


Controlled before-after study to evaluate change in evidence-based practice of speech and language therapy students

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Abstract

Background: The integration of evidence-based practice (EBP) into speech and language therapy (SLT) curricula has been increasingly encouraged in recent years.

Objectives: The study aimed to evaluate whether an educational module on EBP for undergraduate SLT students can improve their EBP competencies.

Methods: The EBP module, taught by a SLT faculty member and a librarian, was delivered over 2 months. All fourth year SLT students (trained group) and all fourth year psychology students (control group) of the University of Liège (Belgium) were asked to participate in the study. Their performance on an adapted Fresno test was measured before and after the module. In addition, the SLT students took a computer-based searching task. They were also asked to share their perceptions towards the module.

Results: All the 47 SLT students and 57/108 psychology students took the pre- and post-tests. Although both groups performed similarly at the baseline, only the trained students gained new skills and knowledge. Furthermore, 36 SLT students shared their perceptions on the module and offered suggestions on ways to improve it.

Discussion-Conclusion: Trained students improved their EBP competencies. Nevertheless, the module could be strengthened along with better integration of EBP into clinical modules and across the curriculum.

Keywords: education, graduate; Europe, western; evidence-based practice (EBP); learning; teaching

Key Messages

- Students should be trained in order to acquire knowledge and skills related to evidence-based practice (EBP).
- Knowledge and skills regarding the first three steps of EBP can be improved when speech and language therapy students participate in a brief EBP module, combining theory and practice.
- Integrating EBP throughout the curriculum is recommended to train students to make evidence-based clinical decisions.
- Future research should focus on the best way to integrate EBP in clinical modules and throughout the curriculum.

Background

Evidence-based practice (EBP) is advised in the health sciences, including in speech and language therapy (SLT) (Roddam & Skeat, 2012; Schlosser

& Raghavendra, 2004). EBP integrates the best research evidence with clinical expertise, patient values and circumstances (Straus, Glasziou, Richardson & Haynes, 2011). The EBP process comprises five steps: (i) asking a question, (ii) searching for evidence, (iii) critically appraising the evidence, (iv) applying the evidence to a specific patient, and (v) assessing the value added by the EBP process (Straus et al., 2011). There are

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many recommendations in the literature about how to practice as an evidence-based SLT (Dollaghan, 2007; Schlosser, Koul & Costello, 2007). Nevertheless, practitioners perceive barriers to the implementation of EBP, such as the nature of research evidence (i.e. inconsistencies in the outcomes of research studies, absence of evidence, reduced clinical applicability) (McCurtin & Roddam, 2012), as well as the lack of time and the lack of skills (Stephens & Upton, 2012). One way to improve the engagement of speech and language therapists with EBP is to give more consideration to it in their initial education.

The integration of EBP into SLT curricula has been increasingly discussed in recent years. Papers have outlined how to implement EBP into a curriculum (Klee, Stringer & Howard, 2009) or investigated the perceptions of either academic and clinical education staff (Togher et al., 2011) or undergraduate students (Cobus-Kuo & Waller, 2016) about EBP education. Instructional methods have also been described, such as problem-based learning (Raghavendra, 2009), case-based learning (McCabe, Purcell, Baker, Madill & Trembath, 2009) or the use of the systematic review process as a learning tool (Proly & Murza, 2009). Other papers have reported the assessment of a single-session intervention using a pre- and post-test design (Grillo, Koenig, Gunter & Kim, 2015), or have investigated the link between EBP competencies and EBP self-efficacy and task value (Spek, Wieringa-de Waard, Lucas & van Dijk, 2013). The most effective methods for teaching each step of the EBP process should be fostered (Dawes et al., 2005). A recent systematic review in the health care field highlights that teaching and learning strategies should focus on implementing multifaceted, clinically integrated approaches with assessment (Young, Rohwer, Volmink & Clarke, 2014). Additionally, learning from other fields may be interesting, given the interdisciplinary nature of SLT (Schlosser & Sigafos, 2009). However, variability in EBP education and heterogeneity in reporting the interventions are two methodological issues that have been raised in this area (Phillips et al., 2014). Due to the limited evidence regarding teaching strategies and learning outcomes, conducting studies on this topic remains essential in order to identify best practices (Dizon,

Grimmer-Somers & Kumar, 2012; Young et al., 2014).

Objectives

The study aimed to evaluate whether an EBP educational module for undergraduate SLT students can improve their EBP competencies. The main objective of this study was to assess the change in knowledge and skills, relating to the first three steps of EBP (i.e. asking a question, searching for evidence and appraising the evidence), when SLT students participated in an EBP educational module. Their performances were compared to those of control students not doing the module. The second objective was to obtain the SLT students' perceptions towards the EBP educational module, as a way of collecting feedback that can help to refine and improve the module.

Methods

Several pieces were implemented to achieve both objectives. The methodological design is presented in Figure 1.

Settings, participants and study design

The Faculty of Psychology, Speech Therapy, and Education of the University of Liège – a public university in the French Community of Belgium – offers a 5 year SLT curriculum. During the three-first years, students undertake mainly theoretical courses (such as in biomedical sciences, psychology, speech therapy) and courses in research methodology (such as statistics, information literacy [IL]). Clinical training is emphasised during the last 2 years. In this context, an educational module focusing on EBP was planned for fourth year SLT students.

