
Establishing contact between school and network	Welcome (friendly, accessible, clearly)	+/#/-	+/+/+
	Introduction	-	+
	Alle network	#	#
Collaboration between school, student and network	Directing student	#	#
	Reciprocal relationship	+	#
	Network conversation	-	-
	Positive attention	+	+
Working together on future prospects	Study career	#	#
	Development points	+	#
	Perspective	-	#
Facilitate necessity	Support study career		
	Administration		
	Policy		
Attitude en organisation (0-10)		6,7	6,1
Relation (0-10)		6,2	5,3
Tuning (0-10)		5,2	5,4
+ = sufficient; - = fail; # = opinions divided			

Table 3 measurement 2 (MM2) **student perceptions** *of network support (n=71) scored on a five-point Likert scale (1=completely disagree- 5=completely agree), compared to measurement 1 (MM1). Categories according to sub scales of network support (Lusse, 2013).*

Category	Item	MM1 M*	MM1 SD**	MM2 M*	MM2 SD**	Difference M*
Student's appreciation of network support.	I like it when my network is interested in my studies.	4.29	1.05	4.20	1.01	- .09
	I need someone in my network to support me in my studies.	3.17	1.32	3.28	1.26	+.11
	I like it when someone of my network has contact with the school.	2.63	1.18	2.77	1.21	+ .14
	My network has agreements about contact with the school.	2.31	1.22	2.27	1.18	- .04
	My network is approached in case of school problems	2.83	1.45	3.14	1.44	+ .31
	My network only receives study information with my consent	3.32	1.33	3.21	1.34	- .11
Average category		3.09		3.15		+ .06
Network knows what is expected of them and feels competent.	My network means the following to me: Asks with interest about my studies.	3.97	1.11	4.08	0.94	+ .11
	Encourages me to learn a profession.	4.04	1.13	4.07	1.11	+ .03
	Advises me how to learn.	3.25	1.33	3.08	1.34	- .17
	Names what I do well.	3.86	1.30	3.86	1.14	0
	Expects realistic study results.	3.74	1.05	3.99	1.10	+ .25
	Encourages my presence at school/work/internship.	3.97	1.15	4.25	1.02	+ .28
	Encourages my time investment in schoolwork.	3.67	1.23	3.72	1.21	+ .05
	Discusses my career aspirations and follow-up.	3.71	1.29	3.85	1.20	+.14
Average category		3.78		3.86		+ .08
Network feels welcome at school	I think it is important that my network: Feels welcome at school.	3.89	1.12	3.73	1.25	- .16
	Experiences the school atmosphere as pleasant.	3.89	1.13	3.60	1.34	- .29
	Experiences school conversations as pleasant.	4.03	1.16	3.86	1.29	-.17
Average category		3.94		3.73		- .21
Teacher knows the student and enjoys trust.	I think it is important that my teacher: Is reliable and focuses on my future.	4.11	1.01	4.45	0.86	+ .34
	Names what I am good at or growing in.	4.26	1.03	4.37	0.87	+ .11
	Knows me as a person with my background	3.63	1.22	3.75	1.13	+ .12
	Has contact with my network	2.71	1.33	3.01	1.36	+ .30
Average category		3.68		3.90		+ .22
Reciprocal relationship between Network and school.	I and my network together: Are present at open days or school discussions	3.24	1.31	3.54	1.36	+ .30
	Are equal discussion partners for school	3.35	1.27	3.56	1.28	+.21
	Seek contact with school if necessary	3.68	1.24	3.93	1.18	+.25
Average category		3.42		3.68		+ .26
Network can be proud of the student and sees perspective in career development.	My network and I together: Are proud of my professional development	4.24	0,91	4.23	1.00	- .01
	Believe in good career opportunities with this profession	4.31	0.88	4.35	0.90	+ .04
	Discuss disappointments openly with the teacher	3.21	1.39	3.30	1.41	+ .09
	Receive guidance in transitional situations (class/internship)	3.31	1.38	3.43	1.37	+ .12
	Receive clarity in difficult choice situations.	3.67	1.28	3.59	1.29	- .08
Average category		3.75		3.78		+ .03
*M=mean, **SD=standard deviation						

Table 4 measurement 2 (MM2) **network perceptions** *of study support (n=25) scored on a five-point Likert scale (1=completely disagree- 5=completely agree), compared to measurement 1 (MM1). Categories according to sub scales of network support (Lusse, 2013).*

Category	item	MM1 M*	MM1 SD**	MM2 M*	MM2 SD**	Difference M*
Student's appreciation of network support.	I like to be involved in the student's studies.	4.74	0.59	4.72	0.54	- .02
	I think the student needs my involvement.	4.44	0.80	4.36	0.70	- .08
	I think it is desirable to have school contact.	4.22	0.97	4.12	0.88	- .10
	I and the student have made agreements about school contact.	3.44	1.45	3.32	1.28	- .12
	I want to be contacted by the school in case of school problems.	4.70	0.87	4.40	0.91	- .30
	I only receive study information if the student wants it.	2.93	1.30	3.36	1.52	+ .43
Average category		4.08			4.05	- .03
Network knows what is expected of them and feels competent.	I ask interestedly about the study.	4.81	0.48	4.80	0.41	+ .01
	I encourage to learn a profession.	4.78	0.51	4.84	0.47	+ .06
	I advise how to learn.	4.04	1.09	3.72	0.98	- .32
	I name what is going well.	4.41	0.93	4.40	0.71	- .01
	I expect realistic study results.	4.52	0.64	4.40	0.58	- .12
	I encourage attendance at school/work/internship.	4.89	0.42	4.76	0.60	- .13
	I encourage time investment in schoolwork.	4.59	0.93	4.52	0.77	- .07
	I discuss career aspirations and follow-up	4.63	0.63	4.36	0.99	- .27
Average category		4.58		4.48		- .10
Network feels welcome at school	I want to be welcome at school.	4.52	0.70	4.56	0.77	+ .04
	I want to experience the school atmosphere.	3.78	1.09	3.48	1.23	-. 30
	I want to be invited to school interviews	4.07	0.96	3.88	1.20	- .19
Average category		4.12		3.97		- .15
Teacher knows the student and enjoys trust.	I trust the teacher, that he wants the best for the future of the student.	4.37	0.74	4.56	0.58	+ .19
	The teacher names what the student is good at or is growing in.	4.07	1.04	4.04	0.93	- .03
	The teacher knows the student as a person with his/her background.	3.70	1.20	3.80	1.15	+ .10
	I want to be able to approach the teacher myself	4.22	1.12	4.08	1.00	- .14
Average category		4.09		4.12		+ .03
Reciprocal relationship between Network and school.	The student and I are present together at open days or school discussions.	3.81	1.21	4.04	1.14	+ .23
	The student and I are equal discussion partners for the school; our opinion counts.	4.22	1.01	3.64	0.99	- .58
	The student and I contact the school together if necessary.	4.11	1.19	4.20	1.08	+ .09
Average category		4.05		3.96		- .09
Network can be proud of the student and sees perspective in career development.	The student and I are proud of the professional development.	4.41	0.89	4.48	0.71	+ .07
	The student and I believe in good career opportunities with this profession.	4.78	0.42	4.76	0.44	- .02
	The student and I discuss disappointments with the teacher in an open manner.	3.37	1.31	3.72	1.17	+ .35
	The student and I receive guidance in transition situations (starting in class or internship).	3.48	1.50	3.56	1.16	+ .08
	The student and I receive clarity in difficult situations about possible choices.	3.74	1.43	3.72	1.10	- .02
Average category		3.96		4.05		+ .09
*M=Mean, **SD=standard deviation						

CONCLUSION AND DISCUSSION

Conclusion summary

Within this intervention study, four sub-questions were used to investigate how a context sensitive intervention on network support can be realized among nursing students at Albeda nursing program, with a view to promoting study success and reducing school drop-out. The literature examined that educational partnership is a prerequisite dimension for being able to shape study-supportive behavior at the network. Study-supportive behavior concerns all activities that the network undertake in relation to the student's career (Lusse, 2013). Systematic attention to network support is associated with an increase in average learning gain (Higgins, Kokotsaki, & Coe, 2012). The effect size of network support on study results in vocational education is unknown.

In order to promote network support, an intervention was chosen with various activities to strengthen the pedagogical triangle and was implemented in first-year groups of vocational education nursing course by teachers on a voluntary basis. The intervention consisted of providing a general information card and basic website for the network. The contact details of the network were collected and regular meetings with the network were realized after 10, 20 and 40 weeks.

The effect of the intervention on the opinion about network support varied among the various parties of the pedagogical triangle. Among the network, this opinion has hardly shifted, while among students and teachers, this opinion has clearly changed. Students and the network seem to attach less importance to informal contact and more importance to being serious joint discussion partners when it matters to the student. Although the latter gives a diffuse picture among the network. The opinions of the two parties have converged on the role of the mentor and student consent for contact. Teachers seem to be positive about more intensive design of the pedagogical triangle with joint policy, time investment, communication and training to be able to deal with the dilemmas that the pedagogical triangle presents during this phase of life. Further conclusions have been elaborated per sub-question.

Conclusion sub-question 1: Problem and context analysis

Social and personal background characteristics of students determine 80% of study success. Motivation, background knowledge and atmosphere at home are aspects that can be influenced (Expertise point LOB, MBO council, 2020). The choice was made to strengthen a supportive network situation. Network support has three dimensions. Firstly, study-supportive network behavior mainly contributes to the student's self-confidence, motivation and self-image. Secondly, communication within the pedagogical triangle of the network, students and school is the basis for a relationship of trust in an educational partnership. Thirdly, parental/network participation, but this probably has no relationship with study success and is not taken into account.

Network support provides students with resources. In vulnerable, overburdened young people, access to these network resources is limited or the ability to use them is limited (Lusse, 2013). South Rotterdam has the highest concentration in the Netherlands with 60% overburdened young people. These young people have an accumulation of problems, at home and outside the home, that make it difficult to obtain a diploma (Eimers & Bekhuis, 2006). Reduced study success and school dropout is mainly a major urban and poverty problem (Winsemius, Tiemeijer, Berg, Jager-Vreugdenhil, & Reekum, 2008). Given this background, stimulating network support is essential and urgent for study success, especially for the target group of our nursing program.

Conclusion sub-question 2: Measurement of experiential knowledge about a study-promoting-network-situation

Educational partnership has three parties. School is the initiator for educational partnership, which is why teachers were asked about their opinion and implementation of pedagogical partnership. Students and the network are the other two parties from the pedagogical triangle. They were asked about their opinion about pedagogical partnership and study-supporting behavior with a focus on career and transition moments of the education.

Teachers show average effort (6.0) in pedagogical partnership, based on personal mentoring. In the previous period there were no collective efforts regarding network support. The scores vary from sufficient, insufficient or difference of opinion. Bottlenecks are facilitation, policy and privacy rules.

Students show opinions that are further apart (SD>1) than those of the network (SD<1). This is probably due to selective responses from the network. The network generally attach greater importance to the pedagogical triangle than the students themselves. However, students find the following items more important:
- 'The network only receive information if the student wants it', shows the student desire for direction.
- 'The importance of experiencing the schools atmosphere' shows the student interest in informal school visits.
- 'Name what the student is good at' shows the student desire for confirmation.
'Contact after student consent' can count on the most support from students of all the variants surveyed (M=3.32), while the network value this variant the lowest (M=2.93). This is where the tension between 'directing and letting go' is perhaps most evident.
The intervention must tack between these extreme opinions. Building a chain of trust between the partners in the pedagogical triangle with careful communication and transparent goals.

Conclusion sub-question 3: Intervention design

For network support in this vocational education context, four emphases were set:

1. Broader definition of the network than parents alone.
2. Continuously finding a balance between steering and letting go.
3. Creating inviting contact around transition phases of the students 'career in two-way traffic with one school contact person.
4. Voluntary, but not without obligation.

The innovation chosen was: Firstly, contact details of the network were collected in order to be able to make contact at all. Secondly, information channels were made available, such as a general information card and a website for the network. Thirdly, meetings were organized with the network; such as an introductory evening (after 10 weeks), and (digital) presence at development interviews (after 20 and 40 weeks).

Conclusion sub-question 4: Effect measurement Intervention

The average student opinion about network support does not shift equally across all sub-scales during the intervention. On the sub-scale 'feeling welcome at school' the average importance that students attach to this decreases on all items. In contrast, on the sub-scale 'reciprocal relationship school and network' the average student appreciation actually increases. At first glance this seems contradictory. But students seem to attach less importance to informal contact and more importance to being serious mutual conversation partners when it matters to the student. The average student appreciation for the role of the teacher increases across all items. Students seem to attach more value to the relationship between their teacher and the network. On the sub-scales 'involvement at the network', 'role of the network' and 'pride of the network and career', the average student appreciation remains approximately the same. However, a few striking shifts in opinions can be seen within these scales. For example, 'approaching the network in case of school problems' is on average really appreciated more positively by students. This is now not far from the item 'only network contact after student consent'. This can be a signal of growing confidence that contact between school and network is considered okay by students. Regarding the role of the network, students on average seem to find it even less desirable to receive study advice from them, but on average to have more appreciation for the incentive to be present and to achieve realistic study results. These are exactly two of the three points that are discussed during development interviews and it seems that students find it okay for this information to be exchanged with the network.

The average network opinion hardly shifts across most subscales during the intervention. The network attach more value to all items than students. This makes the tension between steering and letting go visible across the board. On the subscale 'feeling welcome at school' the average network appreciation decreases across almost all items. The network, like students, seem to attach less value to informal contact on average during the intervention. On the subscales 'reciprocal relationship school and network', 'interference of the network situation', 'pride of the network and career', 'role of teacher' and 'role of the network' the average network appreciation remains approximately the same. It is striking that the opinion on 'student consent to contact', by

students (M= 3.21) and network (M= 3.36), has come closer together. The average appreciation of the 'role of the teacher' by students (M=3.90) and network (M=4.12) has also come closer together. Both parties seem to have reached more agreement on these items during the intervention. The item 'contacting the school yourself' still shows a difference of more than one point between students (M=3.01) and network (M=4.08), but the difference in appreciation between the two parties has decreased. Some items provide a somewhat diffuse picture with contradictions.

The average teacher opinion about network support does not shift equally strongly across all subcategories during the intervention. The intervention priority was 'making contact with the network', because this is a condition for all facets of network support. Teachers assess making contact as positive and want to communicate more together. The category 'collaboration between school and network' shows the same scores with the exception of reciprocity. In the pedagogical triangle, all parties could initiate contact, but teacher opinions are divided about the initiating role of students and network in this; they prefer to see the collaboration together. From this you could conclude that the bond of trust needs to grow even further, so that two-way traffic can take more shape in the pedagogical triangle. Clarity about when to make contact with network or not remains a point of attention in addition to the study-promoting network conversations. In the category 'working together on future prospects', opinions on all items have become divided. Teachers want to give urgency to career, future prospects and development points, because these seem to be serious bottlenecks with regard to study success. In the category 'facilitating', time, policy and content support/training are requested to deal with the dilemmas of the pedagogical triangle. The numerical teacher assessment gives the impression that teachers have started to feel more consciously incompetent during the intervention due to the experienced bottlenecks. You could conclude that the second assessment is a more realistic one than the first.

Discussion and recommendations

The practical study shows strong points in validity and reliability through the mixed-methods design for data collection and triangulation in data analysis. However, there are also aspects that influence the methodological validity somewhat:
- A non-validated questionnaire on network support was used. This is based on the validated observation lists of Lusse. The questionnaire clearly shows which components of network supportive behavior are tense and which are not. A post-measurement can also show which items of network supportive behavior the intervention has had an effect on. An improvement suggestion is to have the questionnaire calculated statically.
- There was a high non-response among the network. The response of 25 was higher than expected, but an improvement suggestion is to have the questionnaire filled in on site during the introductory evening.
- The role of the internship does not officially have a place in the pedagogical triangle, but it does provide a large part of the education in the workplace. An improvement suggestion is to include the workplace in the request for teachers.

Recommendations from this practical study:

1. Continue to bring the sense of urgency of network support and study success to the attention of all parties in the pedagogical triangle. It is not just an activity, but one that has a great influence on the study progress of students. This can be done with a joint starting point during the introductory evening.

2. Have the education administration actively collect data from the network during the first weeks of the school year.

3. Make agreements when it is undesirable or unsafe to contact the network. This requires careful administrative processing to prevent painful communication errors. The introductory meeting is suitable for checking whether study matters can be discussed at the network or not. It is important always to look for someone together with the student who can support them under the given circumstances.

4. Draw up an annual agenda for contact moments with the network and communicate this to all parties in the pedagogical triangle at the beginning of a school year.

5. Contact moments with the network are inviting, but not without obligation. Students are responsible for informing, inviting or calling in the network to conversations about transition moments in the study program. This is in line with various legislation and gives the student a responsible role.

6. Create space in time around the introductory evening, development interviews for teachers to realize network contact.

7. If the network works in healthcare, network involvement can also be used in activities around the professional image in the career learning line (guest lecture, observing on worksite, etc.)

8. Take into account major differences in digital skills of the network. A website or the new parent portal of Albeda asks for an explanation of use by recognizing the tension in various subjects.

9. More network contact requires different skills from teachers. For support or training needs. For example: a network support course or intervision around network contact.

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PREPARING STUDENTS FOR SOCIETY FROM A MATHEMATICAL POINT OF VIEW

Ronald Keijzer*, Michiel Veldhuis**

*Professor of Applied Sciences, IPABO University of Applied Sciences, Jan Tooropstraat 136, 1061 AD Amsterdam, The Netherlands, r.keijzer@ipabo.nl,
**Associate Professor of Applied Sciences, IPABO University of Applied Sciences, Jan Tooropstraat 136, 1061 AD Amsterdam, & Assistant professor of mathematics education, Freudenthal Institute - Utrecht University, Utrecht m.veldhuis@ipabo.nl.

ABSTRACT

Mathematics teaching plays a crucial role in preparing students for the current and future society (OECD, 2018). Whether mathematics teaching in the classrooms actually has the same focus is unclear. We therefore investigate the following research question: How do primary school teachers prepare students for society in their mathematics teaching practice?

In a survey with open-ended questions with 32 teachers and interviews with three teachers, primary school teachers were presented with several situations relevant to functioning in society. Teachers were asked to describe how their teaching – without explicitly referring to mathematics – prepares students for handling these situations. In our analysis we labeled and categorized when and how teachers in their responses refer to their mathematics teaching. From our results emerged that teachers only refer to mathematics teaching in obvious cases when a mathematical content domain was foregrounded. Interestingly, the interviews elicited more references to mathematics teaching, probably due to the interviewer asking follow-up questions focused hereon. We therefore conclude that realizing how mathematics teaching prepares students for society might need expert scaffolding.

INTRODUCTION

Education is generally considered to be a crucial means for the further development of society (United Nations, 2023). This is especially true for mathematics education and is reflected in indicating mathematical literacy as result of mathematics education (Jablonka, 2003). Mathematical literacy is considered to be the capacity of individuals to reason mathematically and solve problems in a variety of 21st century contexts (OECD, 2018). Being mathematically literate includes the ability to reason mathematically and to use mathematical concepts, procedures, facts, and tools to describe, explain, and predict various phenomena. Moreover, mathematical literacy is

essential for accessing, using, interpreting, and communicating mathematical information and ideas, in order to engage in and manage the mathematical demands of a range of situations in daily life. Mathematical literacy for example is needed when traveling, by any means of transport, keeping up one's agenda, and warranting one's financial independence.

We learn from the PIAAC-reports that young people in the Netherlands (ages 16-24) perform mathematically well in these situations (OECD, 2024). Other international assessments such as PISA and TIMSS (Schleicher, 2019; Meelissen, et al., 2024) also establish the Dutch students (in primary and secondary school) as relatively high-performing, but also indicate some room for improvement (notably with respect to higher order mathematical thinking skills such as problem solving). While this strong performance on international assessments is a promising result, it leaves us with the question how mathematics education in the Netherlands leads to such a result. For example, the six mathematics textbooks which are used in Dutch primary education hardly focus on mathematical problem solving, which is central to mathematical literacy. At the same time these mathematics textbooks are followed quite closely and used extensively in Dutch primary education (Inspectie van het Onderwijs, 2024).

In the study described here we explore how primary school teachers perceive their teaching in primary education to explicitly prepare for using mathematics in situations typically for adult life.

