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Flipped Learning and E-Learning as Training Models Focused on the Metaverse

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Abstract

Virtual Learning Environments (EVA) have acquired special importance in the educational field in recent years. The metaverse has been constructed as a learning space with enormous potential. As such, the immersion possibilities of the metaverse increase when compared to other methodologies that already implement technology, such as flipped learning and e-learning. In these learning environments, students require a set of specific abilities and skills. Therefore, this study aims to understand which training approach (flipped learning or e-learning) helps students acquire better skills through a teaching and learning process in the metaverse. This thesis used a pre-post quasi-experimental design of a group containing 173 Spanish high school students to achieve its aim. The data collection has been carried out by the Teaching and Learning Experiences Questionnaire (ETLQ). Among the obtained results, it is discovered that in all the dimensions analyzed, a significant relationship is observed. The greatest difference in means occurs in the LO dimension, meaning that these educational experiences directly impact the student's academic results. It is concluded that both training approaches are adequate in preparing students for training processes carried out in the metaverse since they complement each other. Therefore, as preliminary instruction, the sequential use of these approaches is necessary when familiarizing students with a new learning reality such as the metaverse.

Keywords:

ICT;
Educative Technology;
Flipped Learning;
E-Learning;
Metaverse;
Learning Environments.

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1- Introduction

The global pandemic caused by Covid-19 has been a real revolution for contemporary society [1, 2]. The consequences of this revolution have had significant effects on the educational field and the learning process itself [3, 4]. During the global confinement, there was a considerable increase in techno-pedagogical resources. These resources implement teaching and learning in virtual environments, from digital devices to technological tools [5]. Once confinement ended, a retrospective view reflected that both teachers and students had developed a set of skills in digital competence that allowed them to take advantage of the potential of technology in the new educational context [6]. New learning environments have been developed where it is vital to understand how time outside the classroom is used. And where digital devices become protagonists in creating virtual spaces [7]. In this way, in recent years, teaching methodologies have focused on technology and active learning has increased. This includes E-Learning, Flipped Learning, Blended Learning, and Mobile Learning, among others [8].

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We will now focus on one of the models that promotes the effective use of time outside the classroom using technopedagogy - Flipped Learning. This pedagogical model consists of turning the learning moments [9] so that when the student is not in the educational center, they can continue their training using digital learning platforms [10]. In these virtual spaces, students view the explanatory videos previously created by the teacher and use specifically designed applications and digital resources [11]. Consequently, the teaching period in the classroom can be used to carry out active learning with a high practical component related to the content viewed by the student in the virtual classroom [12]. In this way, Flipped Learning increases student motivation and participation [13] and teacher-student and student-student collaboration and interaction [14]. These benefits have the added value that the student has a greater structure to work with the didactic contents [15] to achieve the curricular objectives [16] and improve their grades in evaluation assessments [17].

On the other hand, we find different methodologies focused on using digital learning spaces such as E-Learning or electronic learning. This learning methodology has gained special importance in recent years, especially with the expansion of new online learning institutions and the adaptation of traditional institutions to online teaching [18-20]. This methodology can be defined as a training process developed purely by using various techno-pedagogical resources [21, 22]. This method of carrying out the training process favors synchronous or asynchronous communication and an adaptation of space and time to teachers' and students' needs [23]. In this way, e-learning favors the processing of significant information [24] through the deployment of non-memoristic-transmittive training actions [25] based on the combination of theoretical content and activity practices [26]. This methodology benefits the performance and participation of students [27], including the promotion of interrelation and collaboration [28].

Continuing with the virtualization of learning, the so-called Virtual Learning Environments (VLE) have recently acquired special importance in education [29]. These environments are configured to create customizable and motivating learning experiences for the student [30]. The metaverse is the most pioneering development within virtual environments in the educational field due to its great potential [31]. Yet, the metaverse is still currently not clearly defined [32]. The metaverse is configured as a 3D virtual world that enables users to interact with content and each other, including using digital objects with a high degree of immersion [33]. The use of augmented reality (AR) combined with virtual reality (VR) generates an immersive world that is realized as a digital extension of the physical world [34, 35]. In this way, when the metaverse is applied to educational environments, it generates flexible, dynamic and motivating learning situations from interactive and collaborative experiences [36, 37]. When the metaverse is used by setting the student as the protagonist, their ability to solve problems and critical thinking improves their learning [38, 39].

In this new learning context, students must have a series of skills for the optimal development of both Blended Learning pedagogical models (Flipped Learning) and learning in virtual environments (E-Learning).

