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Assessing Content Assimilation in Health Research Methodology: A Comparative Study of Lecture and Flipped Classroom Instruction
Evaluación de la asimilación de contenidos en la metodología de investigación en salud: un estudio comparativo de la conferencia y la instrucción en el aula invertida

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Abstract

Virtual education has evolved significantly, driven by the integration of Information and Communication Technology (ICT) resources, particularly during the COVID-19 pandemic. Health Sciences, with their practical components, present unique challenges in virtual education, including maintaining student engagement. This study aimed to compare the effectiveness of the flipped learning methodology with and without in-class content reinforcement in a virtual classroom for previously assimilated materials within Health Sciences. The study involved students in a Kinesiology program using the Blackboard Learn platform. Two groups were established: one completing a

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questionnaire at the beginning of the virtual class (FLI group) and the other at the end following a content reinforcement session (FLI+TRA group). While no statistically significant score differences were found between the two groups, the FLI+TRA group showed higher pass rates and improved average scores, indicating practical benefits. These results suggest that combining flipped learning with traditional in-class instruction can enhance content assimilation in virtual education, fostering increased student engagement and participation. However, further research is needed to explore the full implications and adaptability of this approach. In conclusion, this study highlights the potential of the FLI+TRA approach to improve learning outcomes in complex subjects like Epistemology and Research Methodology within Health Sciences. As virtual education continues to evolve, educators should consider this hybrid teaching model as a valuable tool to provide a more holistic and effective learning experience.

Keywords: flipped learning; traditional classroom; virtual learning; health sciences; kinesiology.

Resumen

La educación virtual ha evolucionado significativamente, impulsada por la integración de recursos de Tecnologías de la Información y Comunicación (TIC), especialmente durante la pandemia de COVID-19. Las Ciencias de la Salud, con sus componentes prácticos, presentan desafíos únicos en la educación virtual, incluida la retención del interés de los estudiantes. Este estudio tuvo como objetivo comparar la efectividad de la metodología de aprendizaje invertido (flipped learning) con y sin refuerzo de contenido en clase en un aula virtual para materiales previamente asimilados en Ciencias de la Salud. El estudio involucró a estudiantes de un programa de Kinesiología utilizando la plataforma Blackboard Learn. Se establecieron dos grupos: uno completando un cuestionario al comienzo de la clase virtual (grupo FLI) y otro al final después de una sesión de refuerzo de contenido en clase (grupo FLI+TRA). Aunque no se encontraron diferencias estadísticamente significativas en las puntuaciones entre los dos grupos, el grupo FLI+TRA mostró tasas de aprobación más altas y puntajes promedio mejorados, lo que indica beneficios prácticos. Estos resultados sugieren que la combinación de aprendizaje invertido con instrucción tradicional en clase puede mejorar la asimilación de contenido en la educación virtual, fomentando un mayor compromiso y participación de los estudiantes. Sin embargo, se necesita más investigación para explorar las implicaciones y la adaptabilidad completas de este enfoque. En conclusión, este estudio resalta el potencial del enfoque FLI+TRA para mejorar los resultados de aprendizaje en materias complejas como Epistemología y Metodología de Investigación en Ciencias de la Salud. A medida que la educación virtual continúa evolucionando, los educadores deben considerar este modelo de enseñanza híbrido como una herramienta valiosa para proporcionar una experiencia de aprendizaje más holística y efectiva.

Palabras clave: aprendizaje invertido; aula tradicional; aprendizaje virtual; ciencias de la salud; kinesiolgía.