BACKGROUND

Studies on mathematics achievement in the Netherlands show that the Netherlands is one of the high-performing countries in the European Union (and OECD-countries). A large majority of Dutch students in primary education realize a basic level in their mathematical performance. However, there is a drawback in student performance on the more advanced level (Von Davier, et al., 2024). A variety of hypotheses have been formulated to possibly explain this discrepancy, one of them concerns the relative absence of problem solving tasks in Dutch textbooks for primary education (Kolovou, Van den Heuvel-Panhuizen, & Bakker, 2009; Kolovou, 2011). Problem solving in mathematics education, as both a means to solve problems about various mathematical content domains and as goal to be able to solve problems mathematically with a variety of approaches, supports students' mathematical literacy development. Moreover, numeracy and mathematical literacy are key in preparing students for the current and future society (OECD, 2018; Hoogland & Van Groenestijn, 2021). Newly developed national core goals for mathematics teaching in primary education in the Netherlands also subscribe to this point of view (Prenger, et al., 2023). The new core goals focus on the need for students to mathematize the world they encounter (e.g., Gravemeijer & Terwel, 2000), the development of a positive mathematical attitude (Oonk & De Goeij, 2006), and the value of recognizing mathematics in daily life and other school subjects. In addition to mathematical content domains such as measurement or fractions, domains such as mathematical problem solving and modelling are included in these core goals. Additionally, students need to explicitly learn how to use mathematical language and

other mathematical representations, and are invited to use mathematical instruments. So the new Dutch core goals ask for the primary mathematics education community – comprising teachers, mathematics specialists, curriculum and textbook developers, researchers, and many more – to develop students' mathematical literacy further. At this time young adults already appear to score well on daily use of mathematics and their developed numeracy, but the content in generally relied upon primary textbooks hardly focuses on mathematical problem solving. Therefore the question rises whether mathematics teaching in the classrooms in the Netherlands is indeed focused on mathematizing and further developing students' mathematical literacy.

RESEARCH QUESTION

Implementing new core goals asks in the first place for establishing whether and how these core goals are already embedded in the current teaching practice. The new Dutch core goals for mathematics in primary education focus on mathematical literacy and the use of mathematics in various situations. To shed light on a part of the current teaching practice related to the students' current or future use of mathematics we strived to answer the following research question in this study:

How do primary school teachers prepare students for society in their mathematics teaching?

RESEARCH DESIGN

Subjects in this study are 34 primary school teachers employed in primary schools in the Netherlands. The majority of these teachers were mathematics specialists. Mathematics specialists' task is to support students in their mathematical development, teachers in their team in their mathematics teaching, and develop schoolwide mathematics education policies. The first step in our study was that we invited these participants to complete an online survey. Thirty-one teachers from various schools, whereof twenty mathematics specialists did so. In the survey, we presented five situations familiar to most people in the Netherlands, namely

- Situation 1: traveling by public transport
- Situation 2: shopping
- Situation 3: participating in a quiz
- Situation 4: planning
- Situation 5: decorating a house

1. Traveling by public transport

When traveling by public transport, digital technology is used to determine the route. With the information thus obtained, the route can be followed or not followed. Paying for the trip is done with a chip card, QR code or a debit card. In all cases it is important to keep track of the costs.

How does your teaching prepare students for this situation?

2. Shopping

Someone does their weekly groceries in the supermarket, having determined in advance what amount of money they could maximally spend. Before entering the shop they decide whether they want to use a manual scanning device, the telephone application, the self-scan-counter, or the classical counter with casher.

How does your teaching prepare students for this situation?

3. Participating in a quiz

During a quiz on television a question is about the extension of a pattern. The pattern is 1 1 2 3 5 8 13..

   A. 18

   B. 19

   C. 20

   D. 21

How does your teaching prepare students for this situation?

4. Planning

In high school a student has a small job and is asked by their supervisor to work some extra hours. The student makes a planning for the week to decide about this extra time for work. In addition to time for school, homework, sports, work and music, they want to keep some free time to meet friends.

How does your teaching prepare students for this situation?

5. Decorating a house

A student moves into their new student room and wants to (re)decorate. They want a bed, desk, couch, and a television in the room, paint the walls and replace the floor.

How does your teaching prepare students for this situation?

Figure 1. The five situations in our online survey, every time followed by the open-ended question *"How does your teaching prepare students for adequately handling this situation?"*

In Figure 1, we describe how the five situations were presented to the participants in our study. We asked participants to formulate in an open format how their teaching is preparing students for the situations, without in the question explicitly referring to mathematics.

To gain additional insight in teachers' motives for preparing students for situations from daily life, we also conducted three semi-structured interviews. The interviewees were experienced teachers who did not participate in the online survey. We asked participants in the interviews to respond to the situations we also used in the survey. We again asked the same question how their teaching prepares for functioning in these situations. The interview setting allowed us to elaborate on the first answers given.

In analysing both the survey and interview data, we labeled responses as: (1) referring to mathematics teaching and (2) referring to other teaching activities. When referring to mathematics teaching we distinguished between (1a) referring to specific content domains and (1b) referring to mathematical activities like modelling or schematizing. Figure 2 provides a scheme for analyzing data.
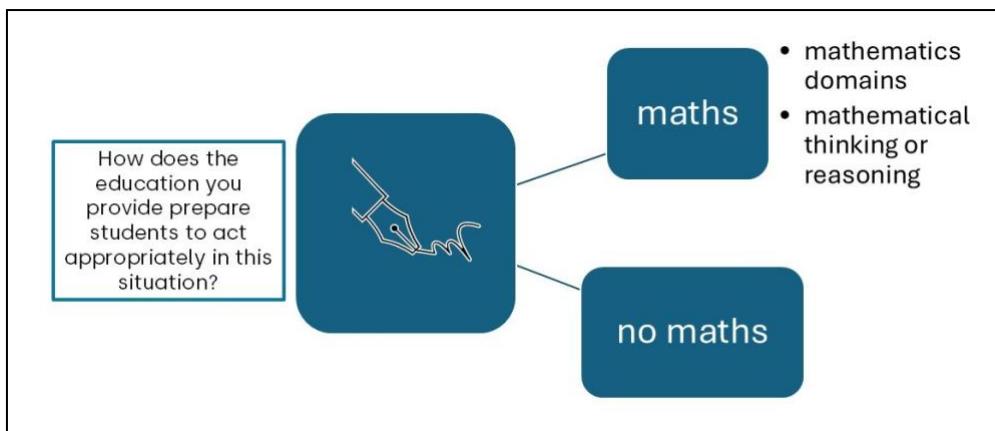

Figure 2. Scheme for analyzing data.

RESULTS
Survey

Our study is aimed at providing an overview of how teachers deal with situations that from an expert point of view demand for knowledge of mathematics. A small number of teachers participated in this study. This is why we consider the results as a mere indication of teachers' ideas. In the following, numerical information is presented only to provide a general picture.

We asked the participants to respond to situations that in from a mathematical perspective ask for particular mathematical skills and knowledge. Because we wanted to know whether primary school teachers would refer to mathematics spontaneously, we did not inform them in preparation about this part of our intention. Below we illuminate three situations and teachers' responses in the survey, shopping in a supermarket, traveling by public transport, and extending a number sequence in a television quiz context. Teachers in the survey mention that shopping in a supermarket is prepared by teaching about money or calculating percentages in mathematics teaching. One of the respondents writes: '*I only teach about making calculations with money; using number relations, using round numbers and addition.*' Another teacher does not refer to mathematics. They write: *'When groceries are needed for thematic activities, teacher and students together are going out shopping.'*

In the situation referring to traveling by public transport, one of the teachers reflects that this situation is discussed, but not always sufficiently: *'In mathematics classes for the higher grades this more or less comes to the fore. I, however, do not think this is enough to help students acting adequately in this situation.'* Several teachers refer to learning to deal with money in this situation. For example, one of the respondents writes: *'We refer to this kind of situation when money is the theme in our school.'*

Most teachers recognize extending a number sequence being a mathematical problem and share that this kind of problem solving tasks is reserved for high performing students. One of them writes: *'We do sequences often for home work. It refers to thinking and reasoning.'* Another one points out: *'This kind of problem is in our mathematics textbook, as extra work.'*

Generally in the survey we see that teachers mention mathematics, when the mathematical domain obviously plays an explicit role in the situations. When doing so the teachers referred to specific mathematics domains and not to approaches of mathematical thinking or reasoning. In less obvious situations teachers share how they focus on the situation mentioned or a related situation in teaching, without any reference to mathematics. Teachers used other (often more logistical or organizational) aspects present in the situations to describe how activities they undertake with their students prepare them for acting in the situations. For example they mention when responding to the planning task context: *'In the higher grades we learn the students how to use their*

agenda.' In several cases they also report that their teaching does not prepare for the situation. Table 1 provides an overview. The numbers in the table indicate the percentage of responses where a specific situation is dealt with in teaching (first column) or where a specific situation is seen as mathematical (second column). The number of respondents is small; the numbers in the table therefore only provide some indication for how the situations presented are dealt with in primary education in mathematics teaching or in teaching more general. For example, the data suggest that planning one's life generally is not seen as mathematical problem.

Table 1. Overview of responses (N=31)

Situation	Attention in teaching	Also related to mathematics
Traveling by public transport	43%	43%
Shopping	29%	39%
Participating in a quiz	67%	87%
Planning one's life	43%	17%
Decorating a house	52%	69%

In the survey, we noticed that mathematics specialists more often refer to mathematics compared to teachers who are not mathematics specialists. A focus on mathematics in teaching, which one might expect from a specialist teacher, might help observing mathematics in daily life situations.

Interviews

The interviews provide us with a means to elaborate with the interviewees on various aspects of the situations. We presented the five situations in the interviews and asked how the teacher's teaching prepared students for the situation. The interview setting facilitated that we could introduce mathematics as a focus during the discussion of each of the situations. Within the interview setting the interviewees provided much more extended responses than in the original digital survey.

When discussing traveling by public transport, a teacher brings in how this refers to using money and using various indications for time. She explains how playing money and various clocks are used in explaining to situation. She adds: *'Using time is done every day.'*

Talking about the supermarket context, one of the interviewees explains how this context is dealt with in mathematics teaching. She also shares how a supermarket visit is part of the teaching program. When discussing the quiz context, one of the teachers recognizes

this as activity being used for stimulating creative thinking in high performing students. Moreover, she adds, that this kind of activities is used in a test she uses to trace underperforming students.

In the same interview we focus on planning one's life. Exploring the situation leads to recognizing links with mathematics teaching, especially with exploring time. When talking about the context of decorating a house one of the interviewees refers to using maps. She explains that these activities are from the mathematics textbook used in the school, but the interviewee tells that she sometimes tries to turn this activities into real 'active' lessons: 'I once asked students to make a map from the school yard, using an appropriate scale.' When asked what she wanted to add to what she mentioned in the interview, this interviewee tells she often plays mathematical games with the students as means for preparing students for their future.

Generally we see in the interviews that teachers here notice mathematics more often than teachers did in the survey. Talking about the situations apparently provides a scaffold for a mathematical perspective. Moreover, in one of the interviews a teacher not only referred to mathematics domains, but also to general mathematical activity of modelling and schematizing.

CONCLUSION

This research focusses on how teacher in their mathematics teaching in primary education prepare students for their future life. We formulated the following research question: How do primary school teachers prepare students for society in their mathematics teaching?

We saw that teachers in their mathematics teaching do prepare students for society, but often they do not report that they are doing so in their mathematics lessons. We are not sure why they do not refer to their mathematics teaching as means for preparing students for their future life. It might be that they in their mathematics teaching are preparing students for situations they will encounter, but are not aware they do so. And therefore, they do not report so, when asked. Although the interviewees did not complete the survey, we consider what we experienced in the interviews as indication that by providing scaffolding in the interviews teachers became more aware of the relation between their teaching practice for mathematics and preparing students for using their mathematics skills and knowledge in situations in daily life. This conclusion is of course preliminary, as only a limited number of teachers participated in the study.

REFLECTION

Prolonged exploration of teachers' considerations on their mathematics teaching is needed to see whether the aforementioned conclusion holds. However, this preliminary

conclusion sets the scene for this prolongation. Namely, in this study, we see how a key research instrument used, the interview, can both serve as means to uncover teachers' ideas on preparing students for society and as tool for professionalizing teachers. This professionalization occurs as the interview provides a scaffold in explicating how teaching can support students for their future roles in society from a mathematical perspective. Moreover, this research provides insight in how teachers can be prepared for new national core goals in mathematics. These core goals explicitly ask for mathematics teaching that is preparing students for situations that demand a mathematical perspective.

Scaffolding teachers might be typical for educating teachers realizing this teaching.
A next step in this research is developing a learning environment for (prospective) teachers supporting them in connecting their mathematics teaching to situation demanding a mathematical perspective. Teacher interviews on mathematics in situations as scaffolds for teachers might well be a promising element for this teacher learning environment.

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DIALOGICAL REFLECTION ON THE NATURE OF CLIMATE SCIENCE: THE TEACHER AS FACILITATOR

Leen Bisschop*, Laura Van den Broeck**, Jelle De Schrijver ***

*Lector/researcher, Odisee University of Applied Sciences, Belgium, leen.bisschop@odisee.be;
**Researcher, Odisee University of Applied Sciences, Belgium,
laura.vandenbroeck@odisee.be;
***Assistant professor/researcher, Antwerp University, Ghent University & Odisee University
of Applied Sciences, Belgium, jelle.deschrijver@uantwerpen.be

ABSTRACT

How can learners develop a more critical attitude towards climate-related misinformation? Helping learners to reflect about science in general and upon the construction of scientific knowledge about climate in particular is promising. After all, a focus on the epistemological aspects of climate science can stimulate learners' critical thinking and (informed) decision-making skills. One of the ways to strengthen learner reflection about science is by turning (student-)teachers into dialogue facilitators in reflective dialogues. The aim of this study is to examine the opportunities and challenges encountered by (student-)teachers and their experiences when engaging in the role of facilitator during these reflective dialogues about (climate) science with learners (14-18y). Through an Educational Design Research (2022-2024), we develop, implement, and evaluate a dialogical teaching method in several research cycles, together with a Professional Learning Community (PLC). This process resulted in the development of a guide with class activities for implementing the dialogical teaching method. Interviews with Flemish (student-)teachers demonstrate that this approach is both relevant and challenging: (student-)teachers feel supported by the didactic learning activities and the associated guidelines to facilitate open dialogues about climate misinformation. On the other hand, teachers feel uncertain about how to support reflective dialogues and find it hard to balance their role of facilitator with their role of expert.

BACKGROUND

In an era where young people are ever more exposed to misinformation, teaching science is challenging, also in the field of climate education (Nation & Feldman, 2022; Walsh, 2020). In part, this challenge is due to learners' lack of understanding and critical reflection of what makes science science (Alam, 2022). For instance, when learners fail to grasp that scientific knowledge is subject to change, they may respond sceptically to evolving insights about climate change. Teachers, in turn, may feel inhibited and uncertain to address such contentious topics as these might lead to confrontation (Sjögren, 2014). Reflecting about Nature of Science (NOS) may help young people critically engage with scientific statements about climate (McComas, 2004; Flener-Lovitt, 2014). Addressing NOS means that learners reflect on the epistemological aspects of science, which include the role of doubt in science or the social embedding of science (Lederman, 2006; Clough, 1997; Colburn, 2004). Gaining insight in NOS helps learners distinguish scientific from non-scientific claims and may foster learners' media literacy skills in the context of (climate) science (Cooper, 2011; Höttecke & Allchin, 2020).

NOS is often only an implicit subject in science education and explicit reflection is frequently lacking (Abd-El Khalick & Lederman, 2000). Engaging in reflective dialogues about science, is one of the ways to elicit reflection about NOS. This approach supports learners to collectively construct an understanding of science (Duschl & Osborne, 2002; Dunlop & De Schrijver, 2020). To facilitate such dialogues, teachers assume the role of facilitator rather than the role of knowledge authority, and adopt thus a developmental approach to teaching (De Schrijver et al., 2021; Walshe & Sund, 2021). In these reflective dialogues, the focus lies on eliciting reflection by exploring different perspectives, exchanging knowledge and experiences, and evaluating possible answers (Hyde & Bineham, 2000).

In an earlier study, a dialogic teaching method was developed to address NOS and climate education in secondary schools (Bisschop et al., 2024). The design principles for the development of the didactic materials include: focusing on how scientific knowledge about climate is constructed, providing opportunities to gain insight into learners' own frame of reference regarding climate change, employing open dialogues that question fundamental insights about science, and assisting learners in critically evaluating sources on climate science. The developed teaching materials include learning activities such as case studies, dialogue exercises, and concept cartoons. In this study, we explore the implementation of this teaching method in secondary schools.

Examples of the developed teaching materials, more specifically didactic cards, can be found below (figures 1-3). The left frame in each figure shows the front of the didactic

card, the right frame shows the back. The front of each card contains a stimulating input about climate. The back contains three steps: the instruction with accompanying guidelines about the approach (I), the processing, in which dialogue and reflection are generated by means of concrete questions (P) and a big question that drives reflection about one or more specific NOS-insights (BQ).
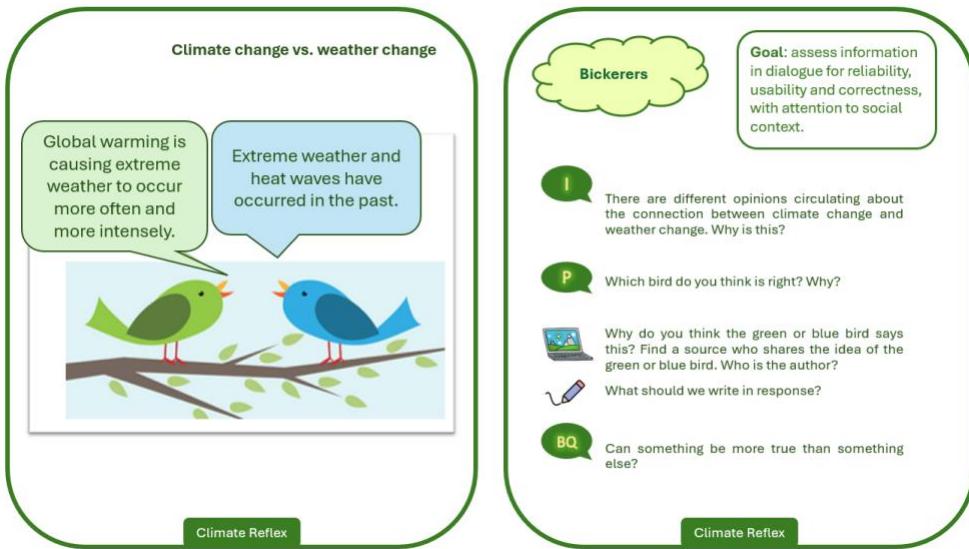
Figure 1

Didactic card with learning activity to stimulate reflection about the social context in which scientific claims are made.
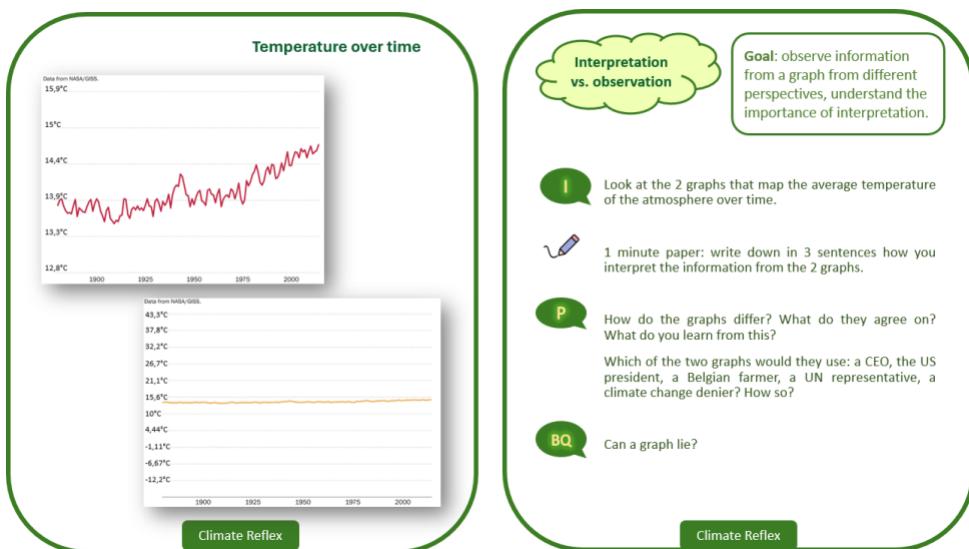
Figure 2

Didactic card with learning activity to stimulate reflection about the interpretation of observational data.
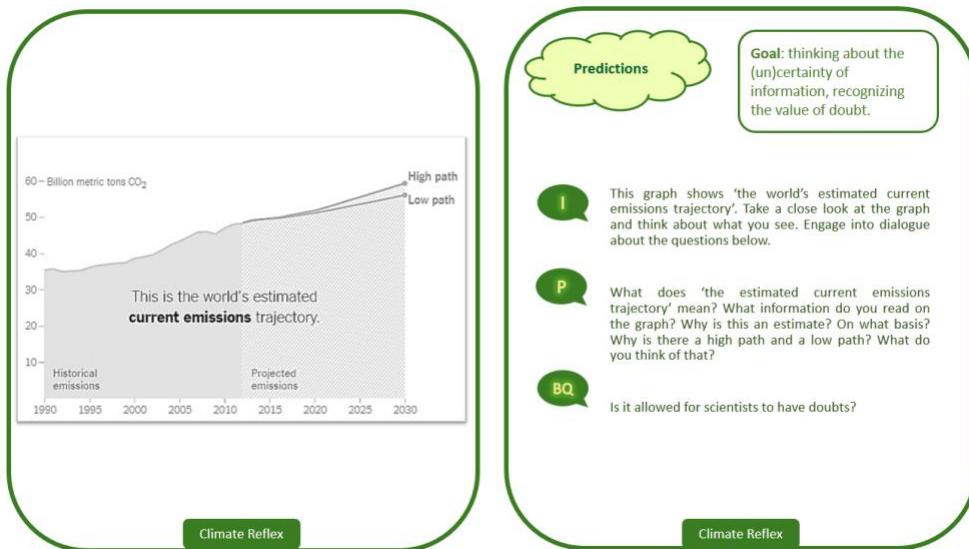
Figure 3
Didactic card with learning activity to stimulate reflection about the (un)certainty of information and about the value of doubt.

