

Characteristics and didactical foundations of a game-based learning approach for chemistry teaching

► Maxime Hansen ◀



PRESS START



Games, chemistry and learning

JOURNAL OF
CHEMICAL EDUCATION

pubs.acs.org/jchemeduc

Technology Report

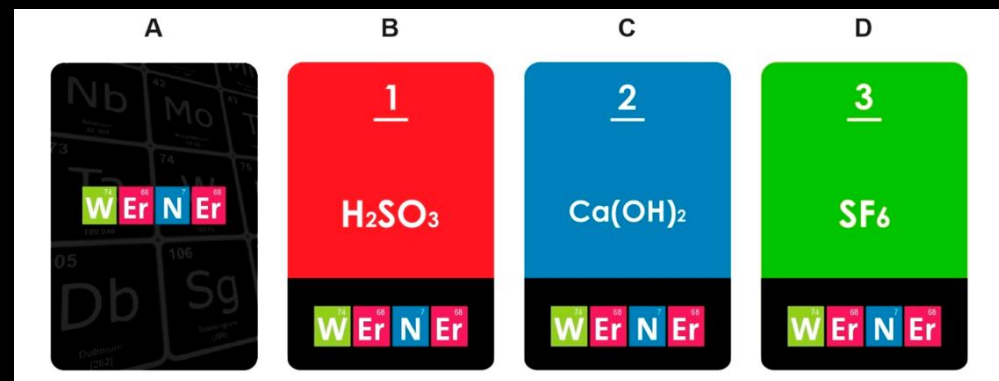
Metal Demon Conqueror Game: A New Digital Game-Based Learning Tool on Factors Affecting Enzyme Activity

Chatchadaporn Pinthong,* Natpawee Pongkaew, Titapa Ampaipis, Jirapipat Thanyaphongphat, Panu Pimviriyakul, and Somchart Maenpuen

Cite This: *J. Chem. Educ.* 2024, 101, 1718–1725

Read Online

(Pinthong et al., 2024)



(Buendía-Atencio et al., 2022)

Organic Chemistry Reaction App

OCRA
Contient des annonces

1 k+
Téléchargements

Installer sur d'autres appareils

Partager



<https://ocradev.itch.io/organic-chemistry-reaction-app/devlog/477872/introducing-ocra>

Maxime Hansen – SIG28 – 09/07/2026



(Engstler & Marohn, 2025)

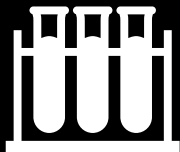
Games, Sciences and Learning

- A systematic literature review of game-based approaches in chemistry education (2014-2024) (Elmali et al., 2026)
- Game-based learning approach on students' motivation and understanding of chemistry concepts: A systematic review of literature (Byusa et al., 2022)
- Game-Based Learning Application in Chemistry Learning: A Systematic Literature Review (Vitarisma et al., 2022)
- Chemistry Game Cards as an Alternative Media for Learning: A Literature Review (Nadila et al., 2024)
- Systematic Literature Review: A Fun Organic Chemistry Learning Experience with Educational Games (Satari et al., 2024)
- **Game-based learning has good chemistry with chemistry education: A three-level meta-analysis** (Hu et al., 2022)
- **Effects of Game-Based Learning on Students' Motivation in Chemistry: A Meta-analysis** (Xu et al., 2025)