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Introduction

Virtual education, defined as instruction or learning when teachers and students are separated by time, space, or both (Dung, 2020), is experiencing a significant transformation. The utilization of new technologies and Information and Communication Technology (ICT) resources, including video conferencing, streaming, and mobile applications, is at the core of virtual teaching. The emergence of virtual teaching platforms like Blackboard Learn and integrated streaming services such as Blackboard Collaborate Ultra has played a pivotal role in bolstering virtual education, particularly during the COVID-19 pandemic (Al-khresheh, 2021), and this trend continues today (Hill, 2019; Raza et al., 2022). In this line, many educational centers such as universities has perceived the COVID-19 pandemic as an opportunity to mix presential and virtual environments, making the learning process more dynamic (Kurbakova et al., 2020). Nonetheless, virtual education requires to the teachers specific skills, knowledge, strategies and attitudes to adapt the content to the non-presential classroom (Spante et al., 2018). In any case, teaching methodology employed in traditional classrooms could be adapted to the virtual mode, but it could be a challenge for teachers (Torres Martin et al., 2021). Nonetheless, it is important to highlight that Blackboard Learn could present several limitations, especially those related to student monitoring and individualization of teaching, that could make difficult establishing alternative teaching methodologies. In addition, difficulties of the students with low resources such as poor internet connections may turn this platform into a means of discrimination, especially in pandemic situations in which no alternatives could be offered. Comparing with its competitors such as Google Classrooms, Blackboard Collaborate offers an integration with Blackboard Learn, thus offering more resources, discussion forums, etc. A great disadvantage is its costs, but they are usually covered by the university, so the students have not to pay for its use.

Virtual education has demonstrated its efficacy in the learning process of Health Science students (Almarzooq et al., 2020). This is noteworthy as Health Sciences often require hands-on practical components, which can pose challenges to the teaching-learning process when delivered virtually, unlike disciplines such as Social Sciences

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(Calderón, 2002). Despite the adoption of commonly used online teaching tools like Blackboard Collaborate Ultra, maintaining student engagement and motivation remains a persistent challenge for educators (Beluce & Oliveira, 2015; Huang et al., 2019). Traditionally, the delivery of content by instructors with the expectation that students will assimilate it has been the predominant approach (Morell, 2004). However, a shift towards methodologies promoting student autonomy and active participation has gained popularity, especially in higher education where students possess the maturity to engage effectively with alternative methods (Hernández et al., 2020; Labrador & Andreu, 2008). In this line, flipped learning is an alternative methodology which consists on recording in-class activities to convey a course: Students watch the video before the class and use the class time to solve complex concepts, answer questions, and students are encouraged to learn actively as well as create bonds with daily lives (Hwang et al., 2015)). Nonetheless, flipped learning could also be applied with alternative material such as books, PDF of the syllabus to study, etc. In the university context, the flipped learning or flipped classroom methodology has gained popularity for its ability to foster student autonomy and enhance the teaching-learning process (Al-Samarraie et al., 2020). Flipped learning allocates classroom time to practical or engaging activities such as discussions and projects (Bergmann & Sams, 2012). This approach has demonstrated its potential to enrich teaching and learning processes, integrate concepts, redefine the roles of educators and students, enhance participation and communication, utilize ICT resources, improve academic performance, and boost the interest of university students (Flores et al., 2016).

Previous research has established the effectiveness of this approach (i.e., flipped learning) in virtual university contexts and especially in Health Sciences. A study conducted by Halasa et al. (2020) demonstrated that flipped classroom is more effective in assimilating nursing contents than traditional classrooms. In addition, a systematic review conducted by Banks & Kay (2022) showed the effectiveness of flipped classrooms in 16 included studies, concluding that flipped learning could be effective in producing positive changes in academic performance, enhancing student satisfaction and self-efficacy linked to well-designed curriculum. In addition, a study conducted by

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Pozo-Sanchez et al. (2019) showed that students perceive and could assimilate better the contents using flipped learning in superior education (e.g., university), whereas during the childhood this methodology could not be very valuable. Nonetheless, it is necessary to check if flipped learning learning could be improved with a traditional reinforcement.

In light of these developments, this study aimed to compare the effectiveness of the flipped learning methodology without in-class content reinforcement against the same methodology with content reinforcement in the virtual classroom for previously assimilated materials. This investigation seeks to shed light on the evolving landscape of virtual education, its applicability in Health Sciences, and the role of pedagogical methodologies in content assimilation.