In addition to the didactic cards, a guide was also developed to support teachers. The guide explains, among other things, the role of the teacher as dialogue facilitator and suggests a number of questions that can help teachers gain insight into what learners think and why. Some examples of questions included in the guide: "Can you give an example?" "Why do you think that?" "Do you think that, or do you know that?" "Can you imagine the opposite?" "Are there other options that could also be true?" "How does this fit in with what you just said?" "Have we discovered something new?"

RESEARCH QUESTIONS

RQ1 Which variables facilitate or hinder the implementation of this dialogue-based teaching method, in order to stimulate the learners' (14-18y) reflection about misinformation in climate science?

RQ2 How do (student-)teachers experience the implementation of this dialogue-based teaching method that focusses on stimulating learners' (14-18y) reflection about misinformation in climate science?

DESIGN

Following the principles of Educational Design Research (2022-2024) (Plomp & Nieveen, 2007; Barab & Squire, 2004), we develop, implement, and evaluate different prototypes of a teaching method called "ClimateReflex" (*in Dutch: "KlimaatReflex"*) through multiple research cycles, in collaboration with (student-)teachers and experts in a Professional Learning Community (PLC) (Bolam et al., 2005). An initial prototype was developed in consultation with the PLC, based on a review of the literature and the experiences of teachers in the field. Six PLC-teachers then introduced the teaching method in six Flemish secondary schools, while student-teachers were asked to introduce the didactic materials during their secondary school internships. Feedback sessions with the PLC were held after each trial phase to refine the method. This iterative process fostered continuous improvement and adaptation.

A mixed-method approach of group- and in-depth interviews of teachers allows documenting the variables that facilitate or hinder the method (RQ1) and exploring their experiences with the teaching method (RQ2) (Ivankova & Creswell, 2009; Brenner, 2006). During these interviews, transcripts of the dialogue during classroom observations were used as prompts. Student-teachers who were asked to test the method during their internships were questioned in group-interviews about the opportunities and challenges in implementing the method (RQ1) and about their experiences (RQ2). The semi-structured interviews focus on topics such as facilitation roles, reflection processes, learner interaction, learning gains, material design, and perceived utility.

Quotes from (student-)teachers were collected during the interviews. Additionally, researchers personally tested the didactic materials with two groups of learners aged 14 to 18 and collected quotes from learners during the implementation of the method.

RESULTS

Opportunities and challenges in the implementation of the teaching method

The implementation of the teaching method revealed both opportunities and challenges, as highlighted by (student-)teacher interviews and dialogue transcripts. Several factors facilitate its successful adoption. A teacher's knowledge of NOS, and what exactly NOS-insights entail, plays a critical role, as does learner engagement and the opportunity for autonomous collaboration of learners during learning activities. Teachers consider it important to engage in genuine conversations with their learners, and see them engage in dialogues with each other, to understand exactly what they think and why. The use of activating and visually appealing learning materials provides support for this purpose. Teachers observed engagement from their learners due to the provided activating

exercises in the method, in which learners actively think along and, in the case of some didactic exercises, literally move through the classroom to take a position in a dialogue. Teachers appreciate the speaking opportunities for learners that the approach offers, which validate non-school knowledge and experiences from learners with different home backgrounds. Learners are given the opportunity to share views on climate science that they gain from their own social context, giving the teacher a better understanding of what learners think and why. For example, one learner (18y) indicated that climate is not being brought to his attention in a good manner and that scientific information doesn't reach him. He is only made aware of the problem by "people with blue hair throwing paint on a painting, who seem rather unstable and actually help climate deniers to prove their point". Participating teachers report that the activating method offers support in posing critical questions about the nature of climate science, thus encouraging learners to assess information for reliability and accuracy. Reactions of learners during the facilitated reflective dialogues show that they were able to look at scientific reporting in a critical way, for example: "Some people use only fragments of the truth and then weave their own narrative around it. It may not be outright lying, but it is not the complete truth" (learner, 17y). Learners did gain insights in modern understandings of NOS, illustrated by this learner (17y): "Science is never finished, but that doesn't mean we shouldn't value what scientists tell us!" Furthermore, a successful adoption can be facilitated by a teacher's developmental approach to teaching, which focuses on fostering learners' growth and encouraging them to construct their own understanding. For example, a science teacher noted: "Otherwise, I use more guided educational conversations; now with this method, there was more an approach from 'wonder', learners also reacted more to each other." This developmental approach contrasts with a transmissive model, where the teacher acts primarily as a source of knowledge, and aligns with pedagogical theories emphasizing active engagement and learner autonomy (Hermans et al. , 2008; Mascolo, 2009).

Challenges determined were workload and uncertainty or inexperience among teachers on how to support reflective dialogues in the classroom. Although there is a great deal of enthusiasm, teachers report that curricula are overloaded, they face high demands, and there is little time to engage in additional activities. For this reason, it proved challenging to find teachers willing to commit to testing the materials in their classrooms. When pre-service teachers were asked to test the materials during their internships, they were initially very enthusiastic. However, in practice, they were unable to implement the materials in their internship classrooms for two key reasons: (1) The mentors at the internship schools were reluctant to allocate time during regular science lessons to work with the developed dialogical method. They felt the topic of climate did not align with the planned lessons, that there was insufficient time to cover the science curriculum goals, and that learners in secondary education (in this case, 14-16y) were experiencing 'climate fatigue,' according to the mentors. (2) The pre-service teachers felt highly

insecure. While they found the materials challenging and were eager to use them if given the opportunity, they found it difficult to implement the dialogical method and expressed a need for additional training in this approach.

Additionally, it became clear throughout the research process that teachers' beliefs influence the way in which the methodology is dealt with by teachers. A teacher's more directive and transmissive approach to teaching impacts the implementation of the didactic materials. In such a knowledge-oriented transmissive approach, the teacher acts as the primary source of knowledge, delivering information directly to learners. Teachers who tested the dialogical method were consistently inspired, though not all of them engaged with the designed materials in a thoughtful manner, as was shown by the transcripts of the classroom dialogues. Teachers did not always succeed in fostering genuine dialogue with their learners, nor in encouraging learners to engage in dialogue with each other. They tend to adopt a directive role and often continue this approach. Teachers were reluctant to foster open-ended dialogues that embraced different scientific perspectives and encouraged thoughtful debate. They see it as their responsibility to impart correct knowledge to learners, and they sometimes resist when scientifically inaccurate views are expressed. In such cases, teachers see it as their duty to interrupt the dialogue immediately and block or refute the 'incorrect' knowledge with scientifically accurate facts. This reveals a strong knowledge-oriented educational perspective among teachers, which acts as a barrier to the implementation of the dialogical and reflective method. This also meant that teachers did not really get to know what learners were thinking and why. In addition to this transmissive, knowledge-oriented approach, also a more normative approach to teaching impacted the implementation of the teaching materials. This normative approach equally runs counter to the emphasis on learners' critical thinking central to the developed dialogical method. Some teachers used the didactic materials to convey a particular message to learners regarding daily life choices and voting behaviour in political elections. For example, one science teacher addressed her learners (16-17y), concluding: "So climate change is a real problem and some people may tell you that it's not that urgent to act, by using correct data but interpreting it in a manipulative way. Think about that when you have to vote!"

Teacher-experiences with the implementation of the teaching method

Teachers declare to feel uncertain about how to support reflective dialogues and find it hard to balance their role of facilitator with their role of expert. It proves difficult for teachers to facilitate reflective dialogues because it is not easy for them to let go of their role as knowledge authority. They find it challenging to introduce different perspectives on climate science and to balance between not moralizing too much (and imposing their own opinion) and not relativizing too much (all opinions are fine). Handling conflicting value frameworks in the classroom proves challenging, and teachers feel uncertain about

addressing complex questions in this context of 'wicked problems', where there is no straightforward answer and where different options and conflicting political, cultural, economic, and ecological values must be weighed. During an in-depth interview about engaging in the role of facilitator, a science teacher noted: "At the time, I often found it difficult to think of all those questions and ask the right questions, even though we were given many example questions in the guide for the teaching materials."

The teachers of the PLC see opportunities for cross-curricular collaboration with language teachers. A science teacher, member of the PLC, mentioned the following: "I asked my colleague who teaches the subject Dutch how to do that, engaging in dialogue." Subsequently, the idea was raised to have the materials used not only by a science teacher, but by a language teacher in a co-teaching format with a science colleague. By sharing the responsibility between colleagues, it may become easier to allow for an open dialogue, as the focus is not on what is scientifically correct, but rather on how science works.

DISCUSSION

This study aligns with other studies emphasizing that reflecting on the Nature of Science (NOS) can help young people critically engage with scientific statements about climate and distinguish scientific from non-scientific claims.[5,6,11] The findings suggest that teachers consider the presented dialogic approach relevant and engaging for learners. The use of activating didactic materials buttresses this approach. (Student-)teachers feel supported by the didactic method and the developed guide to facilitate open dialogues about climate misinformation. Addressing NOS encourages learners to reflect on the epistemological aspects of science, including its evolving nature and social context, which is essential for fostering media literacy and combating misinformation (Lederman, 2006; Clough, 1997; Cooper, 2011). However, challenges such as inexperience or uncertainty among teachers on how to support dialogues require attention. Teachers struggle to let go of their transmissive role and are wary for chaos to arise when learners engage in open dialogues about science.

The science teachers involved in this study tend to have a strongly knowledge-oriented mindset. They seem to assume that learners will naturally make the right choices if they are presented with the correct knowledge. However, there is a distinction between factual knowledge and critical decision-making. This reveals a safety paradox: out of concern, many teachers only share scientifically correct knowledge with their learners and refuse to include alternative perspectives in their lessons. As a result, learners have fewer opportunities to sharpen their critical thinking skills, making them more susceptible to misinformation outside the classroom. The observed reluctance among teachers to shift

away from their transmissive role echoes the call for reflective dialogues that encourage a developmental teaching approach, where teachers facilitate rather than dictate knowledge (Dunlop & De Schrijver, 2020; De Schrijver et al., 2021; Walshe & Sund, 2021). This approach enables learners to explore different perspectives and critically evaluate scientific claims, fostering deeper engagement and understanding (Hyde & Bineham, 2000).

Since we are working with a Professional Learning Community (PLC), our research project is an ongoing process of implementation, evaluation, adjustment, and re-implementation, in collaboration with the teachers who are testing the method in their classrooms. This approach is highly enriching, but sometimes complicates the successful integration of the dialogical approach in practice. The teachers involved in the PLC – who therefore influence the content and development of the method – feel the pressure to meet curriculum goals and are not always willing or able to make time in their lessons for more reflective dialogues focused on critical thinking. They feel strongly responsible for achieving the scientific curriculum objectives, but much less responsible for cross-curricular goals. Again, we see the dominance of a knowledge-oriented educational perspective. In some cases, this even led teachers to modify cards from the material set, which were designed for critical reflection on the nature of scientific knowledge (e.g., 'when do we consider something reliable?'), into cards with more empirical content (e.g., 'what is right, what is wrong') before using them in their classrooms.

This study underscores the need for innovative approaches to climate science education. By incorporating reflective dialogues on NOS, teachers can empower learners to critically evaluate scientific claims and media representations. Our findings highlight the significance of learner engagement and a developmental approach to teaching in facilitating meaningful dialogue and stimulating critical thinking skills. Yet, in order to successfully introduce a teaching method based on critical reflection and dialogue, it may be crucial to make this critical approach part of the teacher's attitude. More support and guidance are needed so that teachers can apply a more developmental pedagogy, which asks for a long-term learning approach in teacher training, where future teachers are encouraged to further develop their own critical thinking skills, and to extend this critical mindset into their practice. Time pressure to meet curriculum objectives is another recurring theme in all (student-)teacher interviews. This obstacle highlights the need to reflect on how such innovative teaching methods can be integrated into the existing educational system without compromising the achievement of curriculum goals.

One possible approach to addressing these challenges is to share the responsibility for facilitating critical and reflective dialogues about climate science among different teachers. The method could be integrated in different subjects, such as language classes. By introducing co-teaching between a science teacher and a language teacher, the topic

of climate can be discussed from a shared effort and investment of time. In this way, the teaching team can contribute together to the resilience of learners against climate misinformation. Furthermore, by approaching the scientific content with a more inquisitive mindset, the dialogue can be decoupled from the specific theme of climate and applied to other current scientific topics as well, such as the transition to sustainable energy or space exploration issues. This makes the method more flexible, while still contributing to learners' critical thinking skills and thereby supporting the achievement of cross-curricular learning goals.

CONCLUSION

This study emphasizes the potential of the developed dialogical method to help learners think critically about scientific information, particularly in the context of climate education. However, it is evident that implementing this method presents challenges, among other things due to the perception of an overloaded curriculum, teacher workload, uncertainty or inexperience among teachers on how to support dialogues, and a knowledge-oriented attitude of teachers. The results point to the need for additional support and training for teachers, particularly in facilitating open dialogues. Co-teaching between teachers of different subjects seems promising, as it allows for a shared effort and time investment.

Finally, these findings underscore the importance of a structural change in how we approach scientific topics and critical thinking in education. Developing a long-term vision for teacher education, with a focus on critical reflection and facilitating dialogues, is crucial for the successful implementation and sustainability of these innovative teaching methods in everyday educational practice. In follow-up research, we will focus on developing reflection exercises for teachers, aimed at encouraging them to think about learners' knowledge and knowledge development. These could include exercises that teachers can do themselves, for example, at the staff table. In this way, we aim to counter the obstacle rooted in teachers' own beliefs about what constitutes good education and what they must achieve with their learners. It is these beliefs that can hinder the introduction of certain forms of critical reflection for learners. Additionally, it would be valuable to ask teachers how they view their role as educators, what knowledge they see as essential to convey, and why. Relevant questions might include: 'Should the science teacher also contribute to learners' citizenship education?' and 'Does knowledge make people better individuals?'

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NAVIGATING COMPLEXITIES OF EDUCATOR PROFESSIONALISATION: IMPLICATIONS ON PROGRAMME DESIGN & EVALUATION

Liesbet Saenen,*Luciano Pirson**, Tom De Schryver***, <u>Elke Emmers,</u>****

*PhD, UHasselt School for Educational Studies, Hasselt, Belgium, liesbet.saenen@uhasselt.be, **PhD, UHasselt School for Educational Studies, Hasselt, Belgium, luciano.pirson@uhasselt.be, ***Associate Professor, Netherlands Defence Academy, Breda, The Netherlands, t.d.schyver@mindef.nl ****Professor, UHasselt School for Educational Studies, Hasselt, Belgium, elke.emmers@uhasselt.be

ABSTRACT

This study explores the principles of effective professional development (PD) through a case study of a Universal Design for Learning (UDL) training programme in higher education (HE). In increasingly diverse HE environments, inclusive teaching is essential. Although UDL frameworks offer robust guidelines for fostering inclusivity, there is limited understanding of how PD interventions translate into sustained behavioural change among educators. This study identified key factors influencing learning transfer. The case study involved a three-day UDL training programme conducted at a Flemish university, attended by 25 participants from various faculties. The training aimed to enhance participants' knowledge, confidence, and ability to implement inclusive teaching strategies. The programme incorporated practical exercises, discussions, and collaborative activities. Data collection included voluntary feedback from participants and expert input during a roundtable discussion at the EAPRIL 2024 conference. Thematic analysis identified three critical factors for effective learning transfer: structured and adaptive training design, trainer scaffolding, and participant self-reflection. Findings highlight that learning transfer requires continuous support, adaptable content, and reflective practices. Trainers play a crucial role in guiding participants through challenges and reinforcing learning outcomes. This study underscores the importance of PD programmes that balance immediate applicability with long-term behavioural change. Future research should explore the interplay between the three critical factors across diverse institutional contexts.

BACKGROUND

The complexity of professionalisation

As higher education (HE) classrooms diversify, educators must create a responsive learning environment (LE) that maximises the potential of various learners (Awang-Hashim et al., 2019). Inclusivity is a fundamental principle that guarantees equitable access, participation, and success for all learners, irrespective of their backgrounds, abilities, or circumstances (Göransson & Nilholm, 2014; Moriña, 2017). Achieving inclusivity in HE necessitates a multifaceted strategy encompassing curriculum, pedagogy, professional development (PD), technology utilisation, and cultural competence training and assessment (Awang-Hashim et al., 2019; Li et al., 2022; Riedel et al., 2023; Jaegler, 2022). The mechanisms supporting effective educator professionalisation remain ambiguous. PD programmes (PDPs) emphasise various sources of conformity (Kelman, 1958) yet lack evidence regarding their impact on daily teaching practices. This study therefore digs deeper into the principles of an effective PDP and uses this PDP on UDL in HE as a case study.

Understanding the context: UDL training as a case study

Universal Design for Learning (UDL) emphasises providing various means of engagement, representation, action, and expression to eliminate learning barriers and promote accessibility and success for all learners (Dalton et al., 2019; Espada-Chavarria et al., 2023; Rose et al., 2006; Sewell et al., 2022). UDL offers a systematic approach to inclusivity by promoting curriculum design that addresses various learning needs. Integrating adaptable teaching techniques and resources accommodates diverse learners, fostering equitable access to education across various LEs, including online and asynchronous courses (Almeqdad et al., 2023; Dalton et al., 2019; Ismailov & Chiu, 2022; Sanger, 2020).

PDPs on UDL can significantly enhance educators' skills in creating and maintaining inclusive LEs by improving their ability to acknowledge learner diversity and implement accessible lesson planning and teaching strategies (Rusconi & Squillaci, 2023). The effectiveness of UDL training seems to be independent of factors such as duration, teaching style, participant profiles, and the type of educators involved. However, despite its theoretical strengths, the empirical evidence about the effectiveness of the PDPs on UDL remains varied (e.g., Fränkel, Sterken & Stinken-Rösner, 2023). The lack of empirical support for the claims warrants more research into the mechanics to make PDPs on UDL a success. This study is contributing to this.

Effective PDP outcomes

Well-structured programmes or content is not enough for effective PDP training outcomes. Educators frequently encounter various challenges: inadequate training and support for personnel constitutes significant obstacles. Inclusion-focused initiatives may

fail if participants lack the necessary skills or continuous support to apply strategies in real-world educational contexts (Fränkel, Sterken & Stinken-Rösner, 2023; Rokhim, Suryadi & Supadi, 2021). Additionally, inclusive education is often hindered by curricular and infrastructural limitations. When a curriculum is poorly tailored to meet the needs of all learners and the infrastructure is insufficient to support their development, their learning experiences are significantly compromised (Rokhim, Suryadi & Supadi, 2021).