For this study, a pre- and post-test study design was used to assess the change in students' EBP knowledge and skills. In addition, a questionnaire examined the perceptions of the trained group towards the educational module. The SLT faculty of the EBP module approached the students and explained the aim of the study. She invited them to participate and announced the dates to take the pre-test and the post-test. Before beginning the pre-test,

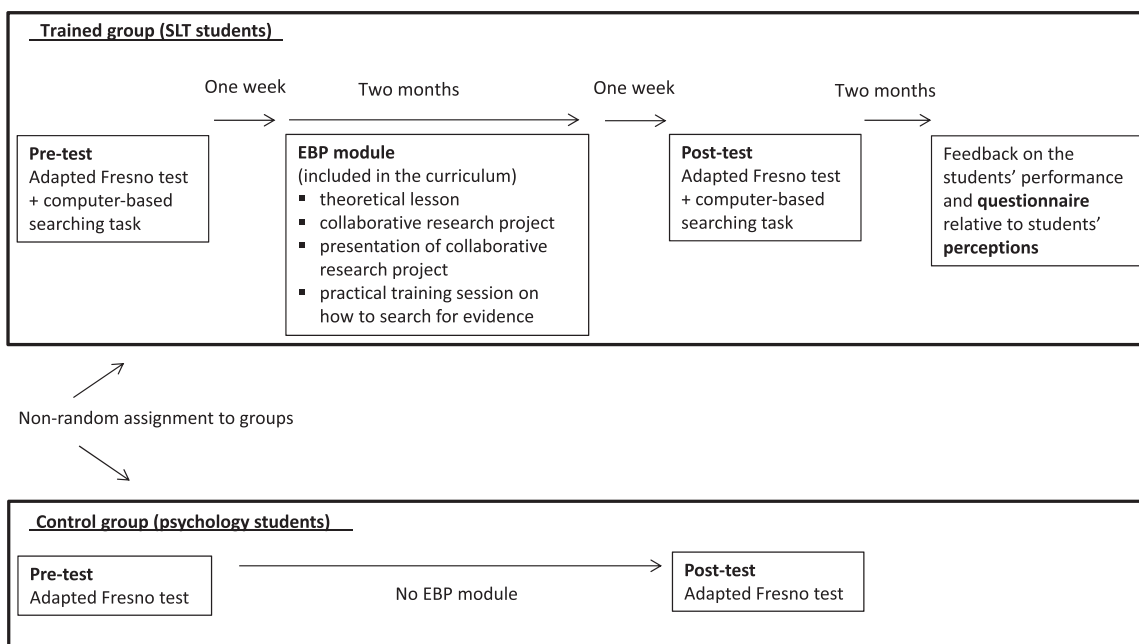


Figure 1 Visual timeline of the methodological design

students were again informed about the study and their participation.

The Faculty of Psychology, Speech Therapy, and Education of the University of Liège also offers a 5 year curriculum in psychology. As with the SLT curriculum, the first 3 years are devoted to theoretical and methodological courses and the last years mainly focus on clinical training. Students in psychology shared several courses with the SLT students but not the educational module on EBP. Therefore, fourth year students in psychology were used as a control group. Their knowledge and skills in EBP were assessed during the same period as those of the SLT students. The teacher-librarian of the EBP module approached the psychology students in one of their courses, with the agreement of the psychology teacher of the course. The teacher-librarian informed the students about the study and invited them to take the pre-test. They were invited to take the post-test during another lesson of this course, about 2 months later.

Ethics and consent

The study received ethics approval from the Ethics Committee of the Medical School of the University of Liège (reference: B707201213509). All the students

received both oral and written information about the study, and were informed that the participation was voluntary and would not affect their grades. Students were asked to sign an informed consent form, written in a language that students were comfortable in.

Educational module

The educational module intended for the trained group was developed and taught by a faculty member of the Department of Speech and Language Therapy and a librarian who had a Master's degree in psychology and who taught the IL course in the second year of the curriculum. The teacher-librarian had previously participated in a workshop on teaching EBP organised by the Oxford Centre for Evidence-Based Medicine. Together both teachers designed the EBP module inspired by an EBP module taught for several years in the Faculty of Medicine at the University of Liège. The module was adapted to SLT, according to the requirements of the SLT curriculum and with the support of a colleague who taught the EBP module in medicine.

The learning objectives of the module were that students would be able to (i) formulate an answerable question, (ii) search for relevant studies in a bibliographic database (e.g. PsycINFO® or

MEDLINE[®] on the Ovid[®] platform) and (iii) evaluate and present a clinical study.

The module was delivered over 2 months and consisted of four parts: (i) a theoretical lesson, (ii) a collaborative research project, (iii) presentation of the collaborative research project, followed by feedback from the teachers, and (iv) practical training that reviewed the skills to searching the literature, followed by a test to assess student learning at the individual level. All students were asked to attend all parts of the module.

The two hour theoretical lesson provided (i) an introduction to EBP, including the levels of evidence and EBP resources, (ii) a review of IL delivered during the second year of the curriculum, and (iii) a brief explanation of a set of criteria useful for the interpretation and the appraisal of published papers. After this first part of the module, students would be able to explain in a theoretical way the EBP process and more specifically how to perform the first three steps.

Then, SLT students had 6 weeks to prepare a research project in groups of about six. Students formed their own groups. They were asked to (i) write a clinical scenario that was of interest to them, (ii) formulate a clinical question, (iii) search for evidence in a bibliographic database (PsycINFO[®] or MEDLINE[®] on the Ovid[®] platform) and select three relevant papers, (iv) summarise and evaluate one of these papers and (v) argue for or against a specific intervention. They received written guidelines providing detailed instructions for the preparation of this work (objectives of the work, structure of the oral presentation, some tips for making slides). During these 6 weeks, students could share their issues regarding this work through an online discussion forum moderated by the teachers.

At the end of this stage, students presented a 20 minutes talk on the results of their collaborative research project, followed by a 10 minutes discussion with the teachers. The teachers graded each project according to a predefined evaluation grid that focused on the quality of the delivered content and oral presentation. All students belonging to the same group received the same mark. At the end of this section of the module, students were to be able to perform the three-first EBP steps for a clinical case and to communicate the results of their work.

Finally, 1 week later, a two hour practical training session on how to search for evidence in PsycINFO[®] or MEDLINE[®] was offered. This part of the module also included exercises about the selection of relevant papers, the access to these papers and knowledge of other EBP resources. Each student received direct help and feedback from the teachers. The last 15–30 minutes were devoted to a test assessing what students had learned (i.e. questions about the search strategy in PsycINFO[®] and the access to the papers). This last part of the module aimed to consolidate the acquired individual knowledge and skills relative to searching for literature.