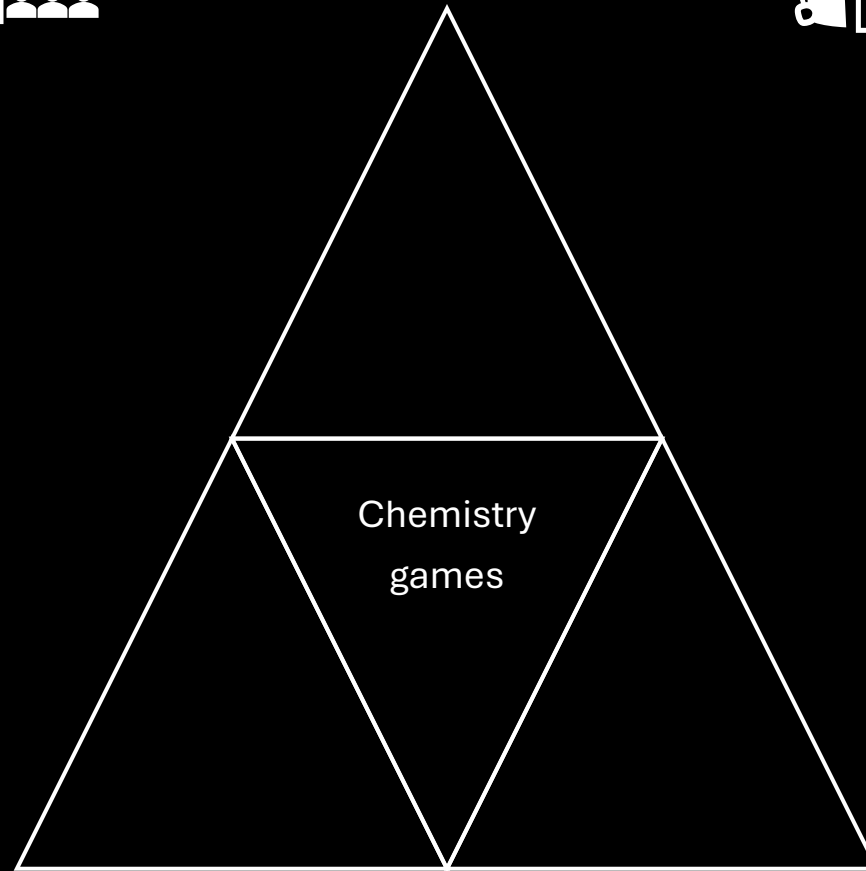
Triforce of this research



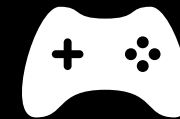
Educational studies



Chemistry didactics



Chemistry
games



Game studies

And then?

From ideas to a research framework



Steps for this research

1. Systematic review (with/without MA) concentrated on a digital game-based learning approach
 - Recommended by the current literature (Elmali et al., 2026; Byusa et al., 2022; Hu et al., 2022)
 - RQ1: *“What is the available body of literature about Digital Game-Based Learning (DGBL) practices for chemistry education from secondary through higher education?”*
 - RQ2: *“What are the characteristics of DGBL practices in chemistry education from secondary through higher education?”*

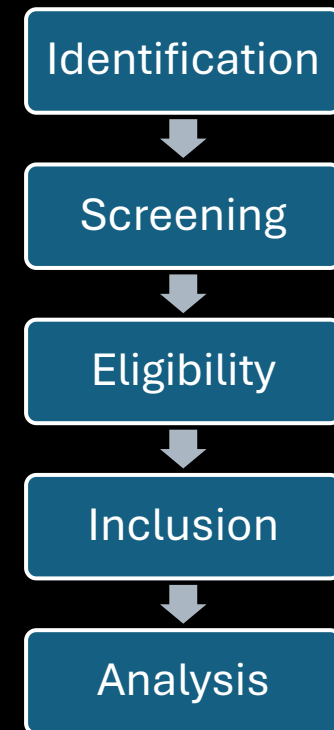
Steps for this research

1. Systematic review (with/without MA) concentrated on a digital game-based learning approach
 - RQ3: *“What is the efficacy of a DGBL approach in chemistry education compared to traditional teaching methods for students from secondary through higher education? (media comparison) ”*
 - RQ4: *” Which elements of DGBL in chemistry education have the greatest impact on students from secondary through higher education? (value-added comparison)”*

Steps for this research

1. Systematic review (with/without MA) concentrated on a digital game-based learning approach

➤ PRISMA framework (Page et al., 2021)



