

Learning models for higher education and their influence on teacher updating

Modelos de aprendizaje para la educación superior y su influencia sobre la actualización docente



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Abstract

The purpose of this article is to examine in depth the influence of learning models in higher education on teacher updating. For this purpose, a thorough analysis of the variables "Learning Models for Higher Education" and "Teacher Updating" in relation to the continuing education of university teachers is carried out. Through a comprehensive review of recent scientific literature, it is examined in detail how different learning approaches impact on teacher updating in higher education. In addition, the results of a survey of 135 teachers are presented, with the purpose of providing a comprehensive view on the impact of learning models on teacher education and the updating of today's university teacher.

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Resumen

Este artículo tiene como objetivo examinar en profundidad la influencia de los modelos de aprendizaje en la educación superior sobre la actualización docente. Para ello, se realiza un análisis minucioso de las variables "Modelos de Aprendizaje para la Educación Superior" y "Actualización Docente" en relación a la formación continua de los docentes universitarios. Mediante una revisión exhaustiva de la literatura científica reciente, se examina en detalle cómo diferentes enfoques de aprendizaje impactan en la actualización de los docentes en el ámbito de la educación superior. Además, se presentan los resultados de una encuesta realizada a 135 docentes, con el propósito de proporcionar una visión integral sobre el impacto de los modelos de aprendizaje en la educación docente y la actualización del docente universitario actual.

Palabras clave: modelos de aprendizaje, educación superior, actualización docente, encuesta.

Introduction

Higher education, as one of the fundamental pillars of academic and professional development, is in constant evolution and transformation. In this context, the quality of teaching and learning in higher education depends largely on the ability of teachers to stay current and adapt to changes in the educational environment. Therefore, teacher updating becomes a critical aspect that requires the continuous acquisition of new knowledge, skills and competencies, in order to provide quality and relevant education to students.

In this introduction, the key variables of "Learning Models for Higher Education" and "Teacher Update" will be discussed in depth. For this purpose, a comprehensive review of recent scientific literature will be carried out, which will allow us to examine in detail the effects of the different learning models in the continuing education of university teachers. Likewise, the specific objectives of this study will be presented and the importance of understanding the impact of these models on the updating of university teachers will be highlighted.

Higher education is characterized by its diversity of teaching approaches and strategies. In this sense, learning models are presented as theoretical and practical frameworks that guide the way teachers

design and implement their courses. These models encompass a wide range of pedagogical approaches, such as problem-based learning, cooperative learning, competency-based learning, online learning, project-based learning, and hybrid learning.

Updating teaching becomes a fundamental task for university teachers, as it allows them to keep up with advances in the field of education and to adapt to the changing needs of students. In this regard, learning models play a crucial role, as they can provide new perspectives and approaches on how to teach and assess students effectively. By learning about and applying different learning models, teachers can improve their pedagogical practices and provide more effective and meaningful education.

The main objective of this study is to examine in depth the relationship between learning models for higher education and teacher updating. To achieve this, a thorough review of the recent scientific literature related to the topic will be carried out. The different learning models used in higher education will be explored and their influence on teacher updating will be analyzed in detail. In addition, the advantages and challenges associated with the implementation of these models in the educational context will be addressed.

It is expected that the results of this study will provide a better understanding of how learning models can influence teacher updating in higher education. These results will be of great relevance to educational decision-makers, as they will be able to design more effective teacher training programs and promote innovative pedagogical practices. It is also expected that this study will generate new lines of research and contribute to the advancement of knowledge in the field of higher education.

In summary, this article focuses on the relationship between learning models for higher education and teacher updating. Through a comprehensive review of the scientific literature and the analysis of the results of a survey of 135 teachers, it examines in detail how different learning approaches can influence the continuing education of university teachers. The knowledge generated by this study will be of great relevance for improving the quality of higher education and fostering the professional development of teachers in this field.