Methods

Experimental Design

The current study was conducted within the curriculum of the "Epistemology and Research Methodology" course, a part of the Kinesiology program at the University Andrés Bello (Santiago, Chile). This course was part of the first semester of the second year. Teaching for this course was a collaborative effort, with 70% of instruction delivered by faculty from the University Andrés Bello and the remaining 30% by faculty from the University Europea de Madrid. The portion of the course conducted by the University Europea de Madrid (the focus of this study) was entirely online, utilizing the Blackboard Learn platform. The instructional methodology employed within the course was the flipped learning approach, where students received detailed PDF documents containing the study material. This material was organized into two units, each comprising several topics (seven topics for the first unit and eleven topics for the second unit). An schematic approach of the study design is shown in Figure 1.

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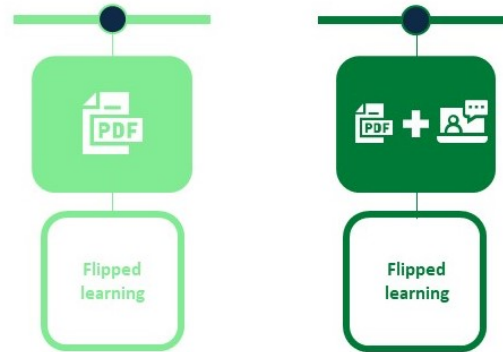


Figure 1. Experimental approach of the study

Assessment within the University Europea de Madrid segment of the course consisted of three graded activities and a final exam. Prior to each graded task and the final exam, a virtual class session was conducted by faculty from the University Europea de Madrid. These sessions aimed to address student queries and engage in activities aligned with the flipped learning methodology.

The present study aimed to evaluate, using a 10-question questionnaire in 5 minutes, whether students had correctly assimilated the course content. Specifically, the questionnaire assessed topics including "Randomized Clinical Study," "Scientific Articles," "Article Structure," "Scientific Article Writing," and "Journal Quality." This questionnaire corresponded to the third graded activity, and students were already familiar with this assessment method. Two student groups were established within the course. One group completed the questionnaire at the beginning of the virtual class (FLI group), while the other group completed the questionnaire at the end of the class following a reinforcement session covering the content of the topics taught through traditional methodology (FLI+TRA group). The present study followed a quasi-experimental design, since no randomization of the groups was made. Randomization was not possible due to the groups conformed by the university, according to the schedule needs of the students. Nonetheless, the content was the same for both groups (i.e., same PDFs). Consequently, the professor could not influence the results due to different explanations of the contents in the FLI+TRA group or the FLI group. In

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addition, it is important to highlight that one class (i.e., FLI) followed the other one (i.e., FLI+TRA), thus not allowing students to communicate from one class to another. Figure 1 illustrates the schematic representation of the experimental design.

Participants

Each group comprised ten students, totaling twenty participants. In the FLI+TRA group, class participation was at 100%, while in the FLI group, participation stood at 70%. The age of the participants ranged from 19 to 24 years, with twelve male and five female students. All participants were enrolled in the Kinesiology program at the University Andrés Bello, registered for the "Epistemology and Research Methodology" course, and received instruction from the University Europea de Madrid, as previously outlined. This course served as their initial exposure to research methodology content, ensuring that no group had previously undertaken the course with a higher level of knowledge.

Procedure

A 10-question online questionnaire was administered either at the beginning of the virtual class (FLI) or at the end of the virtual class following a review session (FLI+TRA). The virtual class sessions were conducted using the Blackboard Collaborate Ultra platform. The questionnaire was administered via Google Forms, with automated scoring. Each of the ten questions had four answer options, with one correct response, except for one question with two correct options.

Pre-Questionnaire Virtual Class (FLI+TRA)

The virtual theoretical class preceding the questionnaire in the FLI+TRA group consisted of two parts. The first twenty minutes were dedicated to addressing student queries regarding the content they had previously studied through the provided PDF documents, which extensively covered the assessable content from each topic. Subsequently, a sixty-minute session was devoted to reviewing all theoretical content through a lecture by the instructor. Throughout the class, students were encouraged to reflect on the topic content through questions and were required to provide examples for

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each assessable content item from the topics. Following this, ten minutes were allocated for the administration of the questionnaire. The entire class duration was ninety minutes. It was explicitly communicated that the questionnaire would not contribute to their course grade but was intended as a simulation for the final exam.