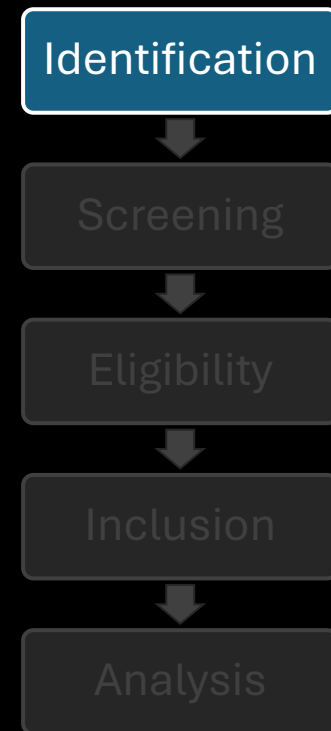
Steps for this research

1. Systematic review (with/without MA) concentrated on a digital game-based learning approach

➤ PRISMA framework

- Databases: ERIC, SCOPUS, EBSCO
- Journals: JCE, CERP
- Grey literature

(Chemical OR Chemistry OR descriptor:(Chemistry)) AND ("Game-based Learning" OR Gamification OR "Educational Games" OR "Video Games" OR "Computer Games" OR "Serious Game") AND ("Electronic Learning" OR "Educational Technology" OR "Handheld Devices" OR "Technology Integration" OR "Technology Used in Education" OR "Computers")

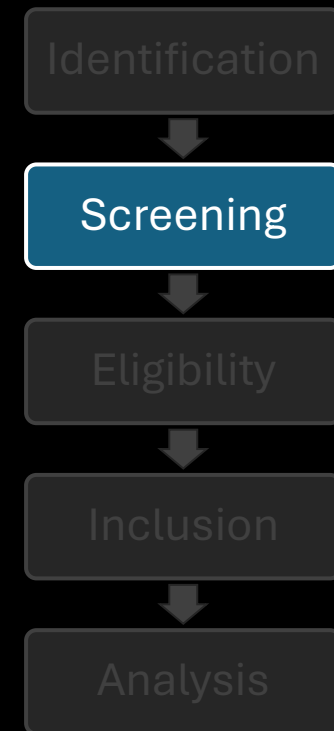


Steps for this research

1. Systematic review (with/without MA) concentrated on a digital game-based learning approach

➤ PRISMA framework

- Large and general research keys → 2929 records
- Duplicate removed → 2240 records
- Pre-screening only for chemistry education and game approaches
- **Current phase of the research**

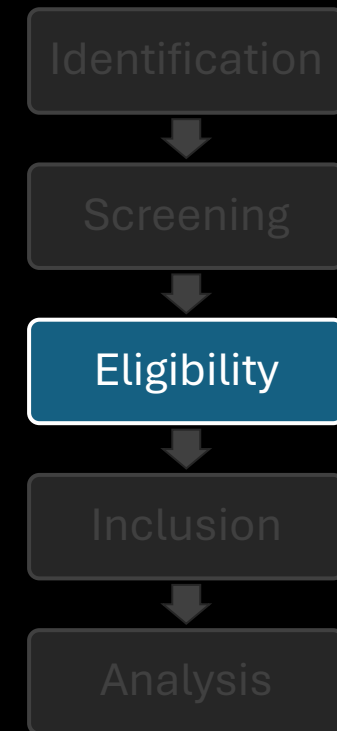


Steps for this research

1. Systematic review (with/without MA) concentrated on a digital game-based learning approach

➤ PRISMA framework

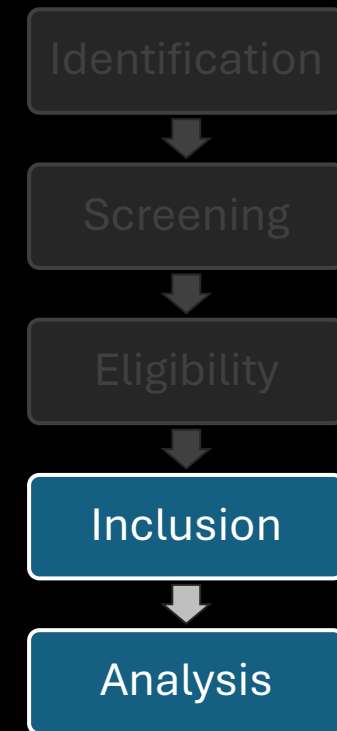
- Game-based learning approach
- Digital or mixed media
- Primary research
- Language
- Accessibility
- ...