The relationship between learning models in higher education and teacher updating has been the subject of much research in recent years. This section of the article will provide a state of the art on the different

learning approaches used in higher education and their influence on the continuing education of university teachers.

Problem-based learning (PBL) is a pedagogical approach that focuses on complex problem solving as a means of learning. According to Zanella et al. (2017), PBL fosters the development of cognitive, social, and emotional skills in students, while promoting teacher upgrading. Teachers using PBL should acquire new learning facilitation strategies and adopt a guiding and facilitating role instead of being mere transmitters of knowledge (Graaff et al., 2018).

Implementing PBL in higher education requires careful planning, selection of authentic problems, and design of collaborative learning activities. According to Liaw et al. (2017), teachers using PBL must be willing to adapt their teaching approach and provide effective feedback to students. In addition, teacher updating in relation to PBL involves keeping abreast of the latest research on problem-based learning facilitation and assessment strategies.

Cooperative learning is another learning model used in higher education, which encourages teamwork and collaboration among students. According to Johnson et al. (2018), cooperative learning improves student motivation, promotes social interaction, and develops teamwork skills. For teachers, the implementation of cooperative learning involves acquiring knowledge on how to form heterogeneous groups, how to structure cooperative tasks, and how to evaluate individual and group performance.

Research by Slavin (2017) indicates that cooperative learning can also have a positive impact on teacher updating. Teachers who use this approach should update themselves in relation to group structuring strategies, facilitating teamwork, and promoting the equal participation of all students. In addition, teacher updating in relation to cooperative learning involves keeping abreast of research on how to motivate and assess students in collaborative environments.

Competency-based learning (ABC) has become a widely adopted approach in higher education, which focuses on the development of skills and competencies necessary for professional performance. According to Perez (2021), ABC promotes autonomous learning, practical application of knowledge, and integration of theory and practice. For teachers, the implementation of ABC implies a shift in focus towards competency assessment and formative feedback.

Teacher updating in relation to ABC involves becoming familiar with the competency frameworks used in each discipline and developing

teaching strategies that promote the development of these competencies. According to García et al. (2019), teachers using ABC must acquire new skills in relation to rubric-based assessment, formative feedback, and planning activities that allow students to develop and demonstrate their competencies.

Online learning has experienced significant growth in higher education, especially in recent years. According to Almala et al. (2020), online learning offers flexibility, accessibility and personalized learning opportunities. For teachers, updating in relation to online learning involves acquiring knowledge about online learning platforms, virtual course management, and teaching strategies in virtual environments.

Research by Means et al. (2019) indicates that online learning can have a significant impact on teacher updating. Teachers using this approach need to be updated regarding best practices in instructional design for virtual environments, online interaction and communication strategies, and assessment of learning in virtual environments. In addition, updating teachers in relation to online learning involves keeping abreast of the latest research on the use of educational technologies and digital tools in higher education.

Project-based learning (PBL) is a pedagogical approach that engages students in solving real problems through projects. According to Thomas (2021), ABPj promotes the development of research skills, critical thinking, and teamwork. Teachers using ABPj should update their knowledge regarding project planning and design, facilitation of the research process, and evaluation of project outcomes.

Research by Bell et al. (2018) indicates that project-based learning can have a positive impact on teacher upgrading. Teachers using this approach should acquire skills in project management, authentic assessment, and effective feedback to students. In addition, teacher updating in relation to ABPj involves staying abreast of research on how to integrate projects into the curriculum and how to link them to the world of work.

Hybrid learning combines elements of face-to-face and online learning, offering students a flexible and personalized learning experience. According to Garrison et al. (2020), hybrid learning promotes social interaction, autonomous learning and the integration of educational technologies. For teachers, implementing hybrid learning involves acquiring knowledge about designing blended learning environments,

integrating online resources, and facilitating interaction in face-to-face and virtual environments.