One of the main conditions necessary for the optimal practical application of pedagogical models in virtual contexts is related to the teaching and learning environment itself. An optimal suitable learning environment must meet a set of main requirements [40-46]:

- Search for meaningful learning based on prior experiences;
- Advancing the correlation between what has been learned with the real world;
- Use of feedback to students to improve their learning;
- Encouraging participation, enthusiasm, and enjoyment of the learning process;
- Development of procedural learning and drawing conclusions;
- Development of tasks allowing collaboration and positive interaction;
- Promotion of reflective, transversal, and interdisciplinary learning;
- Establishment of appropriate evaluation systems, strategies, and tools.

Learning skills related to their approach to learning are also fundamental. The main competencies associated to this dimension of learning are listed below:

- Systematization and organization of the learning process;
- Responsibility for achieving positive learning outcomes;
- Optimized organization of study time;
- Prior review of the evidence before drawing conclusions;
- Development of chains of thought from comprehensive reading;
- Communicate ideas effectively;
- Diversity of approaches for overcoming comprehension difficulties.

Finally, skills related to students' critical thinking are also recognized. They will function an optimal organization and management of knowledge when applying them properly at a practical level. The main competences related to this dimension of learning are the following:

- Analysis and organization of information;
- Evaluation of topics critically and reflexively;
- Application of theoretical knowledge to practice;
- Development of new ideas from previous ones.

In short, optimal conditions in the training environment and an adequate level of skills will allow for optimal development of the teaching and learning process in Virtual Learning Environments. The development of the metaverse at an educational level and its acceptance as a potent immersion tool will depend largely on whether the learning environment is adequate. This includes whether the students have the skills and competencies necessary for optimal performance in these virtual learning spaces.

1-1- Justification and Research Objective

After the literature presentation on flipped learning and e-learning, the path has been demonstrated as has the potential of these techno-pedagogical models in the teaching and learning processes [47, 48]. In this sense, at the same pace as society, education is changing and adjusting to the requirements of an increasingly diverse and technological world [49, 50]. Likewise, the Covid-19 pandemic has forcibly virtualized many life actions, including educational ones [51].

As such, teaching skills are critical in carrying out instructional processes appropriate to the reality and needs of students [52]. In the same way, the skills and abilities of students become relevant when carrying out learning in any environment, characterized by ubiquity [53]. The metaverse is found in this area as a virtual environment that allows the user to be immersed in a reality parallel to the physical world [54]. The metaverse enables all kinds of interactions, including formative ones [55]. But, a set of skills is needed to take place effectively, such as systematization and organization of the learning process, responsibility for achieving positive learning results, optimized organization of study time, analysis and organization of information, evaluation of topics critically and reflectively, application of theoretical knowledge to practice, and development of new ideas from previous ones.

To our knowledge, no study has been completed on which training model is best suited to teach students with future metaverse-oriented learning. That is why this study has been performed. To learn which training approach (flipped learning or e-learning) causes students to acquire better skills when carrying out a teaching and learning process in the metaverse.

2- Materials and Methods

2-1- Research Design

A quantitative research plan has been created to achieve the stated objective and answer the diverse research questions. Specifically, the plan is quasi-experimental of the pre-post type. For correct development, the methodological recommendations of the experts have been followed [56].

The study variables have also been defined. The training approach employed is designed as an independent variable, including the approach's application in the analyzed dimensions.

2-2- Participants

173 secondary education Spanish students participated in the study. 45.08% were men, and the rest were women with a mean age of 15 years (SD = 1.38). These subjects were chosen using an intentional sampling technique. The sampling technique is justified because the researchers are aware of using these techno-pedagogical approaches by the teachers who collaborated in the study. Initially, the sample comprised 193 students. Still, due to sample death (change of educational center of the students, absenteeism, and refusal to take part in the study), it was reduced to 173. Based on previous studies, the literature shows that the sample volume used is acceptable for the investigation. That is, the sample size does not imply any limitation or production of bias [57, 58].

2-3- Instrument

The data collection has been produced by adapting the Teaching and Learning Experiences Questionnaire (ETLQ) to the Spanish context [59]. It is a tool comprised of three dimensions (Teaching and learning environment; Student learning approach; Critical thinking), representing a total of 32 items. In addition, the researchers collected the students' learning outcomes by registering the teachers who collaborated in the study. The instrument follows a 5-point Likert scale response format, with 1(one) being the most negative value and 5(five) being the most positive.