Measures of knowledge and skills

Trained group. Two tests were used 1 week before and 1 week after the educational module in order to measure changes in skills and knowledge related to the three-first steps of EBP: an adapted Fresno test and a computer-based searching task requiring a search in PsycINFO[®].

The original Fresno test is a tool developed to assess EBP competencies. It was first validated with English speaking medical students (Ramos, Schafer & Tracz, 2003) and then adapted for students in other fields (Crabtree, Justiss & Swinehart, 2012; Spek, de Wolf, van Dijk & Lucas, 2012). The original Fresno test, composed of two clinical scenarios in medicine and 12 items (Ramos et al., 2003), was modified for the purpose of this study. The adapted questionnaire was in French, based on two new clinical scenarios relevant to SLT (Appendix 1) and included the first seven items (focused on three-first steps of EBP) of the original Fresno test: (i) asking a well-structured clinical question, (ii) listing the EBP resources, (iii) specifying the best study design to answer a clinical question, (iv) explaining how to perform an efficient literature search in a bibliographic database and appraisal criteria for published studies regarding, (v) the relevance, (vi) the internal validity and (vii) the magnitude and significance of an effect. The last five items of the original Fresno test concerning diagnosis and complex statistical calculations were excluded because the educational module did not focus on these topics. The pre-test and the post-test were

exactly the same, except the clinical scenarios. The ones used in the post-test had the same level of complexity but were different to those used in the pre-test (Appendix 1). Students were asked to write their name on the tests to compare their performances before and after the module.

The students' responses were graded using the recommended standardised evaluation criteria of the original Fresno test (Ramos et al., 2003). First, both teachers graded a number of questionnaires together. Then, they independently graded the same set of 20 other questionnaires. Finally, they compared and discussed their evaluation. At the end of this process, only the teacher-librarian graded all the questionnaires, being confident in the reliability of the grading system. The total possible score was 168 (24 points per item).

In addition to the adapted Fresno test, the trained students were given a computer-based searching task in PsycINFO[®] to find relevant literature about one of the two scenarios proposed in the adapted Fresno test. The search strategy of each student was evaluated according to the following criteria: (i) the choice of terms (use of the thesaurus, relevant keywords, and synonyms), (ii) the correct use of Boolean operators and (iii) the application of limits relative to the study design.

Control group. The performances of the control group were measured during the same period as those of the trained group, through an adapted Fresno test. The control group received the same adapted Fresno test as the SLT students, except the scenarios were related to psychology rather than SLT (two for the pre-test and two others for the post-test, similar in complexity; Appendix 2). These scenarios were written with the support of a psychology faculty member. Similar to the SLT students, students in psychology were asked to write their name on the tests. Due to technical and time constraints, the control group did not take the computer-based searching task.

Perceptions of the trained group towards the educational module

Two weeks after the post-test, one hour was devoted to the EBP module during another course held by both the SLT teacher and the teacher-librarian. It

gave the teachers access to the students in a different context. The trained students received feedback on their performance in the EBP module. The students who attended this course were also invited to share their perceptions of the educational module and their learning through a questionnaire, tailored to the study's purpose with the support of a specialist in educational sciences. They were asked to indicate their level of agreement with 20 statements, using a four-point Likert scale, from 'strongly disagree' to 'strongly agree' (see Table 4). Students also had the opportunity to make any comments they had at the end of the questionnaire ('Would you like to make any other comments on the educational module, the assessment...?').

Data analyses

Results on the adapted Fresno test were expressed as means \pm standard deviations (SDs) for normally distributed quantitative variables. The normality of the quantitative variables was investigated graphically using a histogram and assessed using the Shapiro-Wilk hypothesis test. All quantitative variables considered in this article met the normality assumption. Mean scores between the pre- and the post-test were compared by the paired Student *t*-test, while the unpaired Student *t*-test was used to compare mean scores between both groups of students. The McNemar test was used to compare the proportions of the evaluation criteria of the search strategies in PsycINFO[®] between the pre- and the post-test (computer-based searching tasks). All the results were considered to be significant at the 5% critical level ($P < 0.05$). Statistical analyses were carried out using Statistica 10 (StatSoft France, Paris, France). Results on the questionnaire about the perceptions of the trained group were expressed as count and percentage. The qualitative data of the comments section of the questionnaire were grouped, and themes were identified.

Results

Figure 2 illustrates the flow of participants through the study. All 47 fourth year SLT students (trained group) completed the pre- and post-tests. Thirty-six participated in the course held by both