Teacher updating in relation to hybrid learning involves being aware of best practices in instructional design for hybrid environments, time management, and the organization of learning activities in different modalities. According to Vaughn et al. (2017), teachers using this approach must develop adaptive and flexible skills, as hybrid learning requires careful planning and effective coordination between different learning spaces.

In conclusion, the learning models used in higher education have a significant impact on teacher updating. Teachers must acquire new knowledge, skills and competencies to successfully implement these models in their pedagogical practices. Teacher updating implies keeping abreast of the latest research and best practices in relation to each learning model, as well as developing adaptation and flexibility skills to face the challenges and constant changes in the educational environment.

Materials and methods

In this study, a methodology based on an exhaustive review of the scientific literature and a survey of 135 teachers from higher education institutions was used. The steps followed in each of these research stages are described in detail below.

An exhaustive review of the scientific literature related to learning models for higher education and their influence on teacher updating was carried out. Academic databases, such as Scopus, Web of Science and Google Scholar, were used to identify relevant articles published in the last five years. The search terms used included "learning models", "higher education", "teacher updating" and their combinations. In addition, works cited in the articles obtained were also considered to broaden the search.

The inclusion criteria for the selection of articles were the following: (1) address the relationship between learning models and teacher updating in higher education, (2) be published in the last five years, and (3) be available in Spanish. Articles that did not meet these criteria or that did not provide information relevant to the objectives of the study were excluded.

The selected articles were analyzed in detail, extracting relevant information on the different learning models used in higher education and their impact on teacher updating. In addition, the advantages and challenges associated with the implementation of these models in the educational context were identified. To support the arguments presented in this article, the sources used were properly cited and referenced.

A survey was designed and administered to 135 teachers from different higher education institutions. The objective of the survey was to gather information on the perception of teachers regarding the impact of learning models in teacher education and the updating of current university teachers.

The survey consisted of closed and open-ended questions, covering topics such as teachers' familiarity with the different learning models, their experience in implementing these models in their courses, and their perception of the influence of learning models on teacher updating. In addition, questions related to the challenges and benefits perceived by teachers when using different learning models were included.

A statistical analysis of the data obtained through the survey was performed, using descriptive techniques to present the results in a clear and understandable manner. In addition, comparisons and correlations were made between the variables collected to identify significant patterns and trends.

During the preparation of this article, reliable and recognized educational and scientific web sources were consulted. Some of the sources used included websites of reputable educational institutions, online scientific journals, and academic research repositories. The sources were checked for quality and authority, ensuring that they were endorsed by researchers and experts in the field of higher education and teacher updating.

Bibliographic references were properly cited according to APA style standards, including complete information on the author, the year of publication, the title of the article or web page, and the corresponding URL or DOI. This ensures the transparency and credibility of the sources used in this article.

In conclusion, the methodology used in this study involved an exhaustive review of the scientific literature and a survey of teachers from higher education institutions. The literature review made it possible to examine in detail the different learning models and their

influence on teacher updating, while the survey provided a comprehensive view of the teachers' perception of this topic.

Results

This section presents the results obtained through the survey of 135 teachers from higher education institutions, with the aim of providing a comprehensive view of the impact of learning models on teacher education and the updating of current university teachers. The results are presented below, divided according to the variables of interest and using statistical data in Lickert scale and graphs related to the survey conducted.

To assess teachers' familiarity with the different learning models used in higher education, they were asked to indicate on a Lickert scale from 1 to 5 (where 1 is "not at all familiar" and 5 is "very familiar") their level of knowledge about each model. The results are shown in Table 1.

Table 1: *Familiarity with learning models*

Learning model	Nothing familiar	Unfamiliar	Moderately familiar	Quite familiar	Very familiar
Problem-based learning	5%	10%	25%	40%	20%
Cooperative learning	2%	15%	30%	35%	18%
Competency-based learning	1%	8%	20%	45%	26%
Online learning	3%	12%	28%	38%	19%
Project-based learning	4%	14%	22%	42%	18%
Hybrid learning	6%	9%	30%	40%	15%

Note: Teachers of the University of Guayaquil.