There are measurement instruments available, such as the LTSI and LTEM, that provide insights into the extent to which learning transfer has occurred (LTEM) and the contingent factors that might have either hindered or facilitated learning transfer (LTSI) (Holton et al., 2000; Thalheimer, 2018). These survey instruments evaluate the degree of learning transfer from any learning intervention and can assess whether a curriculum is (poorly) aligned with the needs of learners or the performance infrastructure. These tools will illuminate what makes UDL PDP training effective and how to maximise its effectiveness.

Drivers for effective educator professionalisation programmes

Despite growing attention to the importance of PD in fostering inclusive practices, much of the existing research emphasises the broad outcomes of PD rather than delving into the specific mechanisms that drive their effectiveness. The effectiveness of these PDP programmes is a subject of ongoing research, with mixed results regarding their impact on teaching practices and learner outcomes due to challenges, such as divergent views on training goals or challenges in measuring impact (Gibbs & Coffey, 2000; Loyalka et al., 2019). There remains a critical gap in understanding how PD interventions translate into meaningful behavioural change among educators. Specifically, little is known about the contextual and systemic factors that support or hinder this process. Using a case study, this study seeks to bridge this gap. The research aims to uncover the mechanisms that enable the transfer of learning into effective inclusive practices, addressing the question: *What are the fundamental factors that facilitate effective training and learning in educator professionalisation?*

METHODS

The case study

Qualitative research was used to answer this exploratory question. Using a single case study, we examined a UDL training course in HE to answer our research question. This case study involved a three-day UDL course. A Flemish HE institute hosted the training to help educators construct inclusive LEs. Three key components comprised the

program. First, using the Triandis paradigm (1971), which defines attitudes as emotional, cognitive, and behavioural responses to stimuli, it sought to educate educators about inclusion and diversity. The training promoted inclusive attitudes across several dimensions as a core mindset. Second, the programme provided practical tools and methods to assist educators in implementing inclusive teaching practices that prioritise accessibility, representation, and decolonisation. Third, the programme sought to boost instructors' self-efficacy, the confidence that they can meet varied learning requirements, a concept rooted in Bandura (1969, 1997), who found it to predict motivation and performance.

The training programme consisted of three non-consecutive days (one month between every training day), each with distinct objectives. The first day focused on building awareness, increasing learners' participation, and fostering a diversity-responsive mindset. Activities emphasised transitioning from presentation-based teaching to interactive and inclusive teaching approaches. The second day concentrated on developing competencies in inclusive teaching methods, such as creating accessible study guides and applying UDL principles, focusing on accessibility, representation, and decolonisation. The third day addressed inclusive assessment practices, including alternative grading methods and effective feedback, emphasising practical application and behavioural change.

To simplify and categorise the training activities, Laurillard's (2012) framework of six learning types was used. These types provide a structured lens to understand the diverse activities within the programme. First, **acquisition activities** included presentations and reflective discussions that provided foundational knowledge about UDL and inclusive practices. For example, participants reflected on how UDL principles could be applied in their teaching. Second, **discussion activities** enabled participants to share experiences and perspectives on implementing inclusive teaching methods, such as group dialogues about accessible study guides and assessment techniques. Third, **practice activities** involved practical exercises where participants developed and tested skills in inclusive teaching, such as designing alternative assessment methods or creating inclusive teaching materials. Fourth, **investigation activities** included exploring case studies to apply UDL principles to realistic scenarios, such as examining the impact of representation and accessibility in teaching resources. Fifth, **collaboration activities** promoted peer learning through group projects and sharing best practices, often facilitated by tools like Padlets. For example, participants collaborated to create inclusive study guides. Finally, **production activities** consolidated learning by requiring participants to create tangible outputs, such as portfolios of inclusive teaching strategies for diverse learners. Feedback activities were added as an additional part of the process. The learning activities are visually mapped onto Laurillard's (2012) framework in Figure 1, providing a clear overview of the programme's design.

Figure   **1**
UDL programme design
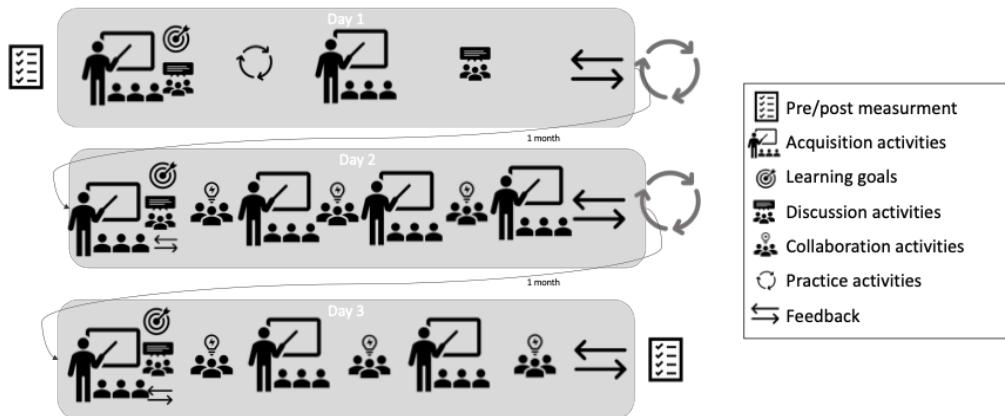
This mapping illustrates the diverse approaches used to achieve the training's objectives and highlights the alignment between the activities. By integrating theoretical insights with practical applications, this training programme offers a comprehensive example of how to support educators in fostering inclusive LEs. As such, it serves as a robust case study for analysing training effectiveness and learning transfer.

Research data, participants and analytical approach

Data for this research was gathered from two primary sources to ensure diverse perspectives and enable data triangulation through cross-analysis of participant feedback and expert input:

1. **Participant Feedback**: Voluntary feedback was collected at the end of the UDL training from participants through an anonymous survey. Approximately 40% of the participants completed this survey, offering insights into their experiences and perceptions of the training. Here, questions such as 'what did you think of the training?', 'what is useful from the training?' or 'what have you already been able to do with the training in practice?' were asked. This post-measurement feedback was essential in understanding how the participants evaluated the immediate applicability and value of the course.

2. **Expert Feedback**: A roundtable discussion was conducted during the EAPRIL 2024 conference, involving trainers, academics, and practitioners. The session was organised to gather additional input on the design and delivery of the UDL course and explore ways to improve future iterations of the program. This provided a broader perspective on the course's perceived strengths and potential areas for improvement.

The UDL course was attended by 25 participants, all affiliated with a Flemish university. The group represented a diverse mix of academic disciplines, with participants from various faculties, ensuring a broad range of perspectives. Although the audience was

predominantly female, the diversity in professional backgrounds contributed to rich discussions and reflections during the sessions. Participation in the course was entirely voluntary, and the sessions took place over two years, in 2022 and 2023.

The data collected from both sources were analysed using thematic analysis. To enhance the rigour of the analysis, thematic coding was performed independently by two senior researchers, and any discrepancies were discussed to reach consensus and increase the inter reliability of the findings.

RESULTS

The numerous insights and observations of the experts and course participants were quite diverse and related to all the different stages of the course. The remarks and suggestions related to aspects before, during and after the course. We have clustered these comments thematically, inspired by the Gioia (2013) method. The data structure can be found below in Table 1.

Table 1

Thematic clustering of the data

Illustrative quotes [a,b]	Second-order concepts	Aggregate dimensions
- Maybe begin each session with what an opportunity to listen what happened in practice. (E) - One month in between seems quite long to me. Doesn't it fade into the background then? Two weeks would be better. (E)	Concerns about knowledge retention and embedding of what has been learnt in the course	Learning Transfer
- We have seen many concrete examples, including examples how other course participants approach it. (P) - I think I will only make minor adjustments for the time being: e.g., adjusting names in case studies. In the long term, actions will probably have to be taken. I have already discussed it within the team. (P) - I am going to change a number of small things, such as giving an overview of the trajectory in each lesson, making objectives clear, taking time to get in (but this still needs to be worked out :-), etc. (P)	Inspiration and questions about practical feasibility of implementing what has been learned	
- Can or can't the learning objectives be adjusted along the course? (E) - Start from the experiences of the learners instead of theory. (E)	The train-the-trainer needs to repeat the learning goals and tailor it to the teacher's needs.	Scaffolding: Repeat and Tailor the content to the learning needs
- I intend to provide more diverse teaching materials from which students can choose to practice learning material. (P) - I will organize my lessons differently: first a short recap presentation and then let them practice new learning material. (P)	The teacher's trainer needs to repeat the learning goals and tailor it to the student's needs.	
- Are the learning goals achieved? (E) - Is there enough time for Feedback/reflection? (E)	Systematic evaluation and feedback	
- Participants indicate that the 6 principles provide a solid basis. - I am more aware of how students think and how this way of thinking should be accommodated by the teacher. However, I have also become concerned by the practical implications/obstacles around this. I sometimes experience resistance in myself; it is good that I have done some introspection. (P) - How to build a lesson like a car that can be adapted to the needs of the student (adjusting mirrors, moving seats forward). That you can remain authentic as a teacher, strengthened my confidence. (P) - Awareness and understanding have certainly expanded. Decolonization: to make the course a bit more light-hearted, I showed a photo of Mr. Hooke with 'Hooke's law'. I am now looking for another way to make the course more light-hearted and will now also try to name Hooke's law differently. (P)	Personal growth, reflection, and awareness	Self-efficacy

Note. a = Dutch quotes are translated to English. Care was taken to ensure that the translation and the original quotes remained closely related. b = source (E) = expert, (P) = participant

Theme 1: Concerns about learning transfer

Experts were primarily concerned with the link between the UDL course and participants' practice, questioning what was retained by the participants. One expert highlighted the risk of spreading the course over time: '*One month in between seems quite long... Two weeks would be better.*' They also suggested ways to promote the transfer of learning to the workplace, such as beginning each session with a reflection on practice (see first row, Table 1).

Participants echoed similar concerns, framing them slightly differently. They emphasised the practical value of the course, noting, '*We have seen many concrete examples, including how others approach it.*' They also shared intentions to make small adjustments in their curricula, such as modifying case study names or providing clearer lesson objectives. One participant said, '*I think I will only make minor adjustments for now, like adjusting names in case studies... I've already discussed it within the team.*' Another participant mentioned, '*I'm going to change a number of small things, like giving an overview of the trajectory in each lesson...*' (see second row, Table 1)

We infer from these quotes that **both groups recognised the course's value**. Participants appreciated the **immediate applications** the UDL course offered, while experts were **concerned with embedding knowledge into daily practice**. Both groups' responses align with the concept of learning transfer, defined by Talheimer as the use of learnt experiences in real-world situations (Talheimer, 2018).

Theme 2: Scaffolding

Another important theme identified was the need for trainers to support learning transfer through scaffolding techniques (Van de Pol et al., 2010). Experts emphasised starting from learners' experiences rather than from theory. They argued that starting from personal learning goals makes it easier to guide learners towards final objectives. Continuous monitoring was deemed essential, with systematic evaluation and feedback in place to assess whether learning goals were achieved.

Experts repeatedly asked '*Whether the learning goals had been achieved?*' Participants highlighted the importance of adapting content to learners' needs, such as offering diverse teaching materials for practice. Both groups stressed **the importance of continuously tailoring the course to participants' specific needs** and ensuring **learning transfer** during the training programme.

Theme 3: Self-efficacy

While learning transfer must be supported by the trainer and the course, course participants ultimately need to take ownership. Experts emphasised structured evaluations and feedback, while participants focused on personal growth and reflection. One participant stated, '*I am more aware of how students think and how this way of thinking should be accommodated by the teacher. However, I have also become concerned by the practical implications/obstacles around this.*' This reflects

the concept of self-efficacy: 'People's judgments of their capabilities to organise and execute courses of action required to attain designated types of performances' (Bandura, 1985, p. 391).

The three identified themes are interconnected. One expert summarised the interplay: "To achieve meaningful transformational learning, there must be inspiring, reflecting, and experiencing to transform; that's transformative learning. Experts focused on structural aspects, such as **session connections and consistency of learning goals,** while participants appreciated **the practical inspiration and applicability** to their work context. Achieving transformational learning requires learning transfer, scaffolding, and self-efficacy.

Discussion

This study examined the fundamentals of educator professionalisation training and learning. Thus, a three-day UDL training programme was analysed using the LTSI and LTEM models. Analysis of participant and expert comments revealed three key factors: learning transfer, scaffolding, and self-efficacy.

In this study, **learning transfer between training sessions and practice was a key concern**. Experts emphasised session timing and integration of learning objectives, as research shows that well-timed, integrated training improves retention (Holton et al., 2003). Professionals recommended starting each session with reflective discussions to maintain continuity and reinforce competence. While participants valued the course, they prioritised immediate applicability. The tension between short-term application and long-term sustainability points to the need for institutional support (Hutchins et al., 2013).

The findings highlight **the trainer's role in accommodating diverse learning needs and transmitting information**. Experts recommended adapting training to participants' prior experiences and rigorously assessing progress. Educators should evolve from content delivery to transformative learning facilitation, helping participants connect reflections to learning outcomes to enhance decision-making and competence. Participants emphasised flexibility in training design, suggesting varied materials and adjusted session goals. Earlier studies (Capp, 2017; Nijakowska & Guz, 2024) underline the importance of adaptation in inclusive teaching programmes.

Self-reflection is crucial for behavioural transformation. Experts emphasised **formal evaluation**, while participants highlighted **introspection and personal growth** for UDL implementation. According to Bandura's (1997) self-efficacy theory, confidence in one's abilities predicts motivation and persistence. The integration of personal capacity for transfer (LTSI) and decision-making competence (LTEM) illustrates how self-evaluation helps learners identify problems and adjust their practice.

Limitations and Future Directions

This study has its limitations. As a single case study, the findings are context-specific and may not be generalisable to other training programmes or institutional settings. To examine the relationship between the three factors, longitudinal and mixed-methods research should fill these gaps.

CONCLUSION

This study investigated the ways in which UDL training within PDPs can promote behaviour change among teachers. Three essential elements emerged: learning transfer, trainer support and self-reflection. Collectively, these elements provide a solid foundation for designing effective PDPs that support teachers in implementing inclusive teaching principles.

Learning transfer requires a carefully tuned and flexible design of training sessions, in which both reflective moments and practical applicability are of equal importance. Trainers perform a crucial function in this process by aligning content with participants' experiences and providing ongoing support. Self-reflection promotes ownership and strengthens teachers' confidence, enabling them to integrate the principles of UDL into their teaching practices with greater conviction and sustainability.

To maximise the impact of UDL training, PDPs should not focus solely on short-term inspiration, but also on long-term support and promotion of behavioural change. Integrating reflection, flexibility and structural guidance can contribute to a deeper application of inclusive teaching practices within these programmes.

Educational institutions, policymakers and trainers are encouraged to integrate the principles of UDL into PDPs strategically. This requires collaboration and an ongoing investment in reflective and practice-based methods. Only by collaborating can we foster a LE that is both sustainable and inclusive, ensuring benefits for all learners.

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MONITORING THE EFFECTIVENESS OF A SCHOOL-UNIVERSITY PARTNERSHIP TO IMPROVE PROFESSIONAL DEVELOPMENT

Alexander F. Koch*, Edna Milena Sarmiento-Márquez**

*Researcher, University of Teacher Education Lucerne, Frohburgstrasse 3, 6002 Lucerne, Switzerland, alexander.koch@phlu.ch., **PhD candidate, University of Tallin, Narva street 25, Tallinn, Estonia, msm@tlu.ee.

ABSTRACT

School-University Partnerships (SUPs) are collaborations between research institutions and educational organisations aimed at fostering innovations and bridging the gap between research and practice. Despite potential benefits, SUPs face challenges due to their long-time span and evolving nature, requiring negotiation of different visions and addressing organizational challenges within partner institutions. Evaluating factors like Autonomy, Relatedness, Usefulness, Implementation, and Stress within SUPs is crucial for understanding the dynamics of teacher professional development and the effectiveness of collaborative practices. This study assesses the effectiveness of a SUP in promoting autonomy, relatedness, usefulness, implementation, and low stress among stakeholders in science education in Swiss compulsory schools. Results indicate that teachers developed subject-specific-methodological competence significantly, suggesting long-term programs can impact teachers' skills. Motivational factors play a minor role in program implementation, with usefulness and stress significantly influencing integration into teaching practice. Soft coaching over a longer period is highlighted as beneficial for supporting developmental work and fostering a bottom-up development process.

BACKGROUND

In the context of school and teaching development, a transfer-oriented perspective can be used to ask how scientifically sound findings can be brought into schools and fruitfully implemented there. Implementation in the sense of knowledge-oriented professionalisation could help teachers rethink, optimize, and adapt their teaching in a student-oriented way. But the hope that teachers will incorporate the knowledge they have gained into their teaching practice is anything but trivial: "A lot of people complain that [...] the sustainability and transfer of what was learned to the everyday practice are rather low" (Huber, 2011, p. 840). So, which factors can support the effectiveness of initiatives promoting the knowledge development of teachers in collaborative settings?

This article deals with the question of which variables contribute to the integration of innovative teaching into everyday school and teaching practice through university support. Empirical evaluation data from questionnaires and a knowledge test are used to answer this question.

THEORY

Transfer of Educational Innovation

Against the background of current issues in implementation and transfer research in the school sector, we would like to highlight two questions: Question 1: What are the success factors for the successful implementation of teaching development processes? And question 2 is on how knowledge/ competence develops over a longer period of time. In order to approach these questions, we will first develop a theoretical framework based on transfer and practicability in the context of instructional development.

Vertical Transfer

Vertical transfer depicts a transfer of what has been learned to a more complex example situation that takes place during the learning sequence (Salman, 2009, p. 174). In teacher further education, this means that a certain content is transferred to a practical relevant issue in order to become relevant to learning. According to (2011), the combination of the results of practical research and intermediaries, e. g. coaches, can lead to innovations being implemented in a more practically suitable way. Such persons could be professionals from a university or a university of teacher education or colleges who already have teaching and transfer experience and can thus integrate research results as innovation into praxis. Such support can catalyse

the vertical transfer from the academic context to the practical context and can have quality-enhancing effects within the whole school (Koch-Priewe, 2011, p. 75).

However, in the context of teacher education and development events, professionalisation/continuous professional development, the question of the design of further and continuing education remains open. Which factors can support the effectiveness of initiatives promoting the knowledge development of teachers in collaborative settings so that teachers can relate the content to their own school and teaching contexts?

Horizontal Transfer

Horizontal transfer refers to the transfer of what has been learned from the learning situation (learning field) to the field of application (Salman, 2009, p. 174). This type of transfer results in knowledge being put into practice or innovations being implemented in everyday school life. From a horizontal perspective, one could therefore try to change not the content of a training course, but its pedagogical concept, so that what has been learned is actually put into practice. Here, the question arises as to how one can contribute to knowledge becoming relevant for action, or which knowledge is decisive for implementation in professional teaching.

Horizontal transfer thus attempts to minimise the gap between knowledge and action or the way in which knowledge is conveyed in vertical transfer (see Mandl & Gerstenmaier, 2000). Horizontal transfer serves to transfer an innovation into practice.

Practicability

From the above, an innovation program that wants to maximise transfer and innovation implementation, precisely these transfer objectives need to be addressed. Attempts need to be made to make continuing education transferable in both ways, vertically and horizontally. An important component of this is the range of further training courses and modules for teachers.

During the project, teachers need to be able to take part in training courses, attend further training events, or exchange and discuss information in networks. This offer should be characterised by its practical orientation and the integration of teachers' needs because the teacher needs to be seen as key players in the innovation implementation process.

Teachers as Key Players

However, the transfer of knowledge and the communication of the value of an innovation concept – so that it is implemented by teachers – does not only depend on the range of what is offered to them as innovation in a further education course. According to Hasselhorn, Köller, Maaz, and Zimmer (2014), the acceptance of the innovation plays an important role. Acceptance in turn depends on the motivation and motives of the teachers, especially when it comes to the implementation of innovative ideas.

Teachers should therefore be seen as the first initiators of successful instructional development. They are supposed to achieve transfer and implement innovation in their lessons. In the light of innovation, transfer and successful teacher further education and individual development, we first want to highlight focussed statements in order to exemplify key points in professional development. The examples should help to highlight the teacher as a central element:

- Koch-Priewe (2011) speaks of wanting to strengthen individual teachers as a motor for school development (p. 289).
- Stadler (2009) explicitly focuses on teachers as the central pivotal point and places their independent learning at the centre of attention.
- Jäger (2004) makes it clear that school development only works with the acceptance and motivation of the teachers involved (p. 17).