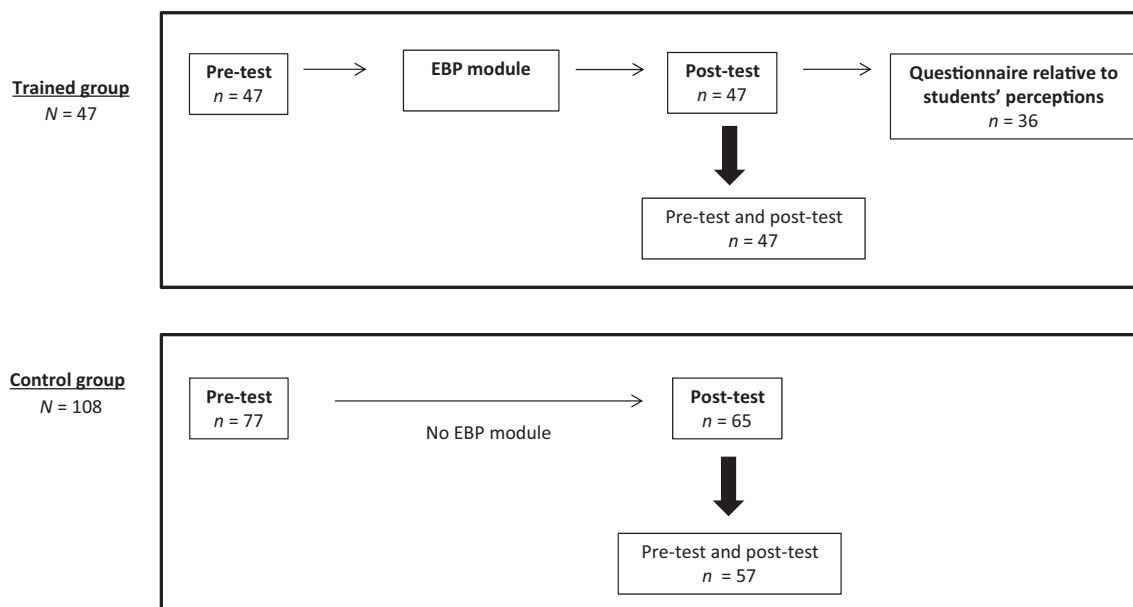


Figure 2 Flow chart of the participants through the study

the SLT teacher and the teacher-librarian 2 weeks after the end of the EBP module and answered the questionnaire regarding their perceptions about the educational module. Seventy-seven out of the 108 fourth year students in psychology (control group) completed the pre-test and 65 out of them completed the post-test. After having collected the questionnaires, it was found that 57 students completed both pre- and post-tests.

Most of these students had attended the IL course during the second year of their curriculum (40 students in the trained group and 47 in the control group). The students who did not attend this course had belonged to another institution previously.

Performances measured using adapted Fresno tests: comparison of pre-test and post-test scores (trained group and control group)

The results of the trained and control groups are presented in Table 1.

Both groups were found to be similar at baseline in terms of knowledge and skills measured using the adapted Fresno tests: the mean total score of the trained group (53.97 ± 14.43) was not statistically different ($P = 0.32$) from the mean total score of the control group (50.87 ± 16.68) at the pre-test.

The mean total score of the trained group was significantly higher ($P < 0.0001$) at the post-test (82.06 ± 16.36) compared to the pre-test (53.97 ± 14.43). Progress was observed on all items, except for relevance and internal validity of a paper.

The mean total score and the score obtained on each item by the control group at the post-test were not statistically different from the scores obtained on the pre-test.

As it was identified that several students in both groups had not attended the IL course during the second year of their curriculum, it seemed interesting to determine if this heterogeneity influenced the results. Therefore, for each subgroup, the means of the total score for the pre-test and for the post-test were compared (Table 2). Both subgroups of students in the trained group increased their performances: from 55.6 ± 14.5 to 83.3 ± 16.4 ($P < 0.0001$) for the students who participated in the IL course, and from 45.0 ± 11.0 to 75.1 ± 15.2 ($P = 0.0003$) for the students who had not participated in the IL course; it should be noted that the performance of both groups at pre-test did not significantly differ ($P = 0.07$). On the contrary, neither of the subgroups of students in the control group improved their performance.

Table 1 Performances of the trained and control groups on the adapted Fresno tests at pre-test and post-test

Questions	Trained group (n = 47)				Control group (n = 57)			
	Pre-test (mean ± SD)	Post-test (mean ± SD)	Difference (mean ± SD)	P-value	Pre-test (mean ± SD)	Post-test (mean ± SD)	Difference (mean ± SD)	P-value
Item 1: question formulation	7.49 ± 5.23	14.28 ± 3.80	6.79 ± 6.14	<0.0001	8.72 ± 5.51	9.72 ± 4.70	1.00 ± 6.21	0.229
Item 2: information sources	11.20 ± 5.46	13.74 ± 5.42	2.55 ± 5.95	0.005	8.77 ± 5.10	8.91 ± 5.32	0.14 ± 4.31	0.807
Item 3: study design	2.55 ± 3.31	10.98 ± 5.46	8.43 ± 5.96	<0.0001	4.00 ± 4.06	4.47 ± 4.17	0.47 ± 5.22	0.496
Item 4: search strategy	10.15 ± 5.16	18.70 ± 3.80	8.55 ± 6.19	<0.0001	9.88 ± 5.52	10.00 ± 4.97	0.12 ± 3.91	0.813
Item 5: relevance of a paper	7.17 ± 7.07	5.04 ± 5.72	-2.13 ± 7.48	0.057	4.46 ± 5.27	5.35 ± 3.60	0.89 ± 5.96	0.261
Item 6: internal validity of a paper	12.91 ± 6.50	15.11 ± 6.65	2.19 ± 8.09	0.070	12.77 ± 7.11	13.35 ± 6.53	0.579 ± 7.10	0.541
Item 7: magnitude and significance of an effect reported in a paper	2.51 ± 3.01	4.21 ± 3.92	1.70 ± 3.72	0.003	2.28 ± 2.10	1.84 ± 2.78	0.44 ± 2.37	0.168
Total score	53.97 ± 14.43	82.06 ± 16.36	28.09 ± 15.27	<0.0001	50.87 ± 16.68	53.64 ± 15.37	2.77 ± 12.56	0.101

The maximum total score was 168 (24 points per item).

Search strategy in a bibliographic database evaluated through a computer-based searching task: comparison of pre-test and post-test results (trained group)

Most search strategies in PsycINFO® of the trained group improve as the use of synonyms did not improve (Table 3). More students searched for evidence by (i) choosing terms from the thesaurus and relevant terms, (ii) using the Boolean operators correctly and (iii) using limits relative to the study design.