This questionnaire presents adequate psychometric properties achieved through various validation and reliability tests. The authors submitted it for structural analyzes to approve the original theoretical model. Then they validated the model as a whole and compared respective relationships. Structural equations were then applied that revealed the model's goodness-of-fit indices. Additionally, factor analyzes were performed along with the CFI, TLI, CMIN, SRMS indices. Reliability was also verified using Cronbach's alpha. The authors of the adaptation of the ETLQ to the Spanish context obtained adequate values in the different tests carried out, confirming the instrument's relevance.

2-4- Procedure and Data Analysis

The study began at the beginning of Covid-19 (March 2019) and was organized in several phases. First, various educational centers in Spain were contacted to conduct the research. Next, the sample and the informed consent of the participants were approved, and the first measurement of the instrument was made. This occurred electronically since society was confined at home due to the pandemic. Next, a didactic unit consisting of 8 sessions was taught through e-learning. Once concluded, the measurement was re-taken with the ETLQ. The next phase of the study continued in September 2020, when the students returned to school. In this case, a didactic unit (also 8 sessions) was taught using the flipped learning approach, with its respective pre-post measurement.

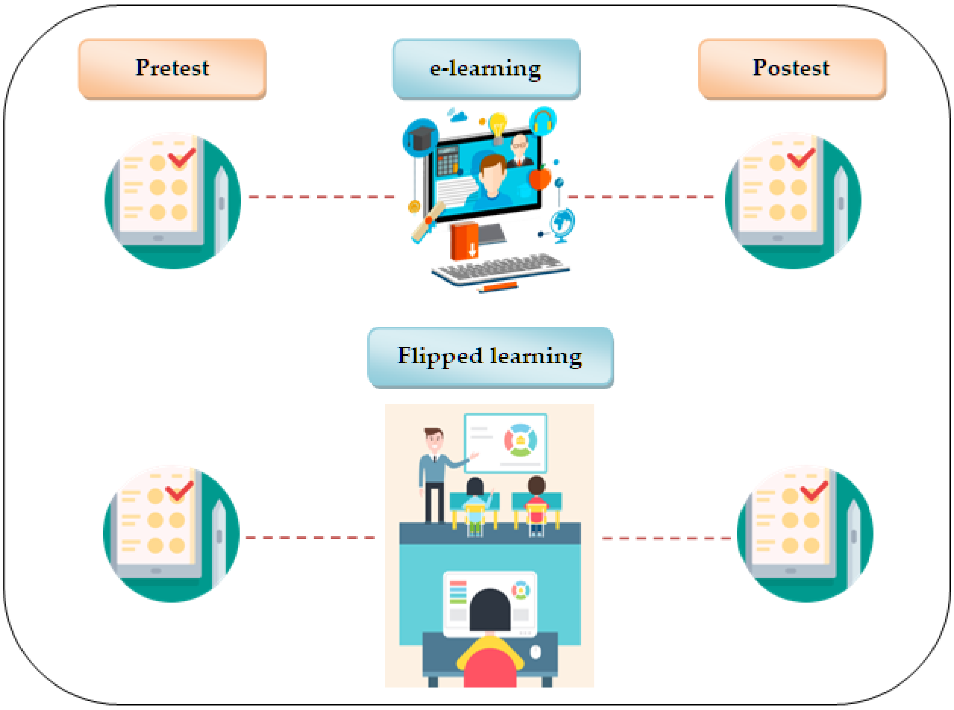

Figure 1. Study phases

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS) v25 program (IBM Corp., Armonk, NY, USA). In this work, statistics such as the mean (M), standard deviation (SD), and the standard error of the mean (SE) are presented. In addition, the Skewness (Skw) and Kurtosis (Kme) tests were also carried out to determine the sampling trend. Furthermore, specific tests were conducted, such as the t-Student test (tn1+n2-2) to compare the means. Similarly, Cohen's d tests and biserial correlation (rxy) were used to calculate the effect size. P values < .05 have been taken to consider statistically significant differences.

3- Results

The values obtained in table one include the pretest measurements taken before starting the educational experience based on e-learning and flipped learning. The results show that they start from similar measurements. In this case, it can be concluded that the values of the dimensions are equivalent. In the pretest measures of the educational experience based on e-learning, it is observed that the dimension with the highest value is TLE. On the other hand, the dimension with the lowest value is LO. The same can be seen with the educational experience based on flipped learning. It is noted that all the dimensions, except LO, show values in the medium-high range. In comparison, LO is situated in the medium-low range. In the post-test measures, both in the educational experience based on e-learning and flipped learning, higher values are found compared to those obtained in the pretest measures. In the educational experience based on e-learning, the dimension with the highest value is LO. In contrast, the one with the lowest value is SLA. In general, the values are in the medium-high range in all dimensions. On the other hand, in the educational experience based on flipped learning, TLE is the dimension with the highest value. This can be compared to LO being the dimension with the lowest value. The values as a whole are in the medium-high range in all dimensions. The data varies for the educational experience based on e-learning. The standard deviation, in most of the dimensions, shows that there is no dispersion of response [60]. In the pretest measures, a small response dispersion is detected in the LO dimension of e-learning and flipped learning. This is also seen in the LO dimension of the flipped learning experience in the posttest measures. Skewness measures show that the sample distribution is normal. Kurtosis indicates a tendency to respond mainly platikurtic.