Post-Questionnaire Virtual Class (FLI)

The virtual theoretical class following the questionnaire in the FLI group spanned eighty minutes (following the initial ten minutes allotted for the questionnaire). During this session, each questionnaire item was revisited, with explanations provided for the correctness or incorrectness of possible answer choices. This dynamic approach addressed student queries and further clarified the topic content. Similar to the FLI+TRA group, it was emphasized that the questionnaire would not impact their course grades but was intended to serve as an exam simulation. The complete ad-hoc questionnaire designed for the intervention is shown in Appendix 1.

Statistical Analysis

A descriptive analysis was performed on the scores of each group, with scores reported as mean \pm standard deviation. Additionally, the percentage of students passing (i.e., scores equal to or exceeding 5) within each group was reported. A simple analysis of variance (ANOVA) was conducted between the two groups. Statistical analysis was performed using the Jamovi software (The Jamovi project, 2019, Version 2.3.18), with significance set at $\alpha < 0.05$.

Results

Results obtained by the students in the ad-hoc designed questionnaire ranged from 0 to 10 points. Scoring obtained by FLI+TRA group was 6.3 ± 2.15 points, whereas FLI group obtained 5 ± 2.67 . ANOVA showed no statistically significant differences between groups ($p = 0.341$). The approval rate in the FLI+TRA group was 80%, whereas the approval rate in the FL group was 57.14%. Therefore, despite the absence of statistically significant differences, FLI+TRA group obtained a mean score

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1.3 points higher than FLI group, with a 22.86% higher approval rate, thus representing a substantial and relevant difference. Results are summarized in Figure 2.

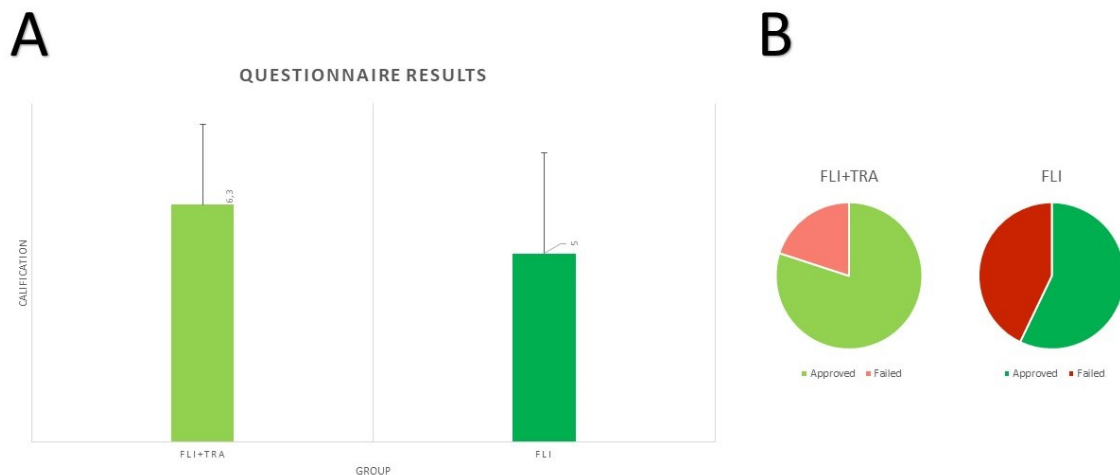


Figure 2. Questionnaire results in flipped learning in addition to traditional explanation (FLI+TRA) group and flipped learning (FLI) group (A) and approval rates (B). FLI+TRA showed higher mean scores and approval rates in the results of the test when compared to FLI.