Perceptions towards the educational module (trained group)

Thirty-six students attended a course run by both the SLT teacher and the teacher-librarian. All students agreed to report their level of agreement with statements relative to their learning and the educational module (Table 4):

- Most of the students considered that they made progress in terms of EBP knowledge and skills;
- 80.6% of the students considered that the practical training session should be organised earlier;
- Relative to collaborative research project, 94.2% of the students considered that the objectives were clear, 74.2% of them considered that the instructions were clear and the guidelines were helpful for all students;
- 61.1% of the students considered that the discussion forum on eCampus was an adequate support for dialogue with teachers and classmates;
- 61.1% of the students were motivated to take the educational module;
- 38.9% of the students considered that the workload stated in the curriculum matched the actual workload;
- All students considered that the teachers were available and 96.9% of them considered that the teachers made the course attractive;
- All students considered this educational module will be helpful in their curriculum and 85.7% of them considered that it will be helpful for their professional life.

Thirty-one of the 36 students in the trained group wrote a comment at the end of the questionnaire.

Table 2 Performances of subgroups on the adapted Fresno tests at pre-test and post-test

Group of students	Attendance at the information literacy course	Pre-test (mean ± SD)	Post-test (mean ± SD)	Difference (mean ± SD)	P-value
Trained group	Yes (n = 40)	55.6 ± 14.5	83.3 ± 16.4	27.7 ± 16.0	<0.0001
	No (n = 7)	45.0 ± 11.0	75.1 ± 15.2	30.1 ± 10.9	0.0003
Control group	Yes (n = 47)	52.6 ± 16.6	55.2 ± 15.8	2.6 ± 12.9	0.172
	No (n = 10)	42.9 ± 15.2	46.4 ± 11.5	3.5 ± 11.3	0.351

Table 3 Analysis of the search strategies performed by the trained group in PsycINFO® (n = 47) in a pre-post design (computer-based searching task)

Evaluation criteria	Pre-test (n = 46)* %	Post-test (n = 46)* %	P-value
Choice of terms			
Search with terms from the thesaurus	65.22	100	<0.0001
Search with the most relevant terms	15.22	54.35	0.0007
Search with complementary terms/synonyms	60.87	56.52	0.71
Use of Boolean operators			
Correct use (without mistakes)	30.43	65.22	0.0017
Use of limits			
Study design	2.17	15.22	0.014

*n = 46 and not 47 due to a problem with the computer file of one student.

All comments illustrated the students' level of agreement with the statements included in the questionnaire. Several themes were identified. The first theme relates to the different parts of the educational module and the students' learning. It appears that the theoretical lesson was an effective review of IL delivered during the second year of the curriculum ('The first part of the EBP module was a good review of IL course and stimulated my interest'). Comments relative to the collaborative research project pointed that: (i) the instructions were clear but more details would be appreciated ('We would have liked to know that we could talk about our searching failures or difficulties') and (ii) students would have preferred smaller groups, as they had encountered difficulties in finding suitable times to meet together ('Groups should be limited to three or four for practical reasons and availability'). Students also appreciated the last practical training session on a computer because they had the opportunity to search for evidence at their own rhythm and with the support of the teachers ('We learned a lot during the practical training session, we did exercises, we had a feedback immediately, with accurate answers to our questions'). However,

they would have preferred to have had this part before the oral presentation in order to improve the quality of their collaborative research project ('The practical session on a computer should be before the oral presentation. This way, we can ask questions and be guided'). Students also mentioned that the workload for this educational module was higher than what was stated in the curriculum. Nevertheless, they mentioned that they would have liked more exercises to improve their skills, particularly on how to formulate a good question or how to choose the best terms from the thesaurus in PsycINFO® ('I think that one or two – even three – additional sessions would not have been a luxury so that I become more comfortable with this methodology').

The second theme is the teachers. Students appreciated their availability, the constructive criticism they made about their work, and the fact that they tried to make the course attractive ('Teachers tried to make this educational module as attractive as possible').

The third theme is the interest of the EBP educational module. Not all the students were initially motivated to participate in this educational

Table 4 Perceptions of the trained group ($n = 36$): level of agreement with the statements relative to their learning and the educational module

Questionnaire items	n^*	Strongly disagree (%)	Disagree (%)	Agree (%)	Strongly agree (%)
Learning throughout the module					
The theoretical lesson allowed you to progress in terms of:					
Knowledge of EBP	31	0.0	3.2	71.0	25.8
Skills in EBP	31	3.2	38.7	45.2	12.9
The preparation of the collaborative research project allowed you to progress in terms of:					
Knowledge of EBP	36	2.9	11.4	48.6	37.1
Skills in EBP	36	0.0	2.8	47.2	50.0
The presentation of the research project prepared in a group allowed you to progress in terms of:					
Communication strategies	36	0.0	25	55.6	19.4
Knowledge of EBP	36	0.0	30.6	58.3	11.1
Skills in EBP	36	2.8	33.3	50	13.9
The final practical training on specialized databases allowed you to progress in term of:					
Knowledge of EBP	36	0.0	2.8	55.5	41.7
Skills in EBP	36	0.0	0.0	41.7	58.3
The practical training session on specialised databases should be organized before the presentation of the collaborative work project					
Objectives, instructions, support					
The objectives of the collaborative research project explained during the theoretical lesson were clear	35	0.0	5.8	77.1	17.1
The instructions for the collaborative research project explained during the theoretical lesson were clear	35	2.9	22.9	57.1	17.1
The guidelines providing detailed instructions for the collaborative research project and some advice for the presentation of the results were helpful	36	0.0	00	44.4	55.6
The discussion forum on eCampus was an adequate support for dialogue with teachers and classmates	36	8.3	30.6	50.0	11.1
Motivation, workload, teachers, interest					
You were motivated to take the educational module	36	2.8	36.1	55.6	5.5
The workload stated in the curriculum matched the actual workload	36	2.8	58.3	36.1	2.8
Teachers were available	36	0.0	0.0	63.9	36.1
Teachers made the course attractive	32	0.0	3.1	81.3	15.6
This educational module will be helpful in your curriculum	36	0.0	0.0	38.9	61.1
This educational module will be helpful for your professional life	35	0.0	14.3	54.3	31.4

*The sample size may be different from 36 due to missing values.

module, but they enjoyed the fact that it simulated professional conditions ('At first, little motivation to search for evidence but being faced to a fictitious patient makes the course content engaging'). Finally, the students considered the module useful for their curriculum and for their

future professional life ('What we learn in class is sometimes not sufficient to provide a relevant and fair answer to the patient, it is therefore essential to know where to find resources').