Table 1. Results obtained for the dimensions of study in e-learning and flipped learning of Secondary Education

	Dimensions	Pretest				Posttest			
		M	SD	Skw	Kme	M	SD	Skw	Kme
E-learning	TLE	3.50	0.426	-1.27	2.67	3.62	0.320	-0.355	0.285
	SLA	3.11	0.336	0.190	-0.446	3.36	0.351	-0.387	-0.295
	CT	3.18	0.472	-0.639	0.161	3.69	0.486	-0.452	-0.332
	LO	1.97	1.06	0.767	-0.709	3.75	0.870	-1.20	1.78
Flipped learning	TLE	3.48	0.420	-1.26	2.61	3.71	0.298	-0.260	0.444
	SLA	3.08	0.346	0.105	-0.218	3.50	0.338	0.057	-0.148
	CT	3.12	0.503	-0.525	-0.185	3.43	0.532	0.060	-0.659
	LO	2.06	1.15	0.814	-0.468	3.28	1.07	-1.22	0.005

Note: TLE = Teaching and learning environment; SLA = Student learning approach; CT = Critical thinking; LO = Learning outcomes.

Significant differences are observed graphically in the LO dimension in the pretest-posttest measurements. On the other hand, in the rest of the dimensions, the values range between 3 and 4 points (Figure 2).

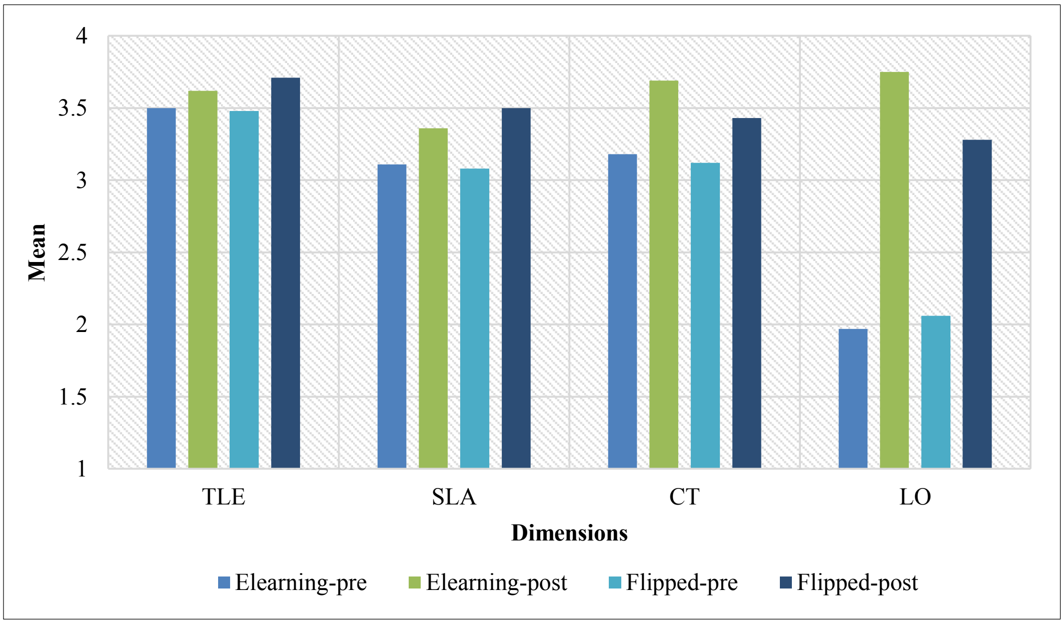

Figure 2. Comparison between e-learning and flipped learning group pretest-posttest

The degree of independence in the results was measured using the student's t-statistic from two different perspectives. From one perspective, independent samples were analyzed. That is, a comparison was made between the educational experience based on e-learning and flipped learning, in both the pretest and posttest. The data shows (Table 2) that comparing the e-learning and flipped learning educational experience in the pretest measures yields non-significant values. There are no significant differences in the means obtained in each dimensions. From the other perspective, considerable differences are observed in the post-test measures in all dimensions. The flipped learning educational experience values are higher in the TLE and SLA dimensions. Whereas in the CT and LO dimensions, the values are higher in the e-learning experience. The TLE dimension shows significant values. The rest of the dimensions show very significant values. The bi-serial correlation shows a medium-low relationship strength, with minimal effect size in all dimensions and insignificant.