These statements show that special attention should be paid to the motivational needs of teachers when designing development projects. Similarly, Huber (2011) describes that professional development of teachers can work if it is linked to the concrete experiences of the teachers. In line with Kirkpatrick and Kirkpatrick (2006), the following four aspects in particular play a decisive role in development projects when it comes to their success:

(1) Participants' satisfaction and their intention to continue participating in the program
(2) Participants' change in attitude, increase in knowledge and acquisition of skills
(3) Change in participants' individual practical activity
(4) Benefits for participants' work

Huber (2011) builds on these fundamental aspects and proposes a comprehensive theoretical framework for the evaluation of instructional and transfer-oriented development processes. This model – in a very condensed form – is presented in Figure 1 below.

Huber (2011) emphasises that usefulness and relevance are core variables for evaluation and also for continued participation in the project. Also, external and internal factors are used for the evaluation. External factors refer to the circumstances in the project, e. g. its realisation or conception. Internal and transfer-relevant factors are the participants' skills, their attitudes or their job satisfaction. These factors also influence the evaluation process. This means that if the programme has no effect in the form of practical transfer, this negatively impacts the satisfaction with the programme and on the participants' motivation to continue participation in the programme.

From the framework, transfer-relevant variables can be operationalised and tested for their significance. In addition to skills and attitudes, usefulness, and the general evaluation of the project, motivational variables and the effort required to carry out the project also may impact the implementation in practice.

These variables can very well be addressed in a collaborative developmental process in which a developing academic institution assists and guides the teachers through the implementation phases. In a wider sense, this can manifest in a school-university partnership.

Figure 4.

Framework for the evaluation of development projects (Huber, 2011), simplified.
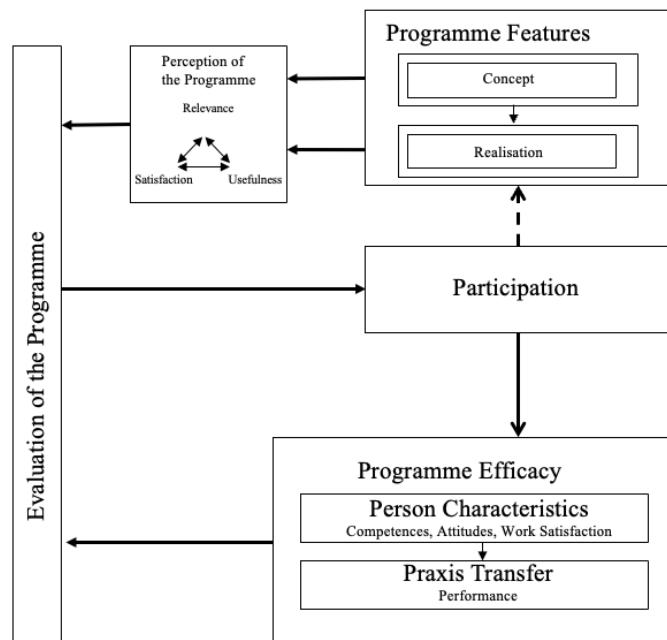
School-University Partnerships

School-University Partnerships (SUPs) are long-term collaborations between research institutions and educational organisations that aim to foster educational innovations and close the gap between research and practice (Coburn et al., 2013).

SUPs offer a platform for implementing knowledge-oriented professionalization by providing a collaborative environment for teachers and researchers to align their goals and practices. SUPs engage educational systems in evidence-based interventions to benefit all involved stakeholders, such as enabling research institutions to investigate new strategies and educational institutions to receive teacher Professional Development or expand learning opportunities (Clark, 1988; Coburn et al., 2013).

Despite their potential benefits, SUPs face challenges due to their long-time span and evolving nature. For instance, it is not always easy to negotiate different visions to build a community of practice that works towards the same goal. Moreover, the different partners integrated with the SUP are subject to organisational challenges in their home organisations.

Several factors can impact the effectiveness of the SUP. Seen as a socio-constructivist collaborative endeavour, an important aspect relates to the participants' *perception* of the programme, which includes satisfaction, perceived relevance, overall quality, and usefulness. These variables are key for understanding the dynamics of teacher professional development and the effectiveness of the SUP in supporting collaborative practices (Kirkpatrick & Kirkpatrick, 2006; Huber, 2011). Satisfaction can be subdivided into motivational factors such as autonomy experience and relatedness (Deci & Ryan, 1990; Koch, 2016) which are important in knowledge transfer processes (Berkemeyer et al., 2011) together with practical issues such as usefulness, evaluation, and implementation (Huber, 2011):

Autonomy refers to the degree of independence and decision-making power teachers have in their organisation; relatedness includes relationships and connections within the partnership. Usefulness assesses the practical value and relevance of the research findings; implementation focuses on the successful integration of these findings into educational practices. Stress delves into the emotional and psychological impact of the partnership on teachers. Evaluation refers to the programme quality in terms of expected outcomes.

These factors were evaluated in the study due to their influence on the effectiveness and sustainability of SUPs and their relationship to teacher competences gained from their participation in the SUP. In this regard, we aim at answering the research question to what extend the SUP under study is effective in promoting the perception of autonomy, relatedness, usefulness, evaluation, implementation and low stress in the implicated stakeholders in relation to competence development.

METHODS

Study Design and Analyses

Our study is situated in science education in K9 school in Switzerland. 125 teachers participated in a programme to develop skills in problem-based science education.

In terms of SUP, three to four schools with two participants each were clustered to a group and a coaching person from the university worked with the teachers. The coaching was divided in individual support within schools and group meetings to discuss progress and share ideas between schools. Data were collected before the programme started and then regularly at the end of the school year for three consecutive years. All data were analysed in a multi-level approach for longitudinal data and a pre-post t-test.

Measures

Programme specific variables were only evaluated in the programme group and beginning after the first year, and the consecutive for two more years. The constructs are listed next and reliability measures are given for the three consecutive measurement time points: Implementation (α= .81, .88, .90), usefulness (α= .77, .79, .82), negative stress (α= .78, .76, .84), evaluation (α= .81, .85, .88), autonomy (α= .56, .67, .72) and relatedness (α= .76, .82, .86), see Table 1. All items of a scale were rated on 4-point Likert scales and previously validated in Berkemeyer et al. (2011).

Table 1
Scale Mean Values and Cronbach Alpha Reliabilities

Variable	α	AM (SD)	AM (α)
Implementation of the Project	.81	3.15 (.53)	.86
Usefulness of the Project	.77	3.13 (.52)	.79
Negative Stress in the Project	.78	2.54 (.73)	.79
Evaluation of the Project	.81	3.02 (.48)	.85
Autonomy in the Project	.56	3.53 (.37)	.65
Relatedness/ Social Integration in the Project	.76	2.99 (.6)	.81

Note: AM-Alpha corresponds to the average internal consistency of the scale over three measurement points

A paper-based test, based on Brovelli et al. (2014), assessed sub-dimensions of pedagogical content knowledge (PCK) as competence and was deployed before and after the programme. The vignettes showed classroom situations including non-optimal situations. Teachers had to reflect on the vignette situations and identify problems that had been validated by experts beforehand. Two independent coders rated the answers of the participants.

Table 2 shows the intercoder reliabilities of the ordinal vignette coding (0: problem not recognized, 1: problem recognized, 2: solution/improvement suggested). Krippendorff's alpha was calculated, as this coefficient is suitable for ordinal data on the one hand and can also deal with missing data on the other. Krippendorff (2004) suggests that values from .67 can be interpreted if the coding is more inferential. On this basis, the reliability of vignette 7 falls well below the threshold; all other values can be considered acceptable due to the high degree of inference of the coding. Vignette 8 does not contain any codable items for PCK, so no values were calculated.

Table 2. *Intercoder reliabilities of the competence test for Pedagogical Content Knowledge*

Vignette/ Construct	k-Alpha (ordinal)	n (Pairs)
Vig. 1	.78	76
Vig. 2	.73	86
Vig. 3	.70	132
Vig. 4	.59	160
Vig. 5	.55	164
Vig. 6	.62	75
Vig. 7	.36	32
Vig. 8	---	---
PCK	.65	725
PCK-atc	.65	346
PCK-dc	.59	110
PCK-mc	.66	269

Notes: atc= Adaptive Teaching Competence, dc= Diagnostic Competence, mc= Methodological Competence

RESULTS

The personal-motivational variables (stress, autonomy, and relatedness) remain stable over time. The project-related criteria evaluation, usefulness and implementation show linear changes. The evaluation of the project changes significantly (p< .001). The average initial level is 3.04, the average growth rate is .10 points. The perceived the usefulness changes significantly: p<.01, average baseline = 3.12, average growth rate = .07. The implementation of the project shows a significant time effect: p< .001, an average initial level= 3.17, and an average growth rate= .16.

When the programme implementation was used as a dependent variable and regressed on motivation and project criteria, the implementation shows significant and positive correlations with the perceived usefulness and the stress experience: More usefulness increases the implementation by 17%, stress increases the implementation by 18%. The time factor remains significant, meaning that the programme is implemented more strongly over time in a form that is not explained by the variables used (see Table 3).

For the overall PCK, there was a marginally significant development over the period of three years ($t(71)$= -1.665, p= .100). Teachers increased their competence from a mean value of .40 to a mean value of .44. This means that, on average, teachers recognised more problems in the vignettes at the end of the project than at the start of the project. The following picture emerges with regard to the sub-dimensions of the PCK: Neither the adaptive teaching competence nor the diagnostic competence showed significant changes. Only the methodological competence increased significantly from AM_{pre}= .37 to AM_{post}= .44 ($t(71)$= -2.118, p= .038). However, this is not significant at an adjusted alpha level due to the triple testing.

In terms of project implementation over time, the PCK subdimensions did not show any significant effects (Table 3). The remaining factor to drive the project implementation was found to be time.

Table 3
Practical Explanatory Variables for the Project Implementation

Dependent Variable: Implementation of the Project	Est. (SE)	t (df)	Sig.
Intercept	3.28 (.04)	84.888 (96.59)	.000
Usefulness of the Project	.17 (.03)	4.998 (219.52)	.000

Negative Stress in the Project	.18 (.03)	5.181 (23.44)	.000
Evaluation of the Project	.02 (.03)	.683 (221.12)	.496
Autonomy in the Project	.03 (.03)	.997 (211.72)	.320
Relatedness/ Social Integration in the Project	.01 (.03)	.283 (226.97)	.777
PCK-atc	.04 (.03)	1.180 (10.75)	.241
PCK-dc	.00 (.03)	-.014 (95.56)	.989
PCK-mc	.00 (.03)	-.101 (95.75)	.920
Time	.09 (.03)	2.950 (96.13)	.004

Notes: atc= Adaptive Teaching Competence, dc= Diagnostic Competence, mc= Methodological Competence

DISCUSSION

This study dealt with the assessment of the effectiveness of a SUP. The results from the teacher assessment show that they developed their subject-specific-methodological competence. This indicates that long-term programmes can have an impact on teachers' skills, even if not addressed directly in an intervention design but rather by person-oriented coaching. One explanation for this could be the design of the project, which aims to rethink one's own teaching in terms of student orientation, e.g., creating cognitively activating lessons that build on prior knowledge and challenge learners cognitively.

Motivational factors only play a minor role in the programme implementation. Neither the opportunity to drive improvements by interests, nor to hold discussions with colleagues seem conducive to implementation. Only the assessment of the benefits for teaching (usefulness) and the effort (stress) increase the transfer of the programme into teaching practice. As predicted in theory, usefulness is a decisive factor for successful and practice-relevant development. The relevance of the stress caused by the programme can be explained by difficulties in negotiating roles and expectations (Gordon et al., 2006) as well as by the expected demands of collaborative work and the development of improved instructional and innovative practices (Desimone, 2009).

Generally, results show that the more effort is put in developmental work, as perceived by the participants, the more can a programme translate into practice. Instead of deep and isolated interventions, further education, as a *soft* coaching process over a longer period of time seems fruitful, especially as it favours a bottom-up development process and values the ecology of teachers.

CONCLUSION

This study highlights the potential of SUPs as an effective approach to fostering teacher professional development, particularly in the context of science education. Our findings underscore the importance of designing professional development initiatives that are not only relevant and practical but also grounded in a collaborative approach that strengthens the relationship between research and practice. Teachers' perceptions of usefulness and the alignment between SUP goals and their professional needs emerged as critical factors for successful implementation, suggesting that more targeted support may enhance long-term outcomes. While the study sheds light on promising directions, it also reveals areas for further exploration. For instance, the dynamic interplay between different factors—autonomy, relatedness, usefulness, implementation, and stress—requires deeper investigation to understand how these evolve over time and contribute to sustained change in teaching practices.

In conclusion, SUPs hold significant potential as a transformative mechanism for professionalizing teaching, bridging the gap between scientific research and classroom practice, and ultimately fostering an environment where both teachers and students can thrive.

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DEVELOPING STEM LEARNING MATERIALS IN NETWORKED TEACHER DESIGN AND RESEARCH TEAMS: CASE NANOWORLD

K. Vyvey * and R. Frans**

*PhD, Researcher in Physics and STEM education at the research center Art of Teaching, Faculty of Teacher Education, University College Leuven-Limburg – Campus Diepenbeek, Agoralaan building B bus 4, B-3590 Diepenbeek, Katrien.Vyvey@ucll.be, **Teacher Educator in Physics and STEM, co-founder of the Expertise Centre Art of Teaching, a research unit focusing on Pedagogical Content Knowledge, Faculty of Teacher Education, University College Leuven-Limburg – Campus Diepenbeek, Agoralaan building B bus 4, B-3590 Diepenbeek, Renaat.Frans@ucll.be.

ABSTRACT

In the University College Leuven-Limburg, campus Diepenbeek, students of the Teacher Education program develop STEM-projects in so-called networked Teacher Design and Research Teams (nTDRT). These teams consist of typically three pre-service teachers with different STEM content knowledge, one or two in-service teachers and a teacher trainer. The teams develop STEM learning materials according to the COOL methodology for iSTEM, implement these materials in a secondary school and investigate the quality of the implementation by Teacher Research. The training method for (pre-service and in-service) teachers, also called the Teacher Design and Research method (TDRM), is illustrated by means of the case 'Nanoworld'.

INTRODUCTION

*The impact of the teacher on student learning increases most rapidly when teachers **learn together** (Hattie, 2017).*

STEM education (Science, Technology, Engineering, Mathematics) plays a crucial role in 21st century education (National Research Council, 2014), but is quite challenging for teachers due to its interdisciplinary character. Most teachers are experts in some, but not all STEM disciplines. Therefore, teachers need support, collaboration and professional development (Margot & Kettler, 2019).

It is the task of teacher education programs to professionalize pre- and in-service teachers in STEM and show them meaningful STEM practices. Studies show that collaboratively designing learning materials is an effective way for teachers to further professionalize (see e.g. Voogt et al., 2011). It allows them to bring

expertise together, to reflect about the new way of teaching in STEM education and to actively shape their STEM teaching (Demeester et al., 2021).

In addition, it is shown that teachers who reflect systematically about their own teaching practices by Teacher Research, have more impact (Gutierez, 2019). Teacher Research is research performed by the teachers themselves, to get systematic answers in interaction with their environment about questions arising from their school practice with the aim to better understand, improve and innovate this practice (Van der Donk & Van Lanen, 2020). Teachers who get the opportunity to perform Teacher Research in a well-functioning team experience this as a support and an enrichment (Lovatt, 2020; Willegems, 2017). Therefore, Teacher Research is an excellent method to monitor the quality of innovative STEM education.

For these two reasons, in the teacher education program of the University Colleges Leuven-Limburg so-called networked Teacher Design and Research Teams (nTDRTs) are installed to professionalize teachers. The teams consist of typically three pre-service teachers, one or two in-service teachers and a teacher trainer as coach. They develop STEM learning materials following the COOL methodology for iSTEM (De Meester et al., 2021), pilot them in a secondary school and investigate the quality of the piloting by Teacher Research (Vyvey et al., 2020).

In this case study it will be shown how the STEM project 'Nanoworld' was developed by a nTDRT. The project starts from the question of wondering: ''How can interactions in the nanoscale world explain what we observe in the wonderful large scale world?' The STEM learning materials will be presented including the strengths and pitfalls that arose from the Teacher Research.

DESIGNING A STEM PROJECT: CASE NANOWORLD

The STEM project Nanoworld was designed by a nTDRT consisting of three pre-service teachers, one in-service teacher and one teacher educator as a coach. The three pre-service teachers had profound content knowledge in Mathematics and Chemistry, Mathematics and Biology, and Chemistry and Physics, respectively.

The STEM learning materials were designed according to a slightly adjusted version of the COOL methodology for iSTEM (De Meester et al., 2021). Four steps are distinguished in the designing process: the context analysis phase, the theme selection phase, the content elaboration phase and the development phase. Throughout all phases the nTDRT members get feedback from the teacher trainer.
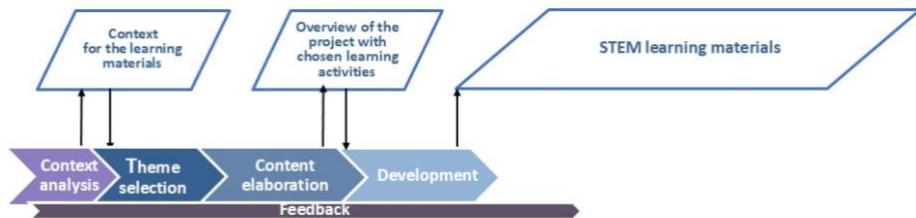
Figure 5 Design process based on the COOL methodology (De Meester et al., 2021).

Context analysis phase

In this phase, the target group for whom the STEM learning materials will be designed is examined, e.g. age, interests, number of students… In addition the teaching context is analysed, e.g. the context of the school, the number of hours that can be spent on the STEM project in the classroom, the equipment... Also the national curricula of the different STEM subjects of the target group are scanned.

The case Nanoworld was designed for a group of 14 students aged 13 to 14 years who chose STEM as a field of study. Eleven hours were allocated to implement the project in the classroom. The intended goals included skills like working safely and sustainably, inquiry based learning, working accurately, correctly using quantities and units, and content knowledge like calculating with exponents and representing forces.

Theme selection phase

In the theme selection phase a suitable theme is chosen. Possible reasons to choose a theme include the skills to be pursued like problem solving or inquiry based learning, the content knowledge to be addressed, possibilities to invoke wonder, social relevance…

The theme 'Nanoworld' offers great opportunities to address the necessary skills and evoke wonder. It fits within the European project Amase about advanced materials www.amaseproject.eu (Amase, 2024) and addresses the United Nations Sustainable Development Goals 4 (Quality Education) and 9 (Industry, Innovation and Infrastructure) (United Nations, 2024).

Nanoworld provides a novel way to approach the sciences physics, chemistry and biology, and mathematics in an interdisciplinary way. Links between the nanoworld in nature and technological applications can be made. The interdisciplinary character of the STEM project can be represented by the STEM helix, which represents each STEM discipline by a DNA strand. By colouring the strands, it becomes visible which disciplines are present in the STEM project and to what extent. The bridges of the STEM helix show the coherence between the disciplines (Andreotti et al., 2017). Figure 2 shows the coloured STEM helix for the Nanoworld project.
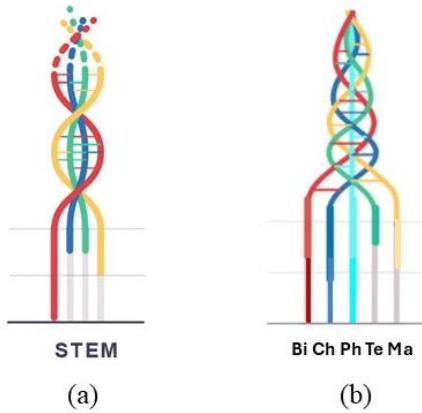
Figure 6 (a) Coloured STEM helix for the Nanoworld project according to Andreotti et al. (2017). (b) Coloured adjusted STEM helix for the Nanoworld project (Bi - Biology, Ch - Chemistry, Ph - Physics, Te - Technology, Ma - Mathematics).

Content elaboration phase

In the content elaboration phase, the nTDRT starts discussing the central wondering or challenge of the project, which forms the common thread throughout the STEM project. Choosing a central wondering will often lead to a more scientific inquiry based approach of the STEM project whilst choosing a central challenge usually results in a more technological and engineering project with a prominent role for design thinking. However, scientific inquiry often demands design thinking and design thinking often demands scientific inquiry.