The last theme is the IL course. Students mentioned that they had given little importance to

this course because they had not understood its usefulness ('It is important to point out the importance of the IL course to the students because it is true that during the second year of the curriculum we gave little importance to the matter'). They suggested to organise lessons in small groups ('It is useful to do exercises in small group and with your help') and to link this IL course with the EBP educational module ('Both courses should be organised together').

Discussion

The aim of this study was to assess the change in knowledge and skills of SLT students related to the first three steps of EBP after participating in an EBP educational module. A before-after study design with a control group was used. The performance of the trained group and the control group were measured using adapted Fresno tests. While both groups performed similarly before the intervention, only the trained group obtained significantly higher scores at the post-test. These results are consistent with previous studies that showed that a brief course can improve the knowledge and skills of the students (Dizon et al., 2012; Just, 2012). Nevertheless, even if students improved their performances, they still need to continue to develop such knowledge and skills. For example, they still did not use the best search strategies in bibliographic databases. Use of the most relevant terms did go up from 15.22% to 54.35%, which is a significant increase, but that means there are still half of the students who could improve how they search for information. In the same idea, only half of the students expanded their searches using a combination of several keywords to express a component of the question despite the usefulness of this procedure (Schlosser, Wend, Bhavnani & Nail-Chiwetalu, 2006). The results also showed that students should be trained in order to acquire knowledge and skills related to EBP. Considering these points, it is essential to integrate, into the curriculum, clinical activities that train students to make evidence-based decisions. This is consistent with other research on teaching EBP in SLT (Cobus-Kuo & Waller, 2016) and in the allied health and medical fields (Dawes et al., 2005; Khan & Coomarasamy, 2006; Young et al., 2014).

It is also notable that trained students improved their performance on the first two steps of EBP but they failed to increase their awareness of the relevance and validity of a paper. Their performance on the interpretation of an effect reported in a study remained weak, even if there is a statistically significant difference between the pre-test and post-test scores. Criteria for appraising a paper were mentioned briefly during the theoretical lesson. Each group of students had to apply these criteria to the paper they had selected for the collaborative research project. The teaching method for this subject matter should be improved. Students need to be trained to assess the different types of studies with the support of critical appraisal worksheets. Teachers should provide more explanations and more exercises, as they did for the EBP literature searching skills and as is described in the literature (Klee et al., 2009; Proly & Murza, 2009; Raghavendra, 2009; Young et al., 2014). Therefore, more time and more consideration should be dedicated to critical appraisal and reading, which are an essential aspects of the training (Gueyffier, 2009).

Based on the analysis of the students' level of agreement with the statements in the questionnaire, it could be stated that, on the whole, the trained students expressed that their EBP competencies improved. These subjective perceptions are consistent with the objective results obtained on both tests. Furthermore, all students who reported their perceptions thought that these skills would be useful in their curriculum, and 85% thought that these skills would be helpful for their future professional life. This perceived utility of the EBP process has possibly increased their motivation to continue to improve their EBP competencies (Aglen, 2016).

The students' performances, perceptions and comments as well as the literature on EBP teaching (Dawes et al., 2005; Gross & Latham, 2013; Ilic, Tepper & Misso, 2012; Young et al., 2014) allow us to highlight what worked and what could be improved. The main strengths of the module are the use of an interactive approach, the focus on clinical practice and the use of several strategies in teaching and learning, as discussed in the literature (Khan & Coomarasamy, 2006). One way to improve the educational module is to provide practical training before the presentation

of the collaborative research project. Teachers should also plan both individual and group exercises to train students to apply the first three EBP steps. Formative and summative assessments would be useful to determine if the students have acquired competencies in EBP. Additionally, teachers should ensure that the workload stated in the curriculum matches the actual workload. Finally, the EBP content should be expanded to include all five steps and integrated into the curriculum, ensuring that clinical situations are varied and advanced to facilitate the complete transfer of competencies. All teachers have a role to play in this training: the SLT teachers, the practitioners who train the students in clinical settings and the librarians who work in academic contexts. The librarians can teach as well as evaluate students' competencies and collaborate with disciplinary teachers to develop courses devoted to EBP (Dorsch & Perry, 2012; Maggio & Kung, 2014).

Potential limitations to this study should be highlighted. Firstly, the participants were not randomised. For ethical reasons, it was not possible to divide the SLT students into a trained group and a control group because the educational module was mandatory. This difficulty associated with conducting randomised controlled trials in this area has been acknowledged in the literature (Dizon et al., 2012). Therefore, the fourth year students in psychology who were not trained in EBP were chosen as a control group; both groups of students shared some courses, including the IL. Secondly, the items and the scoring procedure of the Fresno test, a validated tool, were used but the questionnaire was translated into French and the scenarios were adapted without any external validation. Nevertheless, these changes were developed cautiously. Several steps were performed to translate the test: (i) the Fresno test was translated into French by one of the authors of this paper and the French translation was back-translated into English and checked for consistency by another author, and (ii) the final version was revised by an independent EBP expert. The clinical scenarios were developed according to the original scenarios and with the approval of clinicians. There were no guidelines to develop clinical scenarios for the Fresno test

which would have been useful. In addition, the grading procedure needed to be calibrated by both teachers to reduce the potential subjectivity of this kind of evaluation (Lizarondo, Grimmer & Kumar, 2013). Finally, due to several constraints, only the SLT students underwent the computer-based searching task which involved searches in PsycINFO®. It may have been interesting to have these data also for students in psychology.