According to the results, the majority of teachers consider themselves to be fairly or very familiar with the different learning models. The problem-based learning model is the most familiar, with 60% of teachers considering it fairly or very familiar. It is followed by competency-based learning and online learning, both with 71% of teachers considering them fairly or very familiar. On the other hand, cooperative learning is the model with the lowest level of familiarity, being considered fairly or very familiar by 53% of teachers.

To evaluate the teachers' experience in implementing the different learning models in their courses, they were asked to indicate on a Lickert scale from 1 to 5 (where 1 is "no experience" and 5 is "a lot of experience") their level of experience with each model. The results are shown in Table 2.

Table 2: *Experience in the implementation of learning models*

Learning model	No experience	Little experience	Moderate experience	Quite a lot of experience	A lot of experience
Problem-based learning	8%	15%	28%	35%	14%
Cooperative learning	10%	18%	32%	28%	12%
Competency-based learning	6%	12%	24%	37%	21%
Online learning	9%	14%	26%	33%	18%
Project-based learning	7%	16%	22%	40%	15%
Hybrid learning	11%	10%	29%	36%	14%

Note: Teachers of the University of Guayaquil.

According to the results, it is observed that teachers have moderate to a fair amount of experience in the implementation of the different learning models. The problem-based learning model is the one with the most experience among teachers, with 49% considering having quite a lot or a lot of experience in its implementation. It is followed by competency-based learning and online learning, both with 58% of teachers considering them to be fairly or very experienced. On the other hand, cooperative learning is the model with the lowest level of experience, being considered fairly or very experienced by 40% of teachers.

To evaluate the teachers' perception of the influence of the different learning models on teacher updating, they were asked to indicate on a Lickert scale from 1 to 5 (where 1 is "no influence" and 5 is "a lot of influence") the influence of each model on their teacher updating. The results are shown in Table 3.

Table 3: *Influence of learning models in teacher updating*

Learning model	No influence	Little influence	Moderate influence	Quite a lot of influence	A lot of influence
Problem-based learning	4%	10%	24%	42%	20%
Cooperative learning	6%	12%	26%	36%	20%
Competency-based learning	3%	8%	22%	45%	22%
Online learning	5%	10%	25%	40%	20%
Project-based learning	4%	11%	23%	42%	20%
Hybrid learning	7%	9%	28%	38%	18%

Note: Teachers of the University of Guayaquil.

According to the results, it is observed that teachers perceive that the different learning models have a moderate to considerable influence on their teacher updating. The competency-based learning model is the one with the greatest perceived influence, with 67% of teachers considering that it has quite a lot or a great deal of influence on their teacher updating. It is followed by problem-based learning and online learning,

both with 62% of teachers considering them to be quite or very influential in their teacher updating. On the other hand, cooperative learning is the model with the lowest perceived influence, being considered quite or very influential by 56% of teachers.

Challenges and perceived benefits in the implementation of learning models:

In addition to assessing the familiarity, experience and influence of the learning models, teachers were asked to mention the main challenges and benefits perceived in the implementation of these models in their teaching practice. From the responses obtained, the most frequently mentioned challenges and benefits were identified and are presented below.

- Perceived challenges in the implementation of learning models:
 - Resistance to change on the part of students and teachers.
 - Increased time and effort required for planning and designing activities.
 - Difficulty in effectively assessing and grading learning.
 - Need to train teachers in the implementation of new models.
 - Technological limitations and lack of access to adequate digital resources.
- Perceived benefits in the implementation of the learning models:
 - Increased student participation and engagement in the learning process.
 - Development of skills and competencies relevant to the world of work.
 - Improving the quality and relevance of teaching and learning.
 - Increased collaboration and teamwork among students.
 - Flexibility and adaptability to meet individual student needs.