The central wondering or challenge links the intended goals, i.e. the addressed skills and content knowledge. By breaking the wondering or challenge down in subwonderings or subchallenges a table of contents for the STEM project is obtained.

Once the table of content is more or less clear, scientific experiments are prepared and/or prototypes are built. The necessary materials are ordered. The nTDRT conceives learning activities, discusses the presentation of the STEM project (face-to-face, digital or blended), the amount of scaffolding…

The case Nanoworld was built around the wondering 'How can interactions in the very small explain wondrous observations on the macro scale?'. The central wondering was broken down in following subwonderings: 'How big is a nanoparticle?', 'How does a gecko walk on the ceiling?', 'How does the structure of a butterfly's wing play with the light?' and 'Magnetic fluids'. The learning materials were presented in a Canva and contained several experiments, supporting videos and websites. The four chapters were built around sections 'Set the scene', 'Exploring' and 'Get to work'.

Development phase

Once the structure of the project is clear and the necessary decisions are taken, the STEM project can be written out. This is a time demanding process which usually requires, like the other phases, a lot of feedback and support by the teacher trainers.

The STEM learning materials of the case Nanoworld can be found on the website amaseproject.eu (Amase, 2024).

EALUATING AND IMPROVING A STEM PROJECT BY TEACHER RESEARCH: CASE NANOWORLD

It is crucial that teachers can evaluate and improve their newly developed STEM learning materials and practices in a systematic way themselves. Therefore, the teacher training program at the University Colleges Leuven-Limburg trains the nTDRTs to perform Teacher Research (TR). Teacher Research is systematic research by teachers, possibly supported by other educational professionals, in interaction with their environment to obtain answers about their own teaching practice. This way, teachers can meaningfully improve and innovate school and classroom practices (Van der Donk & Van Lanen, 2020; Cochran-Smith & Lytle, 2009). Therefore, contrary to academic research, Teacher Research depends on the context of the class or the school.

The Teacher Research training at the teacher education program of the University Colleges Leuven-Limburg (UCLL) is based on the results of the European projects Linpilcare and 3DiPhE (Lovatt et al., 2020; Vyvey et al., 2020). Following steps are distinguished in the Teacher Research: the TR research question, data collection, analysing data and conclusion. Based on the conclusion, the STEM learning materials and practices can be adapted and improved. Throughout all phases the nTDRT members get feedback from the teacher trainer

Figure 7 Teacher Research process based on Lovatt et al. (2020).

TR research question

Teacher Research, as developed by the European projects Linpilcare and 3DiPhE, starts form the passion of the teacher (Dana & Yendol-Hoppey, 2014). Only this way, teachers feel involved and motivated. Teachers have a lot of passions, questions and concerns. Nevertheless, they find it often quite difficult to turn these into TR

research questions that can be investigated in their own class or school context. Therefore, protocols, like e.g. the Litmustest, have been developed to help (Dana & Yendol-Hoppey, 2010; Lovatt, 2020).

The Nanoworld nTDRT started from the interest 'How to stimulate wonder?'. In literature, eight strategies for stimulating wonder can be found: (1) show your own wonder as a teacher, (2) engaging with students' questions, experiences and wonder, (3) making time and space for exploration, research and experimentation, (4) making the familiar unfamiliar, (5) encouraging meening-seeking, (6) stimulating imagination, (7) encouraging contemplation, (8) creating an enriched environment (Conijn et al., 2021).

Figure 4 shows how a starting question was turned into TR reserach questions with the help of the Litmustest (Dana & Yendol-Hoppey, 2010; Lovatt, 2020). The final research questions targeted the students group of 13-14 years old students with particular interest for STEM disciplines. The questions were:

- What wonder strategies can be employed when exploring the website asknature.org?

- How can we as teachers support the students in this exploration?

Figure 8 Litmustest (Dana & Yendol-Hoppey, 2010) for the Nanoworld project

Data collection

In a next step, teachers collect data in their class or school. Teachers often think that quantitative data (from e.g. questionnaires) are the only useful data. However, qualitative data from e.g. observations, interviews… are as meaningful and important (Cochran-Smith & Lytle, 2009). To ensure the validity and reliability of the data, it is though important to apply the principle of triangulation. This means that data are collected from at least three different sources or points of view (Van der Donk & Van Lanen, 2020; Cochran-Smith & Lytle, 2009). Possible data collection methods are observations with field notes by the teachers themselves, coteachers, teacher trainers or other external observators…, collections of documents like students' notes or teachers' preparations, interviews with students, coteachers, coaches…, class discussions, videos, keeping logbooks, questionnaires, test results of students… The data are collected during the piloting of the STEM project in a secondary school.

In the Nanoworld project, students were given the opportunity to explore the website asknature.org and to present their wonderings. The collected data consisted of the evaluation of the students' presentations, the analysis of videos taken during the exploring phase and observations by the pre-service coteachers and the in-service teacher of the nTDRT.

Data analysis and conclusions

Good conclusions are based on the data analysis, answer the TR research question and lead to suggestions to improve the teaching practice.

Following conclusions were drawn from the Nanoworld TR. Three Conijn strategies for evoking wonder (Conijn et al., 2021) were clearly exploited by giving the students time to explore the website asknature.org:

- Strategy 3 - making time and space for exploration: Video analysis shows that the students were focused when exploring the website.

- Strategy 4 – making the familiar unfamiliar: Asknature.org contains countless examples where the familiar is made unfamiliar. The students selected several examples in their **presentations**, e.g. the blue butterfly.

- Strategy 2 - engaging with students' questions, experiences and wonder: The students' wonder was **in line with** the wonder of the teachers. Therefore it was easy to engage with the students' wonder because the teachers were prepared to do so.

Following suggestions for improvement came forward:

- Students were given 30 minutes to freely explore the website. This was a bit long. In addition, it would help the students to foresee supporting

questions and guidelines like: What is special about it? What would you like to know about it?

- The students' engagement can be improved by discussing more elements of their presentations during the presentations themselves or afterwards.

THE TEACHER DESIGN AND RESEARCH MODEL

The Teacher Design and Research Model (TDRM) combines the design of the STEM learning materials and the Teacher Research on the STEM practice in one flow. Figure 5 shows the graphical representation of the model. The design process is represented in blue and the Teacher Research process is represented in red.

Phases addressing both designing and researching are represented in purple. The context analysis is represented in purple because this phase is important for both the design and the Teacher Research process. In addition, the piloting and improvement phases are added to the model. During the piloting phase, the designed STEM learning materials are implemented and data for the Teacher Research are gathered. In the improvement phase, the STEM practice is improved based on the results of the Teacher Research.
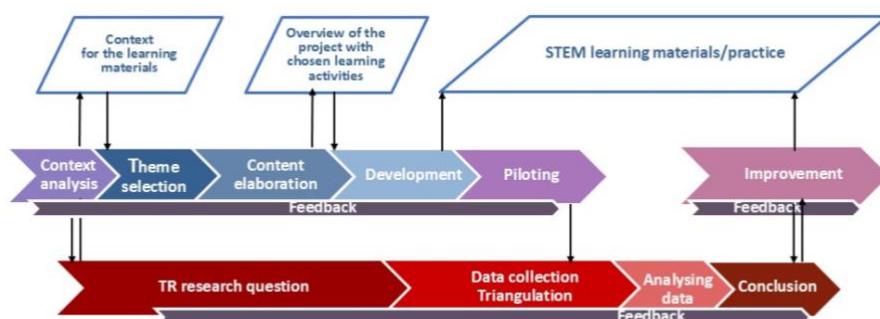
Figure 9 Teacher Design and Reserach Model (TDRM).

The Nanoworld project was piloted at the Sint-Lambertuscollege in Bilzen, Belgium. The class consisted of 14 students aged 13 to 14 years who chose STEM as a field of study.

SUGGESTIONS FOR FUTURE RESEARCH

Both pre-service and in-service teachers appreciate the outcomes of the TDRM trajectory. Every year, the nTDTRTs present their findings at a professional development session which is usually attended by about a hundred teachers.

However, it is recommended to validate the model by future research. Indeed, TDRM brings together two processes, i.e. designing STEM learning materials and Teacher Research, each of which demands a lot from the teacher. Succes of the implementation depends on multiple factors such as the teacher training program, the context of the schools where the piloting is done… Literature shows that the coach (the teacher trainer in our case) plays a crucial role in the functioning of the nTDRTs (see e.g. Becuwe et al., 2016; Huizinga et al., 2013; Binkhorst et al., 2017; Gast et al., 2017). Therefore, also further research on the coaching and the efficiency of the nTDTRTs in the teacher training program is recommended. Finally, it can be examined to what extent the results are generalizable within and outside the context of Flemish education.

CONCLUSION

The TDRM trajectory provides the teacher trainer with a framework to train teachers in STEM. The teacher trainer can have pre-service and in-service teachers collaborate in nTDRTs to teach them the didactics of STEM and Teacher Research. This way, teachers are exposed to new STEM practices and actively shape their own STEM practice. Teacher Research can provide insights in the opportunities and pitfalls of the STEM practices and help further optimize them.

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THE WALLPAPER ROLL METHOD:
SYNTHESIS OF IDIOSYNCRATIC DATA IN MULTIPLE CASE STUDIES INTO WICKED PROBLEMS

Jeroen S. Rozendaal* & Niek van den Berg**

* Professor inquiry-based working in teams, University of Applied Sciences Rotterdam, Museumpark 4, 3015CX, Rotterdam, j.s.rozendaal@hr.nl, ** Professor boundary-crossing by educators and researchers, Aeres University of Applied Sciences Wageningen, Mansholtlaan 18, 6708 PA, Wageningen, n.van.den.berg@aeres.nl

ABSTRACT

Research collaboration between practitioners and research professionals aims to develop both practice and knowledge. However, a tension can arise between these objectives: to preserve local relevance, the content, form, and timing of data collection may vary between cases, complicating the comparability of local data in a multiple case study. The Research-Practice Partnership Tools for Team Learning found a solution in the 'wallpaper roll method,' which enriches the storyline-method with elements from reflexive monitoring and arts-based research. A distinctive feature of the wallpaper roll method is cumulative joint reflection and interpretation based on previously collected local data. In this contribution, we illustrate the various phases and steps of the method with experiences from our own research in which it was developed and tested. The method resulted in both practice development and an overarching conceptual model. This method can enhance the quality of practice-based research in other collaborative projects that employ participatory, action-oriented research approaches and work with diverse, case-specific data. Effective application of the method requires a wide range of professional and research competencies from the collaboration partners. Adequate time and attention are necessary to prepare partnerships for this.

INTRODUCTION

Collaboration between practitioners and researchers helps in understanding and solving complex practical issues. This partnership has a dual purpose: to generate actionable knowledge (Argyris, 2009) that is both useful for the practioners in the partnership and transferable (with possible adaptations) to other contexts. This can be achieved through participatory action research (PAR; Migchelbrink, 2016) on a wicked problem, which takes place parallel in different contexts, after which the

results are analyzed and interpreted across cases to obtain insights of broader relevance.

In a project funded by the Nationaal Regieorgaan Onderwijsonderzoek (NRO, National Directorate for Educational Research) in the Netherlands, the Research Practice Partnership (RPP) Tools for Team Learning investigated one such a wicked problem, namely the positioning, role fulfillment, and role development of master graduates in secondary vocational education (VET). As in the Netherlands teacher training at bachelor's level is often sufficient to teach, master graduates form a specific social capital as possible teacher leaders contributing to educational improvement in their schools. How do they shape that role and what helps and hinders them?

In our RPP, six VET teachers with a master degree worked in different school contexts, collaborating with their teams on several practical issues, which were locally determined by stakeholders. These issues included, for example, the flexibilization of education or the design of hybrid learning environments. This different local issues however, were not the object of our joint research. The master graduates all wanted to contribute to educational quality improvement in their institutions by working together in a research-based way, both formally and informally, to solve practical issues (Consortium Tools for Team Learning, 2022; Van den Berg et al., 2024). Their positioning, role fulfillment, and role development in this process, and the extent to which these were helpful or obstructive, formed our RPP-wide research topic.

Our RPP consisted of six master educated VET teachers and six research professionals. We regularly met to discuss practical problems, exchange knowledge, and share literature on (promoting) collaborative research into educational quality. Insights were then applied by the master graduates in their work with their teams.

During the project, we found that the dual objective of contributing to solving various local practical issues and developing transferable research knowledge brings challenges. To ensure relevance for the participating practices, the content, form, and/or timing of data collection methods needed to align with the actors and/or their work processes. On the one hand, this provided a more valid picture of work practices than strict adherence to a uniform framework would have. On the other hand, this resulted in idiosyncratic data per work practice, which places specific demands on cross-case analyses. We found a solution in the "wallpaper roll method". This paper (based on Consortium Tools voor Teamleren, 2022 and Rozendaal et al., 2024) focuses on the characteristics of this method, illustrated with the case of TOOLS.

The wallpaper roll method builds on the storyline method for interviewing individuals (Gergen, 1988; Sannen, 1998), which fits within the narrative research tradition. The storyline method – in which actors from practice and science articulate

their experiences in a narrative, assign values to them, and identify meaningful moments – has also been previously applied in, for instance, research into the practical knowledge of (groups of) education professionals (Beijaard et al., 1999; Sprenger et al., 2006; Teurlings & Uerz, 2009). We combined this with elements of reflexive monitoring (Van Mierlo et al., 2010) and arts-based research (Van Heijst & Bos, 2019). Reflexive monitoring is a dynamic and adaptive process of learning by doing and vice versa. Arts-based research involves using creative forms when collecting, analyzing and interpreting data. The practical knowledge that the wallpaper method aims to generate can, for example, be made explicit in CIMO statements. Such statements follow the format: "In the case of [context C], [intervention I] helps to initiate [mechanism M] in [target group], which contributes to [outcome O]" (see Denyer et al., 2008).

The wallpaper roll method gets its name from the medium used – a piece of wallpaper roll. The method is characterized by cumulative joint dialogues interpretations, and analyses based on data collected locally by practitioners. In our RPP, these data were gathered over an extended period during which master graduates, along with colleagues, worked in a research-based manner on practical development, and in which the actions of those involved either positively or negatively influenced practice. The data are therefore chronologically ordered on a (physical) timeline.

Through joint reflection and interpretation by practitioners and research professionals, based on the data on the timeline and underlying events, considerations, evaluations, and meanings, the wallpaper roll method aims to do justice to the subjective and representative nature of local data. When conversation partners from practice and research arrive at a shared meaningful interpretation of local research data, it can be assumed that the broader relevance of the statements made increases. The same applies when conversation partners, using the collection of locally interpreted data, then systematically answer the RPP-wide research questions. The dialogue about this stimulates joint knowledge and practice development.

PHASES AND STEPS IN THE WALLPAPER ROLL METHOD

The wallpaper roll method consists of cumulative first, second, and third-order analysis phases (see Box 1), with steps that are partly specific to the method and partly part of the regular practice of PAR. We illustrate each phase with experiences from the research project of the TOOLS consortium. For a graphical overview, see figure 3.

Box 1: The three phases and corresponding steps in the wallpaper roll method.

Collection, analysis, and synthesis of data at the case level: first-order analysis
1. Collecting case-specific data
2. Preparing the wallpaper roll
3. The wallpaper roll dialogue
4. Transcribing, summarizing, validating
5. Distilling lessons learned into statements
Synthesis of cases: second-order analysis
1. Grouping statements
2. Prioritizing
3. Thematizing
Further validation, deepening, and synthesis: third-order analysis
1. Reflecting on themes and statements against insights from practice and science
2. Collecting and linking illustrative material

Collection, analysis, and synthesis of data at the case level: first-order analysis

1. During an agreed period, practitioners collect data that are important for interpreting the local situation and answering RPP-wide research questions locally. Researchers can provide research instruments and interim reports on the analyzed local data. Additionally, personal reflection reports, agendas, minutes, logbooks, project plans, progress reports, and other locally collected data using local instruments can also be used.

2. Prior to each wallpaper roll dialogue, all locally collected data are printed on paper. A researcher (and/or the practitioner(s) themselves) arranges this data chronologically on a piece of wallpaper roll: the physical carrier of the timeline (the x-axis) of the period being examined. The y-axis consists of a positive and negative scale, where the involved parties can later indicate their evaluation of specific moments in relation to the RPP-wide research questions (see Figure 1).

Figure 1: Example of a timeline.

3. The wallpaper roll dialogue itself involves a first-order analysis at the case level by the practitioner, any other involved parties, and a discussion leader (for example, a researcher). An audio recording of the conversation is made for further processing and analyses. The participants stand around the wallpaper roll and discuss the selected period. The discussion leader asks questions such as: What data are we looking at here, what do we see, what is the story behind it, do any data require further clarification at this moment? The practitioner speaks first, followed by any other participants. They explain the data on the timeline and construct their own narrative, supported by previously collected data, about the period.

Next, participants evaluate their own experiences and events, giving the dialogue an evaluative and reflective component. The discussion leader asks a series of questions, for example:
- To what extent are you currently able to work on the RPP-wide practical issue? Mark a cross at the appropriate level (Y-axis) at the current moment.
- To what extent were you able to do so at least three other times? Mark a cross at the appropriate level (Y-axis) for each time.
- Can you draw a continuous line between the crosses? In doing so, participants evaluate the progression by drawing a line that indicates where in time there were moments of growth, dips, or stagnation.
- What were the most meaningful moments? Now select the most meaningful moments (for example, three). These may be different from the moments previously marked with a cross. For instance, they could be moments where the line changed direction, stalled, or when practitioners made significant interventions.

If multiple aspects of the RPP-wide research question(s) are involved, participants can draw multiple lines in different colors or patterns to

distinguish them. The above questions are then repeated, each time focusing on a different aspect.

The discussion leader then asks deeper questions about the progression of the line(s), differences between the participants' lines, and the meaningful moments marked. What happened, what interventions were made, what assumptions were involved, and what was the outcome or consequence? Where possible, the interlocutors relate their experiences to existing literature or insights from elsewhere. The discussion leader then checks if everything important for understanding the case has been covered.

Finally, the practitioner reflects on the conversation and describes its significance for future steps in their work. This enhances the practical relevance of the conversation and provides points of connection for a possible future wallpaper roll dialogue.

4. The recording of the dialogue is transcribed, possibly summarized, and submitted to the participants for validation.

5. Based on the transcript, the researcher transforms the lessons learned into more general statements about which interventions led or could lead to certain effects and under what circumstances. See Box 2 below as an example of a first-order analysis, with two statements formulated based on the analyses.

Box 2: Working method for first-order analysis in our research.

The set of mixed method and qualitative data collection methods (questionnaires with 5-point scales and open-ended questions, discussion guides, instructions for logbooks, documentation of critical incidents, and network analysis) developed within the project focused on collaboration and inquiry-based working within the design groups, as well as on the self-reflection of the master graduates regarding their roles and positioning. These data collection methods not only aimed at identifying the factors and conditions that either support or hinder master graduates in their roles, but also served as a tool to assist them in conducting their inquiry-based work.

At the end of the first project year, each master graduate conducted a wallpaper roll dialogue with the researchers. To prepare for these dialogues, the researchers compiled all research findings from the specific case on a timeline.
At the start of the dialogue, the wallpaper roll with the printed research results was either hung on the wall, laid out on the floor, or placed on a table (see figure 2).

Figure 2. The wallpaper roll method in action.

In some cases, due to the COVID-19 restrictions, a physical meeting was not feasible. In those instances, we opted for an online meeting. We organized the timeline in an Excel spreadsheet. The essence of each data point was briefly summarized to provide an easy and quick overview. Each data point was also linked to the underlying document, which was stored in a shared digital workspace. In this case, that workspace was MS Teams.

The wallpaper roll dialogues were recorded, transcribed, and summarized by the researchers, during which the practical knowledge that emerged from the conversation was articulated in CIMO theorems. The summary and the theorems were then returned to the master graduate for validation, additions, and clarifications, resulting in an ongoing dialogical process during the first phase of analysis until consensus was reached. Throughout the project, two wallpaper roll conversations were held for each case, resulting in 66 theorems. Examples of such theorems are:

"When the design group experiences a lack of time for collaborative inquiry-based work, a supportive facilitation (being flexible, offering space, and setting boundaries) by the master graduates helps to implement collaborative inquiry-based work, at least during the meetings"

"*When the design group's plan and goals are defined, involving a team leader and others in your network can help further develop and implement the plan".*

Synthesis of Cases: Second-Order Analysis

1. The statements derived from the various cases are combined into one set.

2. All RPP partners then prioritize the statements in this set, for example, based on their relevance, usability, or effectiveness for their own case or context. During this process, a selection of statements may be made, with low-rated statements potentially set aside. Statements with similar content are merged.