Conclusions

This study assessed the change in knowledge and skills related to the first three steps of EBP when SLT students participated in an educational module. Their performances were compared to those of similar students not doing the module. The second objective was to obtain the SLT students' perceptions towards the educational module in EBP. Results showed that only the trained students improved their competencies, and that these students perceived their own progress as well as the utility of the module. Strengths of the module have been highlighted and ways to improve it have been suggested. A better integration of EBP into the curriculum is recommended to train students to make evidence-based decisions. Future research should focus on the best way to integrate EBP in clinical activities into courses and across the whole curriculum.

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Conflict of interest

The authors declare that they have no competing interests.

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References

- Aglen, B. (2016). Pedagogical strategies to teach bachelor students evidence-based practice: A systematic review. *Nurse Education Today*, *36*, 255–263. <https://doi.org/10.1016/j.nedt.2015.08.025>.
- Cobus-Kuo, L., & Waller, J. (2016). Teaching information literacy and evidence-based practice in an undergraduate speech-language pathology program: A student reflection. *Contemporary Issues in Communication Science and Disorders*, *43*, 35–49.
- Crabtree, J. L., Justiss, M., & Swinehart, S. (2012). Occupational therapy master-level students' evidence-based practice knowledge and skills before and after fieldwork. *Occupational Therapy in Health Care*, *26*, 138–149. <https://doi.org/10.3109/07380577.2012.694584>.
- Dawes, M., Summerskill, W., Glasziou, P., Cartabellotta, A., Martin, J., Hopayian, K., ... Osborne, J. (2005). Sicily statement on evidence-based practice. *BMC Medical Education*, *5*(1), 1–7. <https://doi.org/10.1186/1472-6920-5-1>.
- Dizon, J. M. R., Grimmer-Somers, K. A., & Kumar, S. (2012). Current evidence on evidence-based practice training in allied health: A systematic review of the literature. *International Journal of Evidence-Based Healthcare*, *10*, 347–360. <https://doi.org/10.1111/j.1744-1609.2012.00295.x>.
- Dollaghan, C. A. (2007). *The handbook for evidence-based practice in communication disorders*. Baltimore, MD: Brookes Publishing.
- Dorsch, J. L., & Perry, G. J. (2012). Evidence-based medicine at the intersection of research interests between academic health sciences librarians and medical educators: A review of the literature. *Journal of the Medical Library Association*, *100*, 251–257. <https://doi.org/10.3163/1536-5050.100.4.006>.
- Grillo, E. U., Koenig, M. A., Gunter, C. D., & Kim, S. (2015). Teaching CSD graduate students to think critically, apply evidence, and write professionally. *Communication Disorders Quarterly*, *36*, 241–251. <https://doi.org/10.1177/1525740114549014>.
- Gross, M., & Latham, D. (2013). Addressing below proficient information literacy skills: Evaluating the efficacy of an evidence-based educational intervention. *Library and Information Science Research*, *35*, 181–190. <https://doi.org/10.1016/j.lisr.2013.03.001>.
- Gueyffier, F. (2009). Critical reading of articles: An essential aspect of modern medical training [La lecture critique d'articles: Un pilier fondamental de la formation médicale moderne]. *La Revue du Praticien*, *59*, 20–24.
- Ilic, D., Tepper, K., & Misso, M. (2012). Teaching evidence-based medicine literature searching skills to medical students during the clinical years: A randomized controlled trial. *Journal of the Medical Library Association*, *100*, 190–196. <https://doi.org/10.3163/1536-5050.100.3.009>.
- Just, M. L. (2012). Is literature search training for medical students and residents effective? A literature review. *Journal of the Medical Library Association*, *100*, 270–276. <https://doi.org/10.3163/1536-5050.100.4.008>.
- Khan, K. S., & Coomarasamy, A. (2006). A hierarchy of effective teaching and learning to acquire competence in evidenced-based medicine. *BMC Medical Education*, *6*(59), 1–9. <https://doi.org/10.1186/1472-6920-6-59>.
- Klee, T., Stringer, H., & Howard, D. (2009). Teaching evidence-based practice to speech and language therapy students in the United Kingdom. *Evidence-Based Communication Assessment and Intervention*, *3*, 195–207. <https://doi.org/10.1080/17489530903399103>.
- Lizarondo, L. M., Grimmer, K., & Kumar, S. (2013). Interrater reliability of the adapted fresno test across multiple raters. *Physiotherapy Canada*, *65*, 135–140. <https://doi.org/10.3138/ptc.2012-15>.
- Maggio, L. A., & Kung, J. Y. (2014). How are medical students trained to locate biomedical information to practice evidence-based medicine? A review of the 2007-2012 literature. *Journal of the Medical Library Association*, *102*, 184–191. <https://doi.org/10.3163/1536-5050.102.3.008>.
- McCabe, P., Purcell, A., Baker, E., Madill, C., & Trembath, D. (2009). Case-based learning: One route to evidence-based practice. *Evidence-Based Communication Assessment and Intervention*, *3*, 208–219. <https://doi.org/10.1080/17489530903399145>.
- McCurtin, A., & Roddam, H. (2012). Evidence-based practice: SLTs under siege or opportunity for growth? The use and nature of research evidence in the profession. *International Journal of Language and Communication Disorders*, *47*, 11–26. <https://doi.org/10.1111/j.1460-6984.2011.00074.x>.
- Phillips, A. C., Lewis, L. K., McEvoy, M. P., Galipeau, J., Glasziou, P., Hammick, M., ... Williams, M. T. (2014). A systematic review of how studies describe educational interventions for evidence-based practice: Stage 1 of the development of a reporting guideline. *BMC Medical Education*, *14*(152), 1–11. <https://doi.org/10.1186/1472-6920-14-152>.
- Proly, J. L., & Murza, K. A. (2009). Building speech-language pathologist capacity for evidence-based practice: A unique graduate course approach. *Evidence-Based Communication Assessment and Intervention*, *3*, 220–231. <https://doi.org/10.1080/17489530903432383>.
- Raghavendra, P. (2009). Teaching evidence-based practice in a problem-based learning course in speech-language pathology. *Evidence-Based Communication Assessment and Intervention*, *3*, 232–237. <https://doi.org/10.1080/17489530903399160>.
- Ramos, K. D., Schafer, S., & Tracz, S. M. (2003). Validation of the Fresno test of competence in evidence based medicine. *BMJ*, *326*(7384), 319–321. <https://doi.org/10.1136/bmj.326.7384.319>.
- Roddam, H., & Skeat, J., Eds. (2012). *Embedding evidence-based practice in speech and language therapy: International examples*. Chichester, UK: Wiley-Blackwell.
- Schlosser, R. W., Koul, R., & Costello, J. (2007). Asking well-built questions for evidence-based practice in augmentative and alternative communication. *Journal of Communication*