Table 2. Study of the value of independence between independent samples with pretest and posttest. Student T for independent samples

Dimensions		μ(X1-X2)	$t_{n1+n2-2}$	df	d	r_{xy}
TLE	pre	0.021(3.50-3.48)	n.s	172	n.s	n.s
	post	-0.087(3.62-3.71)	-2.638**	172	0.005	0.141
SLA	pre	0.030(3.11-3.08)	n.s	172	n.s	n.s
	post	-0.134(3.36-3.50)	-3.619**	172	0.009	0.192
CT	pre	0.065(3.18-3.12)	n.s	172	n.s	n.s
	post	0.263(3.69-3.43)	4.797**	172	0.004	-0.250
LO	pre	-0.092(1.97-2.06)	n.s.	172	n.s	n.s.
	post	0.468(3.75-3.28)	4.463**	172	-0.022	-0.234

Note: μ= mean difference; X1=control group; X2=experimental group; **. Correlation is significant at the 0.01 level; n.s. Correlation not significant

On the other hand, related samples have been analyzed, i.e., between the pretest and posttest of the e-learning and flipped learning educational experiences (table 3). The data shows a significant relationship in all the dimensions analyzed. In that, there has been an improvement in the students. The greatest difference in means is observed in the LO dimension, meaning these educational experiences directly impact students' academic results. The smallest difference in means is observed in the TLE dimension.

Table 3. Study of the value of independence between dependent samples between the control group and experimental group. T for Student for related samples

Dimensions		μ(Y1-Y2)	$t_{n1+n2-2}$	df	SD	SEA
TLE	EL	-0.112(3.50-3.62)	-3.563**	172	0.450	0.034
	FL	-0.231(3.48-3.71)	-6.906**	172	0.440	0.033
SLA	EL	-0.247(3.11-3.36)	-7.448**	172	0.437	0.033
	FL	-0.412(3.08-3.50)	-11.818**	172	0.459	0.034
CT	EL	-0.507(3.18-3.69)	-10.083**	172	0.661	0.050
	FL	-0.309(3.12-3.43)	-5.980**	172	0.680	0.051
LO	EL	-1.78(1.97-3.75)	-18.377**	172	1.27	0.097
	FL	-1.22(2.06-3.28)	-9.470**	172	1.70	0.129

Note: EL= E-learning; FL= Flipped learning; μ= mean difference; Y1=pretest; Y2=posttest; **. Correlation is significant at the 0.01 level; n.s. Correlation not significant.

4- Discussion

4-1- Main Findings of the Present Study

This study focused on discovering which of the two approaches, e-learning or flipped learning, allows a better qualification for students to carry out training actions in the metaverse. The fundamental findings of this research relate to the finding that each of the methodologies used enhances a specific dimension of the teaching and learning process. Although the previous results using e-learning and flipped learning as methodologies were similar, the results obtained after applying the innovative pedagogical experience in each case were very significant.

One of the main findings of this study confirmed that there are no significant differences in the dimensions analyzed in terms of the benefits of e-learning over flipped learning at a general level. It has not been observed that one experience has obtained better results than the other at a general level, as the results are positive in both cases. However, interdimensional differences allow us to verify that each methodology enhances a set of specific dimensions of learning to a greater extent. The flipped learning educational experience has significantly boosted dimensions related to the teaching and learning environment and outcomes. Yet, comparably, the e-learning educational experience has significantly boosted dimensions of critical thinking and academic outcomes. In short, implementing these educational experiences based on e-learning and flipped learning significantly impacts students' teaching and learning process. This aspect is determined by the type of methodology used.

4-2- Comparison with Other Studies

A new education is already an existing reality [8]. A reality that is not only metaphorical but also conceived as a unique environment created by digital tools [29]. A technology that has made it possible to make a sudden change from the pure attendance of the training processes to the pure immersion of the student in a parallel world [31]. This allows that carrying out of training actions in the first person, with an extra element of interaction and motivation in environments controlled and personalized by technology [34]. We must not forget that Covid-19 has harmed society due to its great consequences for people's livelihoods [53]. However, at the educational level, it has brought an extensive repertoire of resources and applications that promote and facilitate instructional processes [51]. This has increased the commitment to the educational metaverse [54]. A space that until recently was unthinkable but is now a reality [55].