3. The RPP partners group the statements based on their connecting or underlying themes (see Box 3 for a detailed description of the second-order analysis). Collective conclusions about themes and underlying statements thus gain a certain degree of 'participatory generalizability' (see Smaling, 2009).

Box 3: Methodology of the second-order analysis in our research.

The 66 theorems were randomly arranged and presented in a digital survey to all RPP partners. Each partner selected three sets of 15 theorems they found most useful for a specific master graduate, a novice master graduate, and an experienced master graduate, respectively. This provided us with more insight into the actions employed by master graduates at different experience levels and their potential development.

During two successive RPP meetings, the selected statements were grouped into themes in subgroups, and the resulting categorizations were compared. This led to an agreement on three dominant themes: statements related to guiding collaborative inquiry in design teams, statements focused on promoting 'alignment' within the organization, and statements regarding self-care for master graduates.

Within these themes, further differentiation was made regarding the experience levels of the master graduates and the organization in relation to collaborative inquiry. This allowed for the development of a conceptual model (see Consortium Tools for Team Learning, 2022, p. 63) with two opposing poles on a continuum for each theme, serving as an overarching framework for discussing underlying insights.

Further validation, deepening, and synthesis: Third-order analysis

1. Subsequently, the RPP partners connect the results of their research with insights from scientific literature and reflections from a group of critical friends (see Box 4 for the third-order analysis process in our research). This

comparison can lead to the validation, refinement, and adjustments of findings that were formulated based on the empirical data.

2. Themes and underlying statements are now more or less detached from the concrete contexts or situations in which they were collected. Transferability to other contexts can be strengthened by linking an exemplary practical case to a theme or statement.

Box 4: Methodology of the third-order analysis in our research.

The conceptual model and the underlying propositions were presented to a group of critical friends from both practice and academia. They assessed the validity and applicability of the insights for a broader audience, as well as the added value to the existing knowledge base. According to them, the propositions concretely and insightfully outline what master graduates can do to promote collaborative research within their own institutions.

Finally, the RPP connected the obtained insights with findings from other research and documented them in a so-called 'practical book' both describing our research project and findings, and inspiring other professionals with numerous examples of what a master can do in different situations. Each chapter was written by senior-researchers in the RPP and reviewed by the other partners in the RPP for validity and accessibility. As an illustration of the insights, the master graduates selected propositions and/or tools about which they wanted to share their experiences. These experiences were recorded in approximately two-minute podcasts, which were added to the online practical book via links.

Figure 2. Overview of the wallpaper roll method.
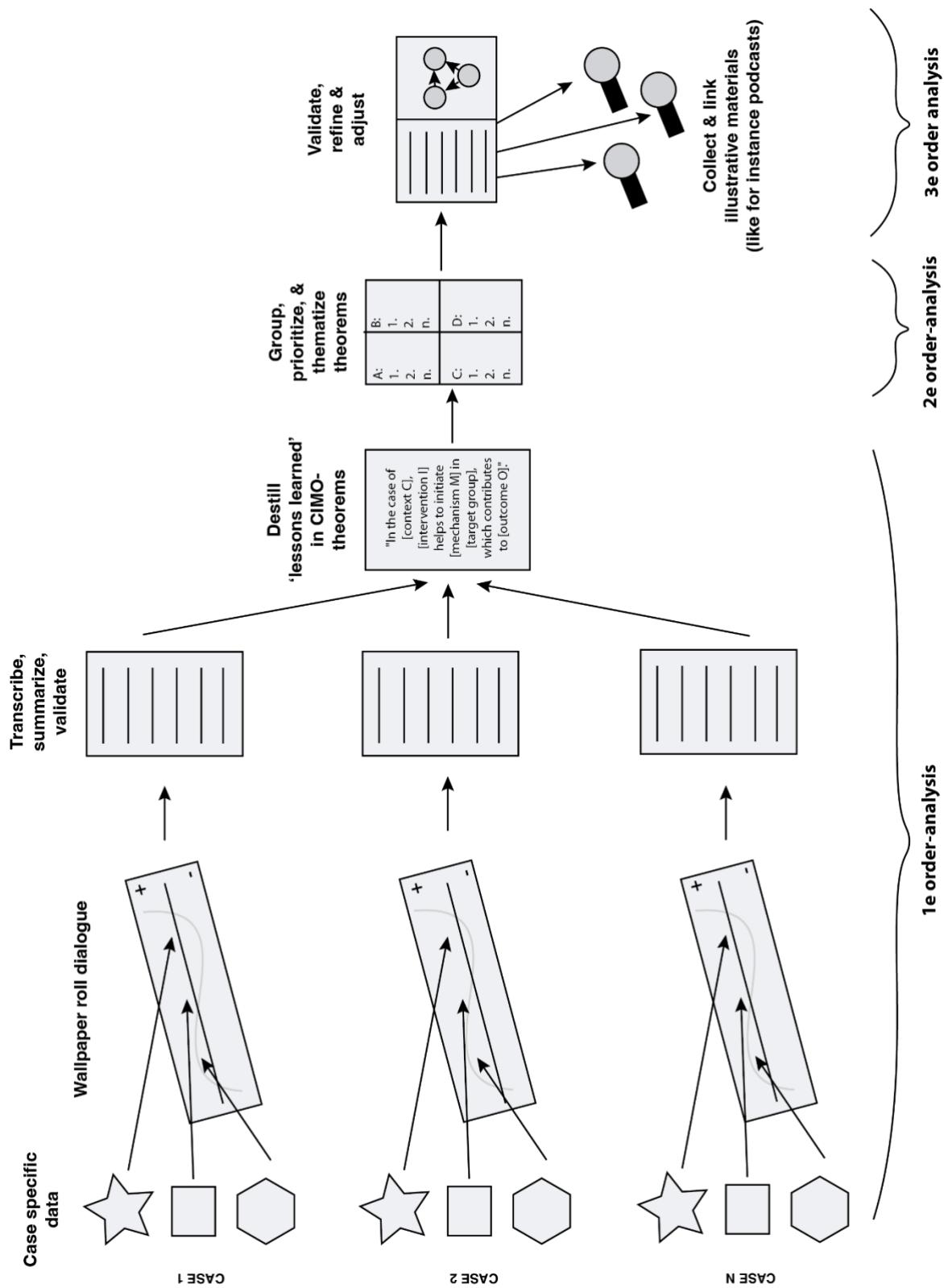
REFLECTION

In the wallpaper roll method, we found a promising way to work with idiosyncratic data in a multiple-case study, addressing both development of included local practices and knowledge. The method provides opportunities to enhance both the professionalization and development of collaborative partners, design groups, and practice contexts, as well as knowledge development (through joint cumulative interpretation of local insights) for a broader audience. Illustrative examples of theorems and tools increase the accessibility of the presented insights.

Other research collaborations that involve participatory and action-oriented research approaches and experience heterogeneous case-specific data can benefit from this method to improve the quality of practice-based research. The method encourages partners to collect data, engage in discussions, share experiences, and learn from each other's knowledge. It offers tools for planning research work, respecting the dynamics of practice, and learning together.

In practice, we experienced the importance of allowing enough space around the timeline to write and draw. This made working with the wallpaper roll a physical experience. Working hands-on with a physical timeline provides focus: you discuss what you see. Due to COVID-19 measures, we sometimes used the wallpaper roll method online, but we definitely preferred physical meetings. Additionally, organizing propositions into subgroups of RPP partners led to productive discussions and negotiations about dominant themes and appealing labels.

For effective use of the wallpaper roll method, partners need to invest in a shared language and understanding of (working on) the RPP-wide practice issue. For example, we found that there were different views on what collaborative research entails. Additionally, not all participants were naturally skilled at identifying and building logical CIMO (Context-Intervention-Mechanism-Outcome) reasoning chains. As a result, some propositions in our research were limited to naming effective interventions, with the context of application and intended concrete outcomes sometimes remaining uncertain. Regular dialogue, sharing relevant literature, or discussing research results and methodologies helped with this.

Intrinsic to PAR and (therefore) also to effective use of the wallpaper roll method is that participants need pedagogical-didactic, agogic, and methodical-systematic research competencies to achieve the multiple goals of PAR. Partners must also be willing and able to work interprofessionally and learn collaboratively through research. This requires not only strong interactive and collective research skills but also mutual trust, openness, and shared authority. While these are important qualities for a collaboration, they are not prerequisites for starting the work together. 'Jumping in' (Van den Berg et al., 2024) offers opportunities for these qualities to develop

through practice, provided sufficient attention is given to support, reflection, and development. The wallpaper roll method certainly provides guidance in this regard.

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COLLABORATIVE RESEARCH IN A CONSORTIUM OF EDUCATIONAL PRACTITIONERS AND RESEARCHERS: REPORT OF A SELF-STUDY ON FUNCTIONING AS A RESEARCH PRACTICE PARTNERSHIP

Niek van den Berg* & Jeroen S. Rozendaal**

* Professor boundary-crossing by educators and researchers, Aeres University of Applied Sciences Wageningen, Mansholtlaan 18, 6708 PA, Wageningen, n.van.den.berg@aeres.nl, ** Professor inquiry-based working in teams, University of Applied Sciences Rotterdam, Museumpark 4, 3015CX, Rotterdam, j.s.rozendaal@hr.nl

ABSTRACT

Consortium Tools voor Teamleren (Tools for Team Learning Consortium), consisting of master graduates in vocational education (mbo) and external educational researchers, has been focusing since 2014 on strengthening the role of master graduates in their schools. The consortium considered itself a Research Practice Partnership (RPP). In RPPs, researchers and practitioners (and possibly other stakeholders) work together in a collective learning process, co-creating effective solutions for a shared practical problem that holds importance and meaning for each of them. This means that RPPs work on both solutions for practical issues and scientific knowledge creation. A key question is how they can best shape the collaboration in this type of research. This article describes the (secondary) research conducted by our consortium on the collaboration in the (primary) research on master's degree holders. After two productive years, consortium members critically reflected on the collaboration in a joint dialogue. This dialogue – fuelled by data previously collected and analysed within the consortium – provides insights into the development of the collaboration and ways to strengthen the collaboration between educational professionals and researchers. The conclusions address challenges in promoting interactivity and developing a common language, a 'jumping in' approach to research, and the tension between practical relevance and methodological rigor. Finally, the recommendations are aimed at participants in other RPPs.

INTRODUCTION

Consortium Tools voor Teamleren (Tools for Team Learning Consortium, shortly referred to as TOOLS), consisting of master graduated teacher leaders (hereafter referred to as master graduates) in vocational education (mbo) and external educational researchers, has been focusing since 2014 on strengthening the role of master graduates (see box). The central primary research question was how the master graduates could better realize their own (teacher leader) role within their teams and organizations, and which conditions and factors might be helpful in their role as facilitators of collaborative inquiry.

BOX. Background for Research on Master Graduates as Facilitators of Collaborative Inquiry in Vocational Education (Primary Research)

> In the Netherlands, teacher training at bachelor's level is often sufficient to teach. Since the introduction of the Teacher Grant in The Netherlands in 2008, new master programs have emerged, and the number of master graduates in education has increased. They form a specific social capital as possible teacher leaders contributing to educational improvement in their schools, by encouraging and guiding colleagues to address practical issues through an inquiry-based approach. However, it often proves challenging to fully realize their potential (Heyma et al., 2017; Sligte & Schenke, 2017; Snoek et al., 2019; Van Kan et al., 2017; Wenner & Campbell, 2017). This is partly because structural collaboration through inquiry-based work on educational quality is still not common practice in many schools (Bouwmans, 2018; Nawijn & Van den Berg, 2020; Teurlings & Hermanussen, 2021).
>
> Master graduates are both dependent on and creators of an inquiry-based learning culture. This requires proactivity in establishing the conditions necessary for their role: recognition, autonomy, scheduled time, resources, and so on. Formal positioning can meet a need (cf. Rozendaal et al., 2019), but it also carries the risk of over-centralization and isolation of the master graduates, which could undermine their potential as brokers between different practices (Akkerman & Bruining, 2016; Hazen et al., 2018; Snoek et al., 2019).
>
> TOOLS, consisting of master graduates in secondary vocational education and external educational researchers, has been focusing since 2014 on strengthening the role of master graduates. Practice-based research into the helpful (and hindering) conditions within and outside the direct work environment of master graduates was funded by the Nationaal Regieorgaan Onderwijsonderzoek (NRO, National Directorate for Educational Research) from 2019 to 2022.

Effective collaboration in practice-based research can be challenging and does not always yield relevant outcomes (e.g., Zuiker et al., 2017). The dual objective of serving both practice and science as in the primary research of TOOLS, is inherent to much practice-based research but is not easy to achieve: practical relevance and methodological rigor can be at odds with each other, presenting dilemmas for those involved (Van den Berg, 2021; Werkgroep Kwaliteit van Praktijkgericht Onderzoek en het Lectoraat, 2017).

(Self-)research into the collaboration within a practice-based research consortium is relevant for two main reasons. Firstly, it helps to monitor the collaboration in the consortium and adjust it where necessary. Secondly, it provides relevant insights for other RPPs and networks around practitioners (Harbers et al., 2019; Heldens, 2017; März et al., 2017; Van den Berg et al., 2021; Van Oeffelt et al., 2021).

This paper (based on Consortium Tools voor Teamleren, 2022 and Van den Berg et al., 2023) focuses on the question of how to collaborate within such a network on practice-based research. To this end, TOOLS conducted self-research into the progress and characteristics of the collaboration in the consortium.

THEORETICAL FRAMEWORK: PRINCIPES FOR COLLABORATION IN RESEARCH PRACTICE PARTNERSHIPS

TOOLS considered itself a Research Practice Partnership (RPP) as described by Coburn and Penuel (2016). In RPPs, researchers and practitioners (and possibly other stakeholders) engage in a collective learning process, co-creating effective solutions for a shared issue that holds importance and meaning for each of them. This means that RPPs work on both solutions for practical issues and the development of scientific knowledge. Solutions developed by RPPs in this manner are more sustainable, scalable, and usable in practice (Coburn & Penuel, 2016).

Equality in collaboration and division of labour: All participants in an RPP influence the collaborative research process and outcome, as co-creation based on equality, reciprocity, openness, and trust. Practitioners and researchers have an equal voice; there is shared authority. However, there is also a division of labour through roles and tasks. In interactive, participatory research as in RPPs, everyone's competencies are needed to collaborate transdisciplinary (Ellström, 2008; Van den Berg, 2016; 2021). Following guidelines for interaction, the partners work intentionally on co-creation, utilizing each other's strengths (Coburn et al., 2013; Coburn & Penuel, 2016; Zuiker et al., 2017). Such strengths could be subject matter knowledge,

pedagogical-didactical and andragogical competencies (the core business of education professionals) and methodological-systematic research competencies (the core business of researchers). Social, project management, and advisory competencies are also necessary (see Teurlings et al., 2011). To ensure the practical relevance of the research, it is advisable to place project leadership within the stakeholder practice (Coburn & Penuel, 2016).

Jumping in: RPP partners learn by doing (cf. Bereiter & Scardamalia, 2014; De Jong, 2019). Therefore, it is advisable not to wait too long before starting to work and learn together through inquiry. Van den Berg (2016) refers to this as 'jumping in': not waiting any longer but beginning somewhere. As Vermaak (2009) puts it, collaborating partners only really get to know a situation or problem by working on it, not by sitting on the sidelines and watching it. The more insights you gain, the more you see (p. 31).

Collective learning: Mutual trust and openness are prerequisites for shared authority, collective learning, and the ability to express and explore one's ideas (Stoll et al., 2006; Zuiker et al., 2017). Trust and openness can grow over time, so it is essential to invest time in creating a community. This allows for addressing and eliminating mutual prejudices and possible feelings of hierarchical differences. It is necessary to exchange perspectives and experiences, negotiate individual opinions, and involve information from (professional) literature (cf. De Jong & Vermeulen, 2022). The collective learning process enabled by this is further enhanced by sharing so-called 'tacit knowledge,' for example, by demonstrating skills to others or by describing experiences and intuitions through narratives, metaphors, or analogies (see Dunbar, 1997, as cited in Bereiter & Scardamalia, 2014; Sprenger et al., 2006).

Working with short-cycle iterative processes (Van den Berg & Kouwenhoven, 2008) and 'evidence-informed' approaches (Van Rossum et al., 2020; Heikkinen et al., 2016) is preferred in an RPP. A typical research approach here is design research (Coburn et al., 2013): exploring issues and developing, testing, and researching solutions within the context of a professional practice. Additionally, an appreciative, participatory, and action-oriented research approach fits well (see Masselink et al., 2021; Migchelbrink, 2016; Van Lieshout et al., 2021). It is crucial to involve all members as actively as possible in all steps of the (research) process; this helps, for example, in embedding the generated knowledge in the work contexts of the practitioners (Harbers et al., 2019; Oolbekkink et al., 2022; Rozendaal et al., 2019). It also helps in transferring knowledge to the scientific community, for example, by presenting preliminary internally validated findings to critical friends from that community. Insights thus emerge through co-creation, as ideas are tested in both practice and science. The joint learning process yields explicit individual and collective outcomes (cf. De Laat & Simons, 2002).

However, collective learning processes are not optimal from the outset; they require growth (Kasl et al., 1997). A 'design mindset' – a continuous awareness of better and/or more sustainable ideas, justifications, and approaches that could prompt redesign or renewed actions – can help appreciate and leverage the diversity and contributions of the different partners (Bereiter & Scardamalia, 2014; De Jong, 2019).

IMPLEMENTATION IN TOOLS: INITIAL DESIGN OF COLLABORATION AS AN RPP

The theoretical insights related to Research Practice Partnerships (RPPs) mentioned above were instrumental in shaping the collaboration between education professionals and researchers within TOOLS during the funded project period from July 2019 to July 2022. Even before this period, the principles of collaborative research within TOOLS, such as shared interests, trust, and openness, along with a certain division of labour, were evident (see Schot et al., 2019). Given the changed composition of the group at the start of the funding period, investments in community-building were anticipated. However, concrete participatory, action-oriented tasks from the project plan were not postponed but initiated immediately, in line with the jumping in approach and the potential of 'learning by doing'.

As a concrete expression of the idea of division of labour, the consortium structure included the roles of master graduates ($n = 6$), intermediate researchers ($n = 3$), senior researchers ($n = 3$), and a project leader (who was also one of the master graduates; see Figure 1). The master graduates would work within their schools with one or more groups of colleagues on a design-based and research-driven approach to a practical issue that was recognized within or across educational teams. They were to be supported by an intermediate researcher. The intermediate researchers had experience in both vocational education and research. Therefore, within the consortium, like the project leader, they were positioned as brokers (Akkerman & Bakker, 2011): connectors, particularly between the master-educated teacher leaders and senior researchers. The primary responsibility of the senior researchers was to lead the comparative case study (primary research) and the self-study of the collaboration within the consortium (secondary research).

FIGURE 1. Organigram of TOOLS
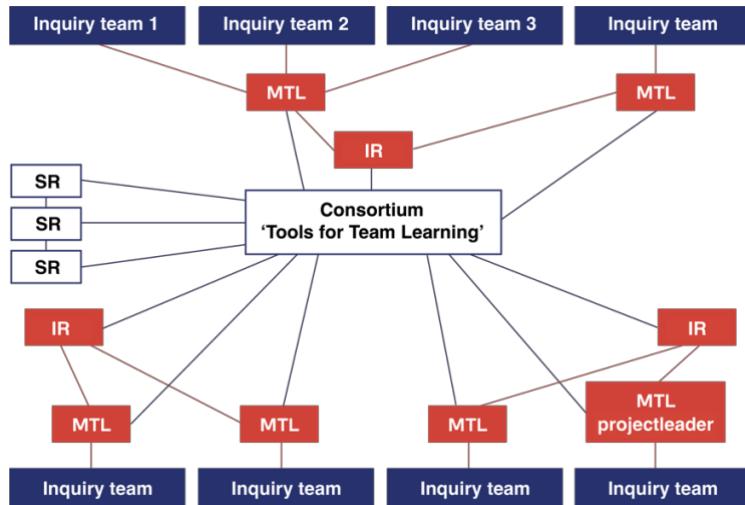
N.b. MTL = Master graduated Teacher Leader ('master graduates' in the text of this paper); IR = intermediate researcher; SR = senior researcher.