Discussion

The utilization of the flipped learning methodology has proven effective in ensuring that the average student passes a test even when encountering the content for the first time. However, providing a small in-class reinforcement after students have autonomously assimilated the content can increase the number of passing grades and elevate the average scores for the same test. Although no statistically significant differences were found in the ANOVA test, the grades are substantially better in the FLI+TRA (flipped learning with traditional instruction) group, showing a higher pass rate. This could be attributed to the small sample size used in the study, which can significantly affect the ability to detect significant differences (Cohen, 1992). However, virtual teaching to large numbers of students does not seem to be a very effective strategy (Rubio Hernández & Olivo-Franco, 2020). Additionally, international teaching, especially in this format for the first time for students, can also be a limiting factor.

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The results of the present study demonstrate that the combination of both methodologies can be more effective in helping students better assimilate content, especially when that content is new and unfamiliar. One possible explanation for these results could be that traditional in-class instruction provides students with an opportunity to clarify doubts and receive more direct guidance from the teacher (Isaza Restrepo, 2005). Although the flipped learning methodology allows students to acquire theoretical knowledge autonomously, some students may struggle to fully comprehend certain concepts without additional guidance and may even resist this methodology (Jordán Lluch, 2014). Traditional in-class instruction, when combined with the flipped learning methodology, can help address these difficulties and provide greater clarity in content understanding.

Moreover, the positive impact of the FLI+TRA approach extends beyond just test scores. It could increase student engagement and participation during class sessions as shown in this study. By encouraging students to ask questions, share ideas, and collaborate on practical activities, this hybrid teaching model promotes active learning and peer interaction. This, in turn, can lead to a deeper comprehension of the material and a more enriched educational experience. Nonetheless, more research is needed in this line to corroborate these preliminary findings, especially in university contexts, where class attendance is not mandatory.

The results of the present study are in line with previous research, since several studies have demonstrated the effectiveness of flipped learning (Halasa et al., 2020; Pozo-Sanchez et al., 2020). In this line, only FLI presented a mean score of 5 (i.e., passed), despite the fact that the students studied the content for the first time. Nonetheless, our study showed that a traditional reinforcement could enhance the benefits of flipped learning, thus promoting the autonomy of the student. Moreover, these positive results could be influenced by the age and autonomy of the students, which is greater than in school contexts. Therefore, teachers in preschool or school should interpret these results with caution, since the autonomy of the students is essential to implement flipped learning and has demonstrated not to be as effective as in university contexts (Pozo-Sanchez et al., 2019).

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While this study focuses on the effectiveness of the FLI+TRA approach for content assimilation, it's important to consider the broader implications for pedagogical practices. The findings suggest that educators should carefully consider the use of flipped learning in conjunction with traditional in-class instruction when introducing new and complex topics, especially in higher education contexts. Such an approach may prove particularly beneficial for students who may struggle with fully comprehending theoretical content independently.

However, it's essential to acknowledge that the effectiveness of the FLI+TRA approach can be influenced by various factors. The quality of the instructor's explanations, the design of in-class activities, and the level of student motivation all play critical roles. Creating a positive learning environment, fostering student-teacher rapport, and ensuring that students feel comfortable seeking clarification are essential elements for the success of this blended approach (Tabera Galván et al., 2015).

Furthermore, the study highlights the potential benefits of early exposure to active learning methodologies. By integrating flipped learning and traditional teaching into the curriculum, educators can help students develop important skills, such as critical thinking, problem-solving, and independent learning. These skills are increasingly valuable in today's rapidly evolving educational landscape and workforce.

Several limitations should be highlighted from this study. Firstly, the small sample size makes difficult to establish firm conclusions derived from the results of the present study. Nonetheless, the similar level of the students (i.e., their first contact with research methodology), as well as the proximity of the two classes (i.e., FLI group class followed the FLI+TRA group class) makes the results of the questionnaire a good indicator of the contents assimilation. Secondly, the virtual mode made difficult to control the honesty of the student without looking at the contents that have been provided (i.e., PDF) during the tests. Nonetheless, the time to complete the test was a limiting factor in this sense, not allowing the student to search in the documents, since the answer was not explicitly reported in the text.