Pedagogical approaches based on technology, autonomous participation, and student involvement, such as e-learning and flipped learning, have significantly developed in recent years [47, 49]. In this sense, its greatest peak occurred during pandemic times and the return to the classroom with blended learning [18]. These approaches have involved techno-pedagogical training to highlight students' abilities, skills, and competencies in the digital aspect [22]. The e-learning and flipped learning training practices have enabled the students to familiarize themselves with content management platforms. This contains their inclusion in the first level of education through technology [52].

The results achieved in this research have reflected relevant aspects such as carrying out a prelude or conducting the students' preparation for the metaverse. Statistically, the resulting pretest measures in both training approaches are similar. On the other hand, when performing the post-test in e-learning and in flipped learning, better results are obtained in the different dimensions analyzed. Specifically, through e-learning, the LO dimension is enhanced [40, 43]. With flipped learning, the TLE dimension demonstrates the highest value [41, 46].

At first, in the comparison of the first measurement of both training approaches, no significant values were found. However, these were reported in the final measure of the post-test in all the dimensions involved in the study [42]. More specifically, the results in the TLE and SLA dimensions increase in the flipped learning approach [44]. However, the CT and LO dimensions stand out in e-learning [45]. As a note of special relevance, it has been revealed that the LO dimension positively impacts students [40].

4-3- Implication and Explanation of Findings

This study presents a set of implications. Firstly, it further expands our knowledge about the metaverse in the educational field. This work allows us to determine which techno-pedagogical approach is more relevant to introduce and train students towards a new way of working with didactic content. The metaverse is a virtual world with enormous educational possibilities. As such, any research that contributes to promoting its commitment and implementation as a new learning space will be relevant to the advancement of science. Through this research, the scientific and educational communities will have a pilot experience that will serve as the foundation and support for future work. In the same way, this work can contribute to training courses for teachers on aspects necessary in the metaverse and their corresponding transfer to students. Lastly, the increase in literature and the commitment of researchers to study determining factors may lead to greater investment by technology companies dedicated to developing the metaverse in education.

5- Conclusion

In short, this research concludes that both approaches are relevant as an introduction to preparing students to acquire the skills and competencies required by a training action in the metaverse. It has been noticed that each techno-pedagogical approach enhances certain dimensions. Therefore, carrying out a learning chain would be relevant, as demonstrated in this study. Both approaches would have to be conducted to reach adequate levels in TLE, SLA, CT, and LO. However, this must be done without causing a sudden change at the methodological level. Since students in the secondary educational stage are accustomed to face-to-face learning, it is recommended to apply flipped learning first. This measure is taken to familiarize students with using platforms and ubiquitous work. Then, after an adaptation period to the hybrid environment, e-learning could be switched to a purely distance approach to immerse the student in a digital space experienced in the first person.

It is important to note that the findings in this study should be treated cautiously. This research is limited to analyzing the Spanish context, so the results achieved can only be generalized to Spanish secondary school students. Likewise, implementing a first methodological approach through e-learning (as a consequence of the confinement forced by Covid-19) could lead to an adaptation and, consequently, an improvement of the skills and abilities of the students. This aspect may have influenced the results of the hybrid approach, followed later by flipped learning. As a future line of work, after this first study in which two techno-pedagogical approaches are put to the test to verify which one obtains the best skills necessary for an optimal training process in the metaverse, it is intended to explore other areas of Spanish geography to examine the findings obtained in this investigation. By doing this, it is intended to internationalize the sample of participants to extend this study to other pioneering countries in the field of the educational metaverse.

6- Declarations

6-1- Author Contributions

Conceptualization, S.P.-S., and N.C.-S.; methodology, J.L.-B.; software, A.-J.M.-G.; formal analysis, A.-J.M.-G.; investigation, J.L.-B., S.P.-S., N.C.-S., and A.-J.M.-G.; data curation, A.-J.M.-G.; writing—original draft preparation, J.L.-B., S.P.-S., N.C.-S., and A.-J.M.-G.; writing—review and editing, J.L.-B., S.P.-S., N.C.-S., and A.-J.M.-G.; visualization, S.P.-S.; supervision, J.L.-B.; project administration, J.L.-B.; funding acquisition, A.-J-M.-G. All authors have read and agreed to the published version of the manuscript.

6-2- Data Availability Statement

The data presented in this study are available in the article.