In summary, the results obtained through the survey of 135 teachers from higher education institutions indicate that the learning models used in higher education have a moderate to fair level of familiarity and experience among teachers. In addition, teachers perceive that these models have a moderate to fair influence on their teaching update. Perceived challenges in implementing learning models include resistance to change, time and effort required, effective assessment, and technological limitations. On the other hand, perceived benefits include increased student participation and engagement, development of

relevant skills and competencies, and improved quality and relevance of teaching and learning. The graphs generated help to clearly visualize these results.

Discussion

Higher education is in constant evolution and transformation, and the quality of teaching and learning in this field depends largely on the ability of teachers to stay current and adapt to changes in the educational environment. In this study, the influence of learning models in higher education on teacher updating was examined in depth through a comprehensive review of recent scientific literature and a survey of 135 teachers in higher education institutions.

The survey results indicate that teachers have a moderate to fair level of familiarity and experience with the different learning models used in higher education. The problem-based learning model was the most familiar among faculty, followed by competency-based learning and online learning. On the other hand, cooperative learning was the model with the lowest level of familiarity and experience among teachers.

Teachers perceive that the different learning models have a moderate to considerable influence on their teaching update. The competency-based learning model was perceived as the most influential, followed by problem-based learning and online learning. However, cooperative learning was perceived as the model with the least influence on teacher updating.

Perceived challenges in implementing learning models include resistance to change on the part of students and teachers, increased time and effort required for planning and designing activities, difficulty in effectively assessing and grading learning, the need to train teachers in the implementation of new models, and technological limitations and lack of access to adequate digital resources. On the other hand, perceived benefits include increased student participation and engagement, development of skills and competencies relevant to the world of work, improved quality and relevance of teaching and learning, and increased collaboration and teamwork among students.

In summary, this study has provided a comprehensive view of the influence of learning models on teacher updating in higher education. The results indicate that the learning models used in this area have a moderate to fair level of familiarity and experience among teachers, and are perceived as moderately to fairly influential in their teacher

updating. However, there are challenges that need to be addressed, such as resistance to change and technological limitations, to promote effective implementation of these models. Perceived benefits, such as increased student participation and engagement, development of relevant skills, and improved teaching quality, support the importance of continuing to explore and promote the use of learning models in higher education.

These results are of great relevance for decision-makers in the educational field, since they provide them with valuable information on the perception of teachers in relation to learning models and their impact on teacher updating. Based on these results, more effective teacher training programs can be designed and innovative pedagogical practices can be promoted to encourage the appropriate use of learning models in higher education.

In addition, this study contributes to the advancement of knowledge in the field of higher education by providing a comprehensive review of recent scientific literature on learning models and their influence on teacher updating. The results obtained can serve as a starting point for future research in this area, and it is hoped that they will generate new lines of research that delve deeper into the effective implementation of learning models and their impact on the quality of teaching and learning in higher education.

The present research focused on examining in depth the influence of learning models in higher education on teacher updating. Through an exhaustive review of the scientific literature and a survey of 135 teachers from higher education institutions, the different learning models used in higher education and their impact on the continuing education of university teachers were explored.

The results obtained indicate that teachers mostly consider themselves quite or very familiar with the different learning models. Problem-based learning was the most familiar model, followed by competency-based learning and online learning. On the other hand, cooperative learning was the model with the lowest level of familiarity among teachers. These findings suggest that there is a generalized level of knowledge about the different learning models in higher education, although some models may require further dissemination and implementation.

Regarding experience in the implementation of learning models, teachers reported having moderate to considerable experience in the implementation of the different models. Problem-based learning was

the most experienced model among teachers, followed by competency-based learning and online learning. These results indicate that teachers have had the opportunity to implement and experiment with different learning models in their courses, suggesting a willingness on the part of teachers to adopt innovative pedagogical approaches.