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Thus, the combination of flipped learning with traditional in-class instruction presents a promising approach to enhance content assimilation in virtual education environments. While the study did not find statistically significant differences, the practical benefits observed in terms of pass rates and improved average scores suggest that this hybrid teaching model warrants further exploration. Educators should consider this approach as a valuable tool in their pedagogical toolbox, especially when introducing new and complex subject matter, to provide students with a more holistic and effective learning experience. In addition, future research should continue to study the best way to facilitate the learning process to the students in complex subjects in Health Sciences such as Epistemology and Research Methodology.

Conclusions

In summary, this study compared the effectiveness of flipped learning methodology with and without in-class content reinforcement for previously assimilated materials in the context of virtual education within Health Sciences. While no statistically significant differences were found in test scores between the two groups, the combination of flipped learning and traditional in-class instruction (FLI+TRA) demonstrated practical benefits, including higher pass rates and improved average scores. This hybrid teaching model promoted increased student engagement and participation, fostering a more enriched learning experience. While the study offers preliminary evidence of the FLI+TRA approach's potential, further research is needed to explore its full implications and adaptability in complex subjects like Epistemology and Research Methodology within Health Sciences, as educators continue to navigate the evolving landscape of virtual education.

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<https://doi.org/10.17979/sportis.2024.10.1.9956>

References

- Al-khresheh, M. (2021). Revisiting the effectiveness of Blackboard learning management system in teaching English in the era of COVID 19. *World Journal of English Language*, 12(1), 1-14. <https://doi.org/10.5430/wjel.v12n1p1>
- Almarzooq, Z. I., Lopes, M., & Kochar, A. (2020). Virtual learning during the COVID-19 pandemic: a disruptive technology in graduate medical education. *Journal of the American College of Cardiology*, 75(20), 2635-2638. <https://doi.org/10.1016/j.jacc.2020.04.015>
- Al-Samarraie, H., Shamsuddin, A., & Alzahrani, A. I. (2020). A flipped classroom model in higher education: a review of the evidence across disciplines. *Educational Technology Research and Development*, 68, 1017-1051. <https://doi.org/10.1007/s11423-019-09718-8>
- Banks, L., & Kay, R. (2022). Exploring flipped classrooms in undergraduate nursing and health science: a systematic review. *Nurse Education in Practice*, 103417. <https://doi.org/10.1016/j.nepr.2022.103417>
- Beluce, A. C., & Oliveira, K. L. D. (2015). Students' motivation for learning in virtual learning environments. *Paidéia (Ribeirão Preto)*, 25, 105-113. <https://doi.org/10.1590/1982-43272560201513>
- Biggs, J., & Tang, C. (2011). *EBOOK: Teaching for Quality Learning at University*. McGraw-hill education (UK).
- Calderón, C. (2002). Criterios de calidad en la investigación cualitativa en salud (ICS): apuntes para un debate necesario. *Revista española de salud pública*, 76, 473-482. <https://doi.org/10.1590/S1135-57272002000500009>
- Cohen, J. (1992). Statistical power analysis. *Current directions in psychological science*, 1(3), 98-101. <https://doi.org/10.1111/1467-8721.ep10768783>
- Dung, D. T. H. (2020). The advantages and disadvantages of virtual learning. *IOSR Journal of Research & Method in Education*, 10(3), 45-48.

Original article. Assessing Content Assimilation in Health Research Methodology: A Comparative Study of Lecture and Flipped Classroom Instruction. Vol. 10, n.º 1; p. 14-31, January 2024.
<https://doi.org/10.17979/sportis.2024.10.1.9956>

Flores, O., Del-Arco, I., & Silva, P. (2016). The flipped classroom model at the university: analysis based on professors' and students' assessment in the educational field. *International Journal of Educational Technology in Higher Education*, 13, 1-12. <https://doi.org/10.1186/s41239-016-0022-1>

Halasa, S., Abusalim, N., Rayyan, M., Constantino, R. E., Nassar, O., Amre, H., ... & Qadri, I. (2020). Comparing student achievement in traditional learning with a combination of blended and flipped learning. *Nursing Open*, 7(4), 1129-1138. <https://doi.org/10.1002/nop2.492>