6-3- Funding

This research was funded by the I + D + i project OTRI-University of Granada with financing code nº 4995, entitled "Services related to the pilot phase of evaluation of educational programs.

6-4- Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board (or Ethics Committee) of the University of Granada.

6-5- Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

6-6- Conflicts of Interest

The authors declare that there is no conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely observed by the authors.

7- References

[1] Pokhrel, S., & Chhetri, R. (2021). A Literature Review on Impact of COVID-19 Pandemic on Teaching and Learning. Higher Education for the Future, 8(1), 133–141. doi:10.1177/2347631120983481.

[2] Turnbull, D., Chugh, R., & Luck, J. (2021). Transitioning to E-Learning during the COVID-19 pandemic: How have Higher Education Institutions responded to the challenge? Education and Information Technologies, 26(5), 6401–6419. doi:10.1007/s10639-021-10633-w.

[3] Alqahtani, A. Y., & Rajkhan, A. A. (2020). E-learning critical success factors during the covid-19 pandemic: A comprehensive analysis of e-learning managerial perspectives. Education Sciences, 10(9), 1–16. doi:10.3390/educsci10090216.

[4] Mishra, L., Gupta, T., & Shree, A. (2020). Online teaching-learning in higher education during lockdown period of COVID-19 pandemic. International Journal of Educational Research Open, 1, 100012. doi:10.1016/j.ijedro.2020.100012.

[5] Lassoued, Z., Alhendawi, M., & Bashitialshaaer, R. (2020). An exploratory study of the obstacles for achieving quality in distance learning during the covid-19 pandemic. Education Sciences, 10(9), 1–13. doi:10.3390/educsci10090232.

[6] Bestiantono, D. S., Agustina, P. Z. R., & Cheng, T.-H. (2020). How Students' Perspectives about Online Learning Amid the COVID-19 Pandemic? Studies in Learning and Teaching, 1(3), 133–139. doi:10.46627/silet.v1i3.46.

[7] Dhawan, S. (2020). Online Learning: A Panacea in the Time of COVID-19 Crisis. Journal of Educational Technology Systems, 49(1), 5–22. doi:10.1177/0047239520934018.

[8] Saany, S. I. A., Abu-Ulbeh, W., Al-Sammarraie, N. A., Baker El-Ebiary, Y. A., Hafiz Yusoff, M., Amir Fazamin, W. M. W. H., & Faradillah, Y. (2020). A new E-learning technique using mobility environment. International Journal of Engineering Trends and Technology, 68(1), 97–100. doi:10.14445/22315381/CATI1P218.

[9] Birgili, B., Seggie, F. N., & Oğuz, E. (2021). The trends and outcomes of flipped learning research between 2012 and 2018: A descriptive content analysis. Journal of Computers in Education, 8(3), 365–394. doi:10.1007/s40692-021-00183-y.

[10] Lai, H. M. (2021). Understanding what determines university students' behavioral engagement in a group-based flipped learning context. Computers and Education, 173, 104290. doi:10.1016/j.compedu.2021.104290.

[11] Østerlie, O., & Mehus, I. (2020). The impact of flipped learning on cognitive knowledge learning and intrinsic motivation in norwegian secondary physical education. Education Sciences, 10(4), 110. doi:10.3390/educsci10040110.

[12] Öztürk, M., & Çakıroğlu, Ü. (2021). Flipped learning design in EFL classrooms: implementing self-regulated learning strategies to develop language skills. Smart Learning Environments, 8(1), 1–20. doi:10.1186/s40561-021-00146-x.

[13] Bredow, C. A., Roehling, P. V., Knorp, A. J., & Sweet, A. M. (2021). To Flip or Not to Flip? A Meta-Analysis of the Efficacy of Flipped Learning in Higher Education. Review of Educational Research, 91(6), 878–918. doi:10.3102/00346543211019122.

[14] Jdaitawi, M. (2020). Does flipped learning promote positive emotions in science education? A comparison between traditional and flipped classroom approaches. Electronic Journal of E-Learning, 18(6), 516–524. doi:10.34190/JEL.18.6.004.

[15] Nerantzi, C. (2020). The Use of Peer Instruction and Flipped Learning to Support Flexible Blended Learning During and After the COVID-19 Pandemic. International Journal of Management and Applied Research, 7(2), 184–195. doi:10.18646/2056.72.20-013.

[16] Zhao, L., He, W., & Su, Y. S. (2021). Innovative Pedagogy and Design-Based Research on Flipped Learning in Higher Education. Frontiers in Psychology, 12, 230. doi:10.3389/fpsyg.2021.577002.