- Disorders*, 40, 225–238. <https://doi.org/10.1016/j.jcomdis.2006.06.008>.
- Schlusser, R. W., & Raghavendra, P. (2004). Evidence-based practice in augmentative and alternative communication. *Augmentative and Alternative Communication*, 20, 1–21. <https://doi.org/10.1080/07434610310001621083>.
- Schlusser, R. W., & Sigafoos, J. (2009). Teaching evidence-based practice: An impetus for further curricular innovation and research. *Evidence-Based Communication Assessment and Intervention*, 3, 191–194. <https://doi.org/10.1080/17489530903519676>.
- Schlusser, R. W., Wend, O., Bhavnani, S., & Nail-Chiwetalu, B. (2006). Use of information-seeking strategies for developing systematic reviews and engaging in evidence-based practice: The application of traditional and comprehensive Pearl Growing. A review. *International Journal of Language and Communication Disorders*, 41, 567–582. <https://doi.org/10.1080/13682820600742190>.
- Spek, B., de Wolf, G. S., van Dijk, N., & Lucas, C. (2012). Development and validation of an assessment instrument for teaching evidence-based practice to students in allied health care: The Dutch Modified Fresno. *Journal of Allied Health*, 41, 77–82.
- Spek, B., Wieringa-de Waard, M., Lucas, C., & van Dijk, N. (2013). Teaching evidence-based practice (EBP) to speech-language therapy students: Are students competent and confident EBP users? *International Journal of Language and Communication Disorders*, 48, 444–452. <https://doi.org/10.1111/1460-6984.12020>.
- Stephens, D., & Upton, D. (2012). Speech and language therapists' understanding and adoption of evidence-based practice. *International Journal of Therapy and Rehabilitation*, 19, 328–332. <https://doi.org/10.12968/ijtr.2012.19.6.328>.
- Straus, S. E., Glasziou, P., Richardson, W. S., & Haynes, R. B. (2011). *Evidence-based medicine: How to practice and teach it*, 4th ed. Edinburgh, UK: Churchill Livingstone Elsevier.
- Togher, L., Yiannoukas, C., Lincoln, M., Power, E., Munro, N., McCabe, P., ... Douglas, J. (2011). Evidence-based practice in speech-language pathology curricula: A scoping study. *International Journal of Speech-Language Pathology*, 13, 459–468. <https://doi.org/10.3109/17549507.2011.595825>.
- Young, T., Rohwer, A., Volmink, J., & Clarke, M. (2014). What are the effects of teaching evidence-based health care (EBHC)? Overview of systematic reviews *PLoS ONE*, 9(1), e86706. <https://doi.org/10.1371/journal.pone.0086706>

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Appendix 1: Clinical scenarios used with French-speaking SLT students

Pre-test

Scenario 1: Anatole is 4 years old and stutters slightly, so it is sometimes difficult to understand him. The stuttering increases when Anatole is tired. His mother wonders if speech and language

therapy is necessary or if the stuttering will resolve itself spontaneously.

Scenario 2: Juliette (7 years old) has finished her first year at school. Like her elder brother, she has difficulties with the written language. She recognises single letters and can read simple syllables but she does not read fluently yet. Her mother comes to you: she has heard about an American method called Fast For Word, developed by Paula Tallal, and about a therapy focused on phonological awareness. She wonders if any of these techniques could help her daughter to progress in reading.

Post-test

Scenario 1: Pierrot is 3 years old and does not speak at all. However, he communicates well using some gestures, he can point and emits some sounds. His hearing has been checked, and it is normal. His mother wonders if speech and language therapy is necessary or if the language will start by itself.

Scenario 2: Molly (7 years old) has Down's syndrome. The speech and language therapist who has worked a lot with her on articulatory aspects and praxis would like to start the learning of the written language. She wonders how to go about it. She is considering working on phonological awareness but she wonders if it is appropriate.

Appendix 2: Clinical scenarios used with French-speaking students in psychology

Pre-test

Scenario 1: Jason is 6 years old. His parents are separated. His father has been jailed for drug trafficking, and Jason has visited him in prison several times. The mother says that since then Jason has not been sleeping and she wonders whether to continue or stop these visits because they disrupt the school learning of her child.

Scenario 2: Julien, 15 years old, is admitted to hospital after attempting to hang himself. He has been taking amphetamines for 4 months because his doctor considers that he is hyperactive. You wonder at first about the treatment taken by Julien: you have heard from a colleague that amphetamines could provoke anxiety and you

have been wondering since then if it is necessary to pursue the treatment of Ritalin.

Post-test

Scenario 1: Kevin, 8 years old, has an attention deficit hyperactivity disorder and is failing at school. The parents do not want their child to take Ritalin for the reasons that his drug increases the risks of dependence and addiction in adulthood. They nevertheless want your opinion on these long term effects.

Scenario 2: Louis, 8 years old, has an intermittent strabismus. Conversion hysteria has been diagnosed. The symptoms disrupting her school integration because teachers fear the onset of strabismus, which makes the child dependent on an adult. The parents, concerned about the well-being of their child, looked for information on the Internet: they read that cognitive behavioural therapy can be helpful for a child with somatoform disorders. They want your opinion on this therapy and also ask questions about the usefulness of a period of hospitalisation.