Hernández, D. J., Ortiz, J. J. G., & Abellán, M. T. (2020). Metodologías activas en la universidad y su relación con los enfoques de enseñanza. *Profesorado, Revista de Currículum y Formación del Profesorado*, 24(1), 76-94. <https://doi.org/10.30827/profesorado.v24i1.8173>

Hill, L. (2019). Blackboard Collaborate Ultra: An Online, Interactive Teaching Tool. *Academy of Management Learning & Education*, 18(4), 640-642. <https://doi.org/10.5465/amle.2019.0027>

Huang, Y. C., Backman, S. J., Backman, K. F., McGuire, F. A., & Moore, D. (2019). An investigation of motivation and experience in virtual learning environments: A self-determination theory. *Education and Information Technologies*, 24, 591-611. <https://doi.org/10.1007/s10639-018-9784-5>

Hwang, G. J., Lai, C. L., & Wang, S. Y. (2015). Seamless flipped learning: a mobile technology-enhanced flipped classroom with effective learning strategies. *Journal of computers in education*, 2, 449-473. <https://doi.org/10.1007/s40692-015-0043-0>

Isaza Restrepo, A. (2005). Clases magistrales versus actividades participativas en el pregrado de medicina. De la teoría a la evidencia. *Revista de estudios sociales*, (20), 83-91. <https://doi.org/10.7440/res20.2005.05>

Original article. Assessing Content Assimilation in Health Research Methodology: A Comparative Study of Lecture and Flipped Classroom Instruction. Vol. 10, n.º 1; p. 14-31, January 2024.
<https://doi.org/10.17979/sportis.2024.10.1.9956>

Jordán Lluch, C., Pérez Peñalver, M. J., & Sanabria Codesal, E. (2014). Investigación del impacto en un aula de matemáticas al utilizar flip education. *Pensamiento matemático*, 4(2), 9-22.

Kurbakova, S., Volkova, Z., & Kurbakov, A. (2020, July). Virtual learning and educational environment: New opportunities and challenges under the COVID-19 pandemic. In *2020 The 4th International Conference on Education and Multimedia Technology* (pp. 167-171). <https://doi.org/10.1145/3416797.3416838>

Labrador, M., & Andreu, M. D. (2008). Metodologías activas. *València: Editorial de la UPV*.

McCue, T. J. (2019, July 31). *E learning climbing to \$325 billion by 2025 UF Canvas absorb Schoology Moodle*. Forbes

McLean, S., Attardi, S. M., Faden, L., & Goldszmidt, M. (2016). Flipped classrooms and student learning: not just surface gains. *Advances in physiology education*. <https://doi.org/10.1152/advan.00098.2015>

Mercado López, E. P. (2020). Limitaciones en el uso del aula invertida en la educación superior. *Revista Transdigital*, 1(1). <https://doi.org/10.56162/transdigital13>

Morell, T. (2004). La interacción en la clase magistral. España.

Pozo-Sanchez, S., Lopez Belmonte, J., Moreno Guerrero, A. J., & Lopez Nunez, J. A. (2019). Impact of educational stage in the application of flipped learning: A contrasting analysis with traditional teaching. *Sustainability*, 11(21), 5968. <https://doi.org/10.3390/su11215968>

Ramírez, D., Hinojosa, C., & Rodríguez, F. (2014). Advantages and disadvantages of flipped classroom: stem students' perception. In *ICERI2014 Proceedings* (pp. 121-127). IATED.

Raza, S. A., Qazi, Z., Qazi, W., & Ahmed, M. (2022). E-learning in higher education during COVID-19: evidence from blackboard learning system. *Journal of*

Original article. Assessing Content Assimilation in Health Research Methodology: A Comparative Study of Lecture and Flipped Classroom Instruction. Vol. 10, n.º 1; p. 14-31, January 2024.
<https://doi.org/10.17979/sportis.2024.10.1.9956>

Applied Research in Higher Education, 14(4), 1603-1622.
<https://doi.org/10.1108/JARHE-02-2021-0054>

Rubio Hernández, F. J., & Olivo-Franco, J. L. (2020). Dificultades del profesorado en sus funciones docentes y posibles soluciones. Un estudio descriptivo actualizado. *Ciencia y Educación*, 4(2), 7-25.
<https://doi.org/10.22206/cyed.2020.v4i2.pp7-25>