[17] Cueva, A., & Inga, E. (2022). Information and Communication Technologies for Education Considering the Flipped Learning Model. Education Sciences, 12(3), 207. doi:10.3390/educsci12030207.

[18] García-Peñalvo, F. J. (2021). Avoiding the dark side of digital transformation in teaching. an institutional reference framework for eLearning in higher education. Sustainability (Switzerland), 13(4), 1–17. doi:10.3390/su13042023.

[19] Jayalath, J., & Esichaikul, V. (2022). Gamification to Enhance Motivation and Engagement in Blended eLearning for Technical and Vocational Education and Training. Technology, Knowledge and Learning, 27(1), 91–118. doi:10.1007/s10758-020-09466-2.

[20] Syed, A. M., Ahmad, S., Alaraifi, A., & Rafi, W. (2021). Identification of operational risks impeding the implementation of eLearning in higher education system. Education and Information Technologies, 26(1), 655–671. doi:10.1007/s10639-020-10281-6.

[21] Abdul-Rahman Al-Malah, D. K., Hamed, S. I., Haider, Z. H., & ALRikabi, S. (2020). The Interactive Role Using the Mozabook Digital Education Application and its Effect on Enhancing the Performance of eLearning. International Journal of Emerging Technologies in Learning, 15(20), 21–41. doi:10.3991/ijet.v15i20.17101.

[22] Jdaitawi, M., Hussein, E. T., Muhaidat, F., & Abu-Joudeh, M. (2022). Probing the Flipped Learning Literature in Social Sciences and Humanities Education. International Journal of Instruction, 15(3), 677–694. doi:10.29333/iji.2022.15337a.

[23] Venieris, G., Cohen, S., Vlismas, O., Naoum, V. C., & Karatzimas, S. (2017). The requirements of different user groups on an online accounting platform. J. for International Business and Entrepreneurship Development, 10(1), 54. doi:10.1504/jibed.2017.082751.

[24] Kucheruk, O. A., Karaman, S. A., Karaman, O. V., & Vinnikova, N. M. (2019). Using ICT tolos for forming profesional competences of future teachers of the Ukrainian language and literature. Information Technologies and Learning Tools, 71(3), 196-214. doi:10.33407/itlt.v71i3.2814.

[25] Cebreiro López, B., Fernández Morante, C., & Arribi Vilela, J. (2017). Formación profesional a distancia: corriendo en la dirección equivocada. Pixel-Bit, Revista de Medios y Educación, 50(50), 65–76. doi:10.12795/pixelbit.2017.i50.04.

[26] Widaningsih, L., Barliana, M. S., Aryanti, T., & Malihah, E. (2018). Inheritance pattern of vocational skills: An ethnographic study on construction workers in Indonesia. Journal of Technical Education and Training, 10(2), 71–81. doi:10.30880/jtet.2018.10.02.007.

[27] Brzezińska, M. (2018). An intuitive app generator and accompanying e-learning modules as examples of successful assistive technology. E-Mentor, 2(74), 19–26. doi:10.15219/em74.1348.

[28] Callan, V. J., Johnston, M. A., Clayton, B., & Poulsen, A. L. (2016). E-assessment: challenges to the legitimacy of VET practitioners and auditors. Journal of Vocational Education and Training, 68(4), 416–435. doi:10.1080/13636820.2016.1231214.

[29] Bogusevschi, D., Muntean, C., & Muntean, G. M. (2020). Teaching and learning physics using 3D virtual learning environment: A case study of combined virtual reality and virtual laboratory in secondary school. Journal of Computers in Mathematics and Science Teaching, 39(1), 5-18.

[30] Reisoğlu, I., Topu, B., Yılmaz, R., Karakuş Yılmaz, T., & Göktaş, Y. (2017). 3D virtual learning environments in education: a meta-review. Asia Pacific Education Review, 18(1), 81–100. doi:10.1007/s12564-016-9467-0.

[31] Falchuk, B., Loeb, S., & Neff, R. (2018). The Social Metaverse: Battle for Privacy. IEEE Technology and Society Magazine, 37(2), 52–61. doi:10.1109/MTS.2018.2826060.

[32] Dahan, N. A., Al-Razgan, M., Al-Laith, A., Alsoufi, M. A., Al-Asaly, M. S., & Alfakih, T. (2022). Metaverse Framework: A Case Study on E-Learning Environment (ELEM). Electronics (Switzerland), 11(10), 1–13. doi:10.3390/electronics11101616.

[33] Park, S., Min, K., & Kim, S. (2021). Differences in learning motivation among bartle's player types