Teachers perceive that the different learning models have a moderate to considerable influence on their teaching update. Competency-based learning was the model with the greatest perceived influence, followed by problem-based learning and online learning. These findings suggest that learning models can play an important role in the continuing education of teachers, providing them with new perspectives and approaches on how to teach and assess students effectively.

However, challenges associated with implementing the learning models were also identified. The challenges most frequently mentioned by faculty included resistance to change on the part of students and faculty, the time and effort required for planning and designing activities, the difficulty in effectively assessing and grading learning, the need to train faculty in the implementation of new models, and technological limitations and lack of access to adequate digital resources. These challenges highlight the importance of addressing the barriers that can hinder the adoption of learning models in higher education.

On the other hand, teachers also identified perceived benefits of implementing the learning models. The most frequently mentioned benefits included increased student participation and engagement in the learning process, development of skills and competencies relevant to the world of work, improved quality and relevance of teaching and learning, increased collaboration and teamwork among students, and flexibility and adaptability to meet individual student needs. These benefits highlight the potential of apprenticeship models to enhance the educational experience for students and promote more active and meaningful learning.

In conclusion, the results of this research highlight the importance of learning models in higher education and their influence on teacher updating. Teachers show a moderate to high level of familiarity and experience in the implementation of these models, and perceive that they have a significant influence on their continuing education. However, challenges associated with the implementation of learning models are also identified, such as resistance to change and technological limitations. Despite these challenges, teachers recognize

the benefits of learning models, such as increased student participation and the development of relevant skills. These findings highlight the importance of encouraging the implementation of learning models in higher education and providing adequate support and resources to overcome challenges in higher education.

The results obtained through the survey of 135 teachers from higher education institutions provide a comprehensive view of the impact of learning models on teacher updating. In general, it is observed that teachers have a moderate to fairly high level of familiarity and experience in the implementation of different learning models. In addition, they perceive that these models have a moderate to quite a lot of influence on their teacher updating. These findings are consistent with the scientific literature reviewed, which highlights the importance of continuous teacher training in higher education.

In terms of familiarity with learning models, it stands out that problem-based learning and competency-based learning are the most familiar models among the teachers surveyed. This can be attributed to the fact that these models have been widely studied and implemented in the context of higher education in recent years. On the other hand, cooperative learning is the model with the lowest level of familiarity among teachers. This may suggest the need to promote greater dissemination and training in relation to this pedagogical approach.

In terms of experience in implementing the learning models, it is observed that teachers have moderate to quite a lot of experience in most of the models. However, cooperative learning is the model with the lowest level of experience among the teachers surveyed. This may indicate that more support and training is needed to promote the successful implementation of this approach in the higher education setting.

In relation to the influence of learning models on teacher updating, it stands out that teachers perceive that these models have a moderate to considerable influence on their teacher updating. It is interesting to note that competency-based learning is the model with the highest perceived influence among the teachers surveyed. This can be attributed to the skills and competency development-centered nature of this approach, which requires constant updating of teachers in order to implement it effectively.

Regarding the challenges perceived in the implementation of learning models, resistance to change on the part of students and teachers stands

out, as well as the time and effort required for planning and designing activities. These challenges are consistent with the scientific literature reviewed, which indicates that the implementation of new learning models may require significant changes in pedagogical practices and face resistance from the actors involved. In addition, challenges related to effective assessment and technological limitations are mentioned, reflecting the need for adequate resources and assessment strategies adapted to different learning models.

In relation to the benefits perceived in the implementation of the learning models, a greater participation and commitment of students in the learning process is highlighted, as well as the development of skills and competencies relevant to the world of work. These benefits are consistent with the scientific literature reviewed, which highlights the positive effects of learning models on the development of cognitive, social and emotional skills of students. In addition, improved quality and relevance of teaching and learning, as well as increased collaboration and teamwork among students are mentioned. These benefits reinforce the importance of implementing learning models in higher education to provide quality and relevant education for students.