Aligned with the philosophy of collaborative research within an RPP, and considering the roles of the consortium members, we conducted an inventory of the participants' expertise, as well as their expectations and desires, before the summer of 2019 using the "Expectations at the Start Questionnaire" (Consortium Tools voor Teamleren, 2022).

The collaboration was structured around bi-monthly consortium meetings, which alternated between the following activities: 1) Peer consultation on the role performance of master graduates within their schools. 2) Comparative case study (primary research) focused on these roles. 3) Collaborative research on the consortium's collaboration and how it could be improved (secondary research).

To ensure the practical relevance of the research, the project leadership was assigned to one of the master graduates. Additionally, the tools and instruments used in the project were designed to support both the role performance of the master graduates and the data collection for the primary and secondary research. The senior researchers were responsible for analysing the data collected locally and - in extension thereof - providing feedback at the local level to inform reflection and potential improvements. They were also tasked with conducting a cross-case analysis at the consortium level to support the primary research.

RESEARCH APPROACH

The actual course of the three-year collaboration on the primary research was reconstructed using the agendas and minutes from various consortium meetings, supplemented by the outcomes of different reflection methods employed by individual members of TOOLS.

Based on these data, a project timeline was created, highlighting significant moments and key events. This timeline also included insights collectively gained by the consortium throughout the project, which impacted the subsequent direction of the collaboration (see also Rozendaal et al., 2024).

Next, the consortium conducted a joint reflective timeline dialogue using the 'wallpaper roll method' (Rozendaal & Van den Berg, 2024), facilitated by an intermediate researcher. This dialogue involved nine out of twelve consortium members (three of the six master graduates, all three intermediate researchers, and all three senior researchers). The dialogue began with a collective review of the timeline, followed by asking the participants how they had experienced the interaction between educational professionals and researchers within the consortium over the three years of the project and what they considered the most significant moments.

The dialogue was recorded, transcribed verbatim, and thematically summarized by one of the senior researchers. The summary and conclusions were then returned to the consortium members for a member check, adjusted based on the feedback, and subsequently finalized.

Finally, the senior researchers compared the research results obtained through this process with the theoretical principles of interactive collaboration as an RPP. Based on this comparison, they drew conclusions and made recommendations on how best to structure and enhance the collaboration between researchers and educational professionals in practice-based educational research.

RESULTS

This section first describes the course of the collaboration, highlighting significant moments, key events, and the insights gained. It then addresses the insights into the collaboration as formulated during the joint reflective dialogue. The term 'we' refers to the consortium members present during this dialogue.

Progress of the first project year

In the first project year (2019/2020), the consortium met six times, initially in person and later online due to COVID-19 measures. Participation was voluntary. The meetings were prepared by the project leader, often together with an intermediate and a senior researcher. Others could also propose agenda items and working methods. Parallel to these meetings, the master graduates worked with their design teams on practical issues such as hybrid learning environments, differentiation, and flexibility. Some of these design teams had been working together for a longer time, while others were newly formed during this project year.

Instrumentation and reference scenario: Senior researchers began developing new or adapting existing research instruments that the master graduates would use at specified times in their practice. One instrument was specifically adapted upon request and in consultation with one of the master graduates and an intermediate researcher. The master graduate wanted a more creative and playful design, leading to the use of insights from Arts-Based Research (e.g. Van Heijst et al., 2019).

During the consortium meetings, discussions were held about the developed instruments and how they could be used in the design teams. A reference scenario was created to provide a rough timeline for the use of the instruments. This scenario was intended to help the master graduates use the instruments and reflect on their benefits for the design teams and the comparative case study. The instruments were also discussed in terms of different research paradigms and best practices for collaborative research. Where possible, preliminary analyses of locally collected data were conducted and fed back to the respective master graduates for reflection and potential adjustments.

Intervision and smaller group meetings: The consortium meetings included time for intervision on guiding collaborative research within the design teams or the role and position of the master graduates in their schools. Critical professional situations in guiding collaborative inquiry were discussed.

In addition to consortium meetings, there were smaller meetings such as discussions between master graduates and their intermediate researchers, between the project leader and others, and between senior researchers. There were also working sessions in various compositions for preparing presentations at conferences.

Tension between practical relevance and methodological rigor: Throughout the first year, the rationale and methodology for using the instruments in the design teams remained a topic of discussion. Questions included why and how the instruments

were used and what to do if the instruments did not fit well with the practice in the design teams. It became clear that synchronous and uniform data collection as described in the reference scenario was not feasible for all design teams. The timing or content of the instruments sometimes disrupted the process in the design teams.

Not all design teams had research-oriented discussions, or the research instruments were not always accessible in terms of language or format. It was agreed that master graduates would use the principle of 'apply or explain': if they did not use the instruments according to the reference scenario, they would document their considerations. It was concluded that the research results needed to be understood and interpreted within their specific practice context. Statistical comparative case analyses were not feasible due to missing data and the context-dependent nature of the data. Consequently, a different approach was sought to compare and interpret the collected data. This led to in-depth conversations with each master graduate at the end of the first project year, referred to as 'wallpaper roll conversations', as we used strips of wallpaper to write and drawn on during the dialogues. On the wallpaper roll, the collected data and developments in the local context were visualized on a timeline and discussed. Each conversation was transcribed, summarized, and approved by the participants.

Progress of the second project year

Preliminary analyses as starting point: In the second project year (2020/2021), the senior researchers formulated a few concise conclusions based on preliminary analyses of data of the first project year:

- There are significant differences among the master graduates concerning their backgrounds, assignments, roles, the composition of their design teams, their contexts, and the extent and forms of collaborative research.
- There are major developments within the six local practices.
- There are substantial differences among consortium members in perspectives on the nature of local and cross-case research and each person's role perceptions.

Narrative descriptions and insights: The experiences of the design teams and master graduates were further illuminated when all consortium members described their experiences in narratives. These stories clarified individual development and demonstrated that personal skills or insights could be explained to others using metaphors or analogies (see Dunbar, 1997 cited in Bereiter & Scardamalia, 2014; Sprenger et al., 2006).

Common language: During the consortium meetings on the conclusions based on the wallpaper roll conversations, we realized that the focus was on the collaborative research process (within design teams and the consortium) rather than the specific substantive questions within the design teams. We recognized that investing in

commonality and mutual dependence was crucial, as these are important principles for an RPP and a good team (Coburn & Penuel, 2016; Teurlings & Hermanussen, 2021). Consequently, two intermediate researchers and the three senior researchers revisited the literature on design and participatory action research and the research plan. They distilled eight elements of collaborative research, articulated in terms of their meaning for the design teams. In two consortium meetings, we discussed the recognizability, applicability, and effectiveness of these elements and their implications for the role of the master graduates in the design teams.

Balancing practical relevance and methodological rigor: The experiences led to a re-evaluation of research instruments and the principle of 'apply or explain'. The master graduates sought more freedom in handling the instruments. It was concluded that a better approach would be 'choose and explain': allowing master graduates to select a suitable instrument and moment in their context and explain their choice. This approach ensures that the instrument serves the design team and/or master graduate effectively. It was also observed that translating or adapting the research instrument to the specific context of the design team or making it more practical could be beneficial.

Sustainability and broader application: In the second project year, we also discussed how to sustain and broaden the impact of our research results and insights. Most master graduates realized that their personal developments could be applied in other design teams or settings. We aimed to work towards sustainable solutions with broader applicability. At the end of the second project year, we conducted and documented six more wallpaper roll conversations about working with the design teams during that year.

Progress of the third project year

In the third project year (2021/2022), the focus of the primary research was on analysing research results collected across the six local practices over the two project years.

We distilled at least three statements from the case summaries for each master graduate per project year. These statements were about significant interventions undertaken that led or would have led to specific effects within a certain context. This process resulted in a list of a total of 66 statements.

We then collectively discussed, interpreted, prioritized, and clustered these statements. This formed the basis for a collaborative dialogue on research collaboration and the role that master graduates could play in it.

Based on this joint analysis of the statements, we concluded that it is essential for master graduates to not only promote and guide collaborative research within the design team, but also to work on alignment and self-care. These three overarching themes structured the outcomes of the primary research and, together with initial

insights from the secondary research, led to the collaboratively written book for both other practitioners and other researchers: *"Samen onderzoekend werken in het mbo"* on collaborative inquiry in secondary vocational education (Consortium Tools voor Teamleren, 2022).

Outomes of the joint reflective dialogue on collaboration

For the secondary research, a joint reflective dialogue was held in the third year based on the timeline during a consortium meeting. Four themes emerged that characterized the collaboration among consortium members.

Mutual trust and shared authority: The consortium partners concluded that the consortium increasingly functioned as a safe space where members could openly and honestly discuss their challenges and learn from each other. Two key elements contributed to this. The reflective sessions allowed members to discuss critical professional situations related to guiding collaborative research, alignment, and self-care. The construction involving three levels – master graduates, intermediate researchers, and senior researchers – enhanced the sense of safety and trust. The master graduates particularly valued the intervision sessions for the opportunity to address and reflect on their experiences with the guiding and senior researchers. Intervision was regarded as part of self-care and a crucial source of professional learning.

> **Master Graduate:** "Through our intervision sessions here, the critical questions posed make you reflect on 'What am I doing now?' and how could I do it differently next time?"

The master graduates noted that discussions with intermediate researchers significantly contributed to their role development in practice. The intermediate researchers asked critical questions and helped the master graduates view their situations from different perspectives. Additionally, intermediate researchers facilitated connections between local practices and the comparative research on those practices, which, according to the master graduates, strengthened the collaborative research work within the design groups.

> **Master Graduate:** "You need someone who is not in the practice but can see parallels or differences in that practice and gives you an encouraging word."

> **Intermediate Researcher:** "The strength lies in the connection between the research that needs to be done and the struggles of the master graduate. How can we conduct that research and also do justice to the practice?"

Intermediate researchers also acted as a bridge between master graduates and senior researchers. Consortium partners concluded that this arrangement, on one hand, prevented senior researchers from being overwhelmed but, on the other hand, increased the distance between senior researchers and master graduates. This potential gap was often bridged during consortium meetings, annual concluding wallpaper roll conversations, and at other times.

> **Intermediate Researcher:** "You see that the wallpaper roll conversations were also a very important moment for senior researchers to understand what happens in the practice. On the one hand, we were brokers, but on the other hand, we were also brokers as a buffer between senior researchers and the master graduates."

The interactions with senior researchers during the wallpaper roll conversations provided master graduates with more insight into their own actions in relation to collaborative research within the design group. Conversely, interactions with master graduates during consortium meetings and wallpaper roll conversations gave senior researchers greater insight into the role of master graduates in the design groups and the tension between practical relevance and methodological approaches in the primary research.

Collaborative research as RPP: The common theme among consortium members was collaborative research, which encompassed both working in design groups (the focus of primary research) and within the consortium as an RPP (the focus of secondary research). Consortium partners concluded that each member grew in knowledge and skill in this area, not so much in research skills in general, but particularly in how to engage others as effectively as possible in collaborative research.

> **Master educated teacher leader:** "On the one hand, the knowledge you need to drive collaborative research, and on the other hand, the ways to [moderate, entice, control versus relinquish], and the use of expertise in roles, such as [subject] expert, process facilitator, team leader."

Initially, the interaction and secondary research within the RPP did not fully capture the attention of all consortium members. As the need for cohesion became more

apparent – e.g., when it became noticeable that RPP members had differing views on appropriate research and project objectives – interest in this topic grew.

According to consortium partners, there was a noticeable improvement in the interaction between practitioners and researchers throughout the project. Important insights were gained even before the three project years began, as TOOLS had already met voluntarily and out of substantive interest. At the start of the grant period, changes in composition due to the selection of master graduates and design groups meant that consortium members differed more than in previous years in their understanding of the project's intentions, principles, and approaches.

True to the project plan, the consortium began with a jumping in approach and learning by doing. In this approach, some partners needed more time to fully integrate. By the beginning of the second project year, we observed significant variability in how collaborative research was interpreted. This led two intermediate researchers and three senior researchers to delve deeper into literature on design-based and participatory action research. Combined with their project experiences, this resulted in an instrument with eight pillars for collaborative research (Consortium Tools voor Teamleren, 2022), which the master graduates could use in their design groups. Consortium members found this approach more valuable than, for instance, a plenary presentation of the literature by a senior researcher.

> **Senior Researcher:** "[That was for me] a starting point to better understand that you are engaged in reciprocal meaning-making and that you need to invest time in it... really a starting point to work more interactively with each other."

Collaboration through task distribution: At the outset of the research project, consortium partners adhered to their initial roles. Master graduates organized their local design groups, while senior researchers designed research instruments and handled data analysis. Over the course of the project, master graduates found more (mental) space to also act as contributors in the comparative research of their local practices. Significant in breaking through the initial role separation were moments of interactive collaboration between researchers and practioners. This included writing the research plan, developing a common language on collaborative research, designing research instruments at the request of master graduates, preparing conference presentations, writing articles, and collaboratively analysing and interpreting insights that consortium partners wanted to share with the outside world.

> **Master educated teacher leader:** "I think I was primarily a sort of consumer... But as things progressed, I started to realize, yes, I am also participating in this research."

The tension between practical relevance and methodological rigor in co-creation:
Sometimes there is a tug-of-war between relevance and rigor. This was particularly evident in the design and application of research instruments (developed by senior researchers) that needed to serve both practice and research purposes. Bundling local data was supposed to enable case-comparative analyses within the primary research. Some level of synchronicity and uniformity in local data collection was expected according to the reference scenario, but in practice, this proved unfeasible because the timing and/or content of the instruments often disrupted the process in the design groups according to the master graduates. As the project progressed, the strategy shifted from the 'apply as instructed' rule (according to the reference scenario) to the 'apply or explain' rule (when deviating from the reference scenario, explain why), and eventually to a 'choose and explain' rule.

> **Senior Researcher:** "You can only start using and benefiting from these instruments when they have a function in your view of what you, as a master graduate, are supposed to do. And if you don't see that... or if you can't use it because your context doesn't allow, you can create all the instruments you want, but they are of no use."

CONCLUSIONS

The consortium served as a crucial external network for master graduates, providing support in initiating and guiding collaborative research. The collaboration within the consortium served as an example for the master graduates on how to shape collaboration in their own design groups. The consortium also acted as a sounding board where they could discuss challenges and dilemmas in their roles as master graduates in their schools. Additionally, the consortium provided all partners with increased knowledge and skills in facilitating research-oriented work and collaboration within design groups. Despite some necessary 'hiccups', the interactivity between master graduates, intermediate researchers, and senior researchers increased throughout the project period. However, there were also challenges in the collaboration. In response to the main question in this paper, we cluster the discussion on these challenges under the headings of interactivity and co-creation, common language, the jumping in approach, and research quality. We conclude with a set of recommendations for consortia.

Interactivity and co-creation: In interactive consortia additional efforts are required to achieve interactivity, especially when some partners are new. A preparatory phase is necessary to get to know each other and to clarify and align mutual understandings of the project's intentions and approach.

Interactivity in a consortium particularly grows when partners work together on boundary objects (Bronkhorst et al., 2019) that have meaning in both practice and research. Examples of these boundary objects in our project include the shared issue, the research plan, a common language, the annual in-depth interviews, the instrument with eight elements of collaborative research, conference presentations, the dialogue in the third project year about 'what do you want others to know about effective interventions by master graduates?' and the final report in a book intended both for practioners and researchers.

When working on boundary objects, attention is needed to distinguish and connect local and collective ambitions. For instance, when a consortium wants instruments to be meaningful in both contexts, this ambition cannot be realized easily. Collective meaning-making and efforts are always essential. For example, the pedagogical competencies of practitioners can help in making research instruments more usable in practice. Similarly, competencies in methodological-systematic work and theoretical insights from researchers in a consortium can support co-creation.

Common language: Initially, brokers – such as the intermediate researchers and the project leader/master graduates in our consortium – play a crucial role in developing and advancing a common language and methodology. By addressing these topics, we can better understand the dynamics of consortium collaboration and how to navigate and enhance these processes effectively. However, they cannot succeed without active brokerage and development of a common language among the other project partners; ideally, everyone should be or become a broker. Working on boundary objects requires active attention to determine what is most appropriate at each moment. This is important not only during the preparation and start but throughout the entire collaboration. It is crucial to continuously determine what level of interactivity is desirable and possible, regularly evaluate and reflect, and adjust activities where necessary. There are likely multiple paths to achieving successful outcomes, but achieving shared, overarching, and transferable conclusions is of great importance, especially in the final phase.

Jumping in-approach: In the project, a tension emerged between the chosen jumping in-approach (Van den Berg, 2016) and the need to better understand each other and align views, intentions, and methods before engaging in substantive project activities. Efforts are needed to develop a shared understanding of the focus and a more deeply shared ambition of the consortium. Additionally, there are efforts required to connect this vision and ambition with practical experiences. The interpretative approach within the primary research appeared to fit better for this project, as it is essential to consider the meanings partners attribute to their daily practical experiences.

In fact, these meanings were necessary to interpret the diverse data from the cases. The question arises whether a slower start could have been beneficial without simultaneously diving into content. The practical experiences of the master graduates enabled the consortium to engage in meaningful dialogues throughout the project. The dialogue based on the experiences and dilemmas of the master graduates contributed to the development of a common language, which itself becomes a boundary object. As Coburn et al. (2013) emphasize, it is crucial to engage in dialogue, with ongoing attention to clarifying the language and views of participants, with the goal of achieving consensus. The resulting shared and validated insights allow for critical reflection on one's own practice and further development. Although jumping in may not always be successful, particularly in the absence of skills and guidance, it is clear that learning by doing (Bereiter & Scardamalia, 2014) can be powerful.

In summary, the combination of a jumping in approach, gaining practical experience, and having a robust dialogue among participants can establish new boundary practices between practice and research (Ellström, 2008; Van den Berg, 2016).

Research quality: Initially, our approach to data collection and analysis did not adequately address both practical relevance and methodological rigor. It became clear that it was not feasible to collect data in schools according to a uniform and fixed scheme, and then statistically aggregate and analyse it. After incorporating more flexibility for the master's graduates, we decided to consolidate locally collected data at the local level into a timeline and accompanying dialogue, and to interpret it collectively within that context. By distilling, selecting, and thematizing statements from this process, we arrived at statements with broader relevance. This more interpretative approach not only addressed the need for (joint) meaning-making but was also expected to better meet both practical relevance and methodological rigor.

An ethical consideration is that practice based research in a consortium presupposes collaboration and involves dialogue between researchers and practitioners about the practice and the research into it. The book we produced illustrates that this approach is effective. The book serves in two ways: First, it reports on our research approach and findings within the work practices of the master graduates and the consortium as a whole (collective process). Second, it provides other master graduates and collaborative partnerships with examples of what they can consider and implement in specific situations in their work practices to achieve (even) better outcomes (collective results).

RECOMMENDATIONS FOR COLLABORATION IN AN RPP BASED ON THEORY AND TOOLS EXPERIENCES

The following recommendations stem from the secondary self-study on collaboration within TOOLS. These recommendations integrate reflections from three rich project years with theoretical insights into RPPs. They are aimed at practitioners and researchers working together on a shared issue within an RPP. The recommendations are relevant to all involved, regardless of their specific role, though some may find certain recommendations particularly pertinent.

1. **Seek a complex joint issue**: Choose an issue that has both practical and scientific relevance. This ensures that the collaboration is meaningful for all parties involved and that the results are valuable for both practice and science.
2. **Ensure practitioners lead the project**: Make sure that practitioners in the RPP take the lead in the project to maintain a focus on practical relevance and ensure that the outcomes are directly applicable to practice.
3. **Take time to get to know each other**: Invest time in both formal and informal interactions. However, do not delay starting substantive work to ensure that a solid foundation is laid before diving into the content.
4. **Regularly define roles and expertise**: Regularly discuss and decide who will take on which roles and what expertise each person will bring to the collaboration. This avoids confusion and ensures that everyone can leverage their strengths.
5. **Identify brokers**: Consider who within the consortium can and wants to act as brokers between practice and research. This is crucial for connecting different perspectives and facilitating effective collaboration.
6. **Act as equal partners**: Regardless of your role, engage as equal partners. Be actively involved in co-creating meaning through dialogue, for instance, by sharing key publications and research data. Allocate sufficient time for these processes.
7. **Focus on co-creating, interpretive research**: Emphasize a co-creative and interpretive approach to strengthen interaction between partners and derive insights that are relevant beyond individual cases. This approach is particularly useful when locally collected research data is rich but difficult to compare across contexts.

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