Steps for this research

1. Systematic review (with/without MA) concentrated on a digital game-based learning approach

➤ PRISMA framework



Steps for this research

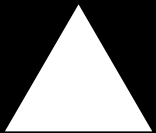
1. Other purposes of a systematic review



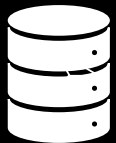
Game mechanics of *game-based learning*



Topics of chemistry, teaching scenarios,...



Didactical models



Database for available games

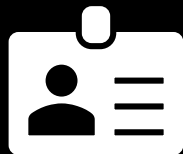
Steps for this research

1. Systematic review (with/without MA) concentrated on a digital game-based learning approach
2. Exploration of the impact of DGBL on
 - Motivation or emotion
 - Cognition
 - **Misconceptions**



More information

Stay in
touch!



Download this
presentation



References

- Buendía-Atencio, C., Pieffet, G. P., & Loret Velásquez, V. P. (2022). Werner: A card game for reinforcement learning of Inorganic Chemistry nomenclature. *Journal of Chemical Education*, 99(5), 2198–2203. <https://doi.org/10.1021/acs.jchemed.2c00166>
- Byusa, E., Kampire, E., & Mwesigye, A. R. (2022). Game-based learning approach on students' motivation and understanding of Chemistry Concepts: A systematic review of literature. *Heliyon*, 8(5). <https://doi.org/10.1016/j.heliyon.2022.e09541>
- Elmali, S., Freund, L., & Tiemann, R. (2026). A systematic literature review of game-based approaches in Chemistry Education (2014–2024). *Chemistry Education Research and Practice*, 27(1), 31–44. <https://doi.org/10.1039/d5rp00248f>
- Engstler, V. L., & Marohn, A. (2025). Designing effective educational escape games: Results from the design-based research project chemical [esc]ape. *Journal of Chemical Education*, 102(10), 4498–4507. <https://doi.org/10.1021/acs.jchemed.5c00761>
- Hu, Y., Gallagher, T., Wouters, P., van der Schaaf, M., & Kester, L. (2022). Game-based learning has good chemistry with Chemistry Education: A three-level meta-analysis. *Journal of Research in Science Teaching*, 59(9), 1499–1543. <https://doi.org/10.1002/tea.21765>
- Introducing OCRA - organic chemistry reaction app by ocradev. (n.d.). <https://ocradev.itch.io/organic-chemistry-reaction-app/devlog/477872/introducing-ocra>
- Nadila, N., Enawaty, E., Erlina, E., & Masriani, M. (2024). Chemistry Game Cards as an alternative media for learning: A literature review. *Hydrogen: Jurnal Kependidikan Kimia*, 12(5), 1058. <https://doi.org/10.33394/hjkk.v12i5.13130>
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., ... Moher, D. (2021). The prisma 2020 statement: An updated guideline for Reporting Systematic Reviews. *BMJ*. <https://doi.org/10.1136/bmj.n71>
- Pinthong, C., Pongkaew, N., Ampaipis, T., Thanyaphongphat, J., Pimviriyakul, P., & Maenpuen, S. (2024). Metal demon conqueror game: A new digital game-based learning tool on factors affecting enzyme activity. *Journal of Chemical Education*, 101(4), 1718–1725. <https://doi.org/10.1021/acs.jchemed.3c01212>
- Satari, C., Wiji, W., Widhiyanti, T., & Mulyani, S. (2024). Systematic literature review: A fun organic chemistry learning experience with educational games. *Jurnal Penelitian Pendidikan IPA*, 10(7), 377–487. <https://doi.org/10.29303/jppipa.v10i7.6855>
- Vitarisma, I., Dasna, W., & Rahayu, S. (2022). Game-based learning application in Chemistry Learning: A systematic literature review. *Jurnal Pendidikan MIPA*, 23(1), 1–12. <https://doi.org/10.23960/jpmipa.v23i1.pp01-12>
- Xu, J. J., Sun, X. F., Liu, Y. N., Zhang, S. Y., & Zhou, Q. (2025). Effects of game-based learning on students' motivation in Chemistry: A meta-analysis. *Journal of Chemical Education*, 102(3), 1117–1128. <https://doi.org/10.1021/acs.jchemed.4c01304>