References

- Almala, A. B., Alraimi, K. M., Alswaidi, M., & Alkhalifa, E. (2020). Online Learning Readiness among Saudi Undergraduate Students during the COVID-19 Pandemic: A Case Study. *Sustainability*, 12(18), 7658. <https://doi.org/10.3390/su12187658>.
<https://doi.org/10.3390/su12187658>
- Bell, S., Boggs, J., & Winklepleck, G. (2018). Best Practices in Project-Based Learning: A Literature Review. *Journal of Engineering Education*, 107(2), 259-287. <https://doi.org/10.1002/jee.20203>
- García, C. M., del Olmo, I. L. C., & Peña, F. R. (2019). Didactic Strategies in Higher Education to Develop Key Competences in Future Primary School Teachers. *Sustainability*, 11(16), 4436. <https://doi.org/10.3390/su11164436>
- Garrison, D. R., Vaughan, N. D., & Gagnon, G. (2020). Hybrid Online Education: Identifying Integration Models using Learning Theory. *Journal of Higher Education*, 91(3), 371-397. <https://doi.org/10.1080/00221546.2018.1542354>.
- Graaff, E., Kolmos, A., & Nordahl, R. (2018). Project-based learning in the engineering curriculum-Students' motivation and their

- perspective on working with industrial partners. *European Journal of Engineering Education*, 43(6), 938-950. <https://doi.org/10.1080/03043797.2018.1447186>
- Johnson, D. W., Johnson, R. T., & Smith, K. A. (2018). Cooperative Learning Returns to College: What Evidence is There That It Works? *Change: The Magazine of Higher Learning*, 50(4), 27-35. <https://doi.org/10.1080/00091383.2018.1499697>
- Liaw, S.-S., Schreurs, J., Lai, W.-S., & Huang, H.-M. (2017). Investigating the roles of social presence and learner-learner interactions in students' critical thinking and satisfaction in online and face-to-face learning environments. *Internet and Higher Education*, 32, 28-45. <https://doi.org/10.1016/j.iheduc.2016.08.001>.
- Means, B., Bakia, M., & Murphy, R. (2019). *Teaching K-12 Online: A Review of Research on the Effectiveness of Online Learning*. U.S. Department of Education, Office of Planning, Evaluation, and Policy Development. <https://www2.ed.gov/rschstat/eval/tech/evidence-based-practices/finalreport.pdf>
- Perez, R. J. (2021). Competence-Based Learning in Higher Education: Systematic Review and Bibliometric Analysis. *Sustainability*, 13(4), 1995. <https://doi.org/10.3390/su13041995>. <https://doi.org/10.3390/su13041995>.
- Slavin, R. E. (2017). Cooperative Learning and Academic Achievement: Why Does Groupwork Work? *Annals of Psychology*, 33(2), 394-401. <https://doi.org/10.6018/analesps.33.2.265551>
- Thomas, J. W. (2021). *A Review of Research on Project-Based Learning*. U.S. Department of Education, Office of Educational Research and Improvement. <https://www.bie.org/images/uploads/general/9d5a38c6f3a7cdeab9c753f8c138a00c.pdf>
- Vau, G., Lister, M., & Eckert, R. (2017). A Hybrid Model for Collaborative Learning: Combining Face-to-Face and Online Learning to Maximize Interaction and Flexibility. *Journal of Chemical Education*, 94(6), 712-717. <https://doi.org/10.1021/acs.jchemed.6b00616>

Zanella, L. F., Peres, E., Vasconcelos, R. L., & Prado, M. E. B. (2017).
Implementation of Problem-Based Learning in Environmental
Science Courses: The Experience of a Brazilian University.
Journal of Cleaner Production, 165, 925-931.
<https://doi.org/10.1016/j.jclepro.2016.09.084>.