Spante, M., Hashemi, S. S., Lundin, M., & Algers, A. (2018). Digital competence and digital literacy in higher education research: Systematic review of concept use. *Cogent Education*, 5(1), 1519143.
<https://doi.org/10.1080/2331186X.2018.1519143>

Tabera Galván, M. V., Álvarez Comino, M. J., Hernando Jerez, A., & Rubio Alonso, M. (2015). Percepción de los estudiantes universitarios de Ciencias de la Salud sobre las actitudes de los docentes y su influencia en el clima de aprendizaje. *Revista Complutense de Educación*.
https://doi.org/10.5209/rev_RCED.2015.v26.n2.43028

Torres Martín, C., Acal, C., El Homrani, M., & Mingorance Estrada, Á. C. (2021). Impact on the virtual learning environment due to COVID-19. *Sustainability*, 13(2), 582. <https://doi.org/10.3390/su13020582>

Yean, L. S. (2019). Promoting active learning and independent learning among primary school students using flipped classroom. *International Journal of Education*, 4(30), 324-341.

Original article. Assessing Content Assimilation in Health Research Methodology: A Comparative Study of Lecture and Flipped Classroom Instruction. Vol. 10, n.º 1; p. 14-31, January 2024.

<https://doi.org/10.17979/sportis.2024.10.1.9956>

APPENDIX 1. AD-HOC QUESTIONNAIRE ELABORATED TO ASSESS THE CONTENTS ASSIMILATION

1. What does phase 2 of a randomized clinical trial correspond to?
 - a. First phase in patients (100-300)
 - b. It is tested on healthy subjects (20-50)
 - c. Efficacy and safety are evaluated, in addition to establishing the correct therapeutic dose
 - d. Long-term adverse effects are evaluated (pharmacovigilance)
2. The dependent variable is the one that...
 - a. Define the intervention
 - b. They are intrinsic to the patient
 - c. Determine treatment results
 - d. They make up the variables necessary to define the descriptive table of the sample.
3. An unambiguous way to identify an author who has common names and surnames, and therefore can be confused with other authors with similar names, is...
 - a. Attaching the PROSPERO profile of each author to the article
 - b. Attaching the ORCID profile of each author to the article
 - c. Attaching the Google Scholar profile of each author to the article
 - d. Attaching the PRISMA profile of each author to the article
4. Meta-analyses...
 - a. They present information from various studies in a qualitative way
 - b. They are written by experts
 - c. They present the information in frequency tables
 - d. They bring together information from various investigations in a quantitative way
5. Regarding exclusion criteria in systematic reviews:
 - a. If one or more of these criteria are met, the study will not be considered
 - b. If two or more of these criteria are met, the study will not be considered
 - c. If three or more of these criteria are met, the study will not be considered
 - d. All exclusion criteria must be met for a study to not be considered
6. When a scientific article is submitted for review, the following possibilities exist:
 - a. Rejection or acceptance of the article
 - b. Rejection, major review, medium review and acceptance
 - c. Rejection, major review, minor review and acceptance
 - d. Rejection, major review, medium review, minor review and acceptance
7. Systematic reviews generally follow the guideline:
 - a. CONSORT

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- b. CARE
 - c. PRISMA
 - d. PROSPERO
 - e. QUOROM
8. The most used impact indexes are:
- a. FECYT ranking and Eigenfactor
 - b. Google Scholar Metrics and Dialnet index
 - c. JCR and SJR journal rankings
 - d. JIR and SNIPE journal rankings
9. In Health Sciences, most of the articles are of the type:
- a. Qualitative
 - b. Quantitative
10. Scientific research tables would be presented in:
- a. At the end of the methodology section, when we have already described in detail what has been done
 - b. In the results section, as a synthesis of these
 - c. Following the figures, to show with exact numbers what has been shown in a more visual way previously
 - d. In the discussion of the results, in the part where reference is made to what appears in the table to comment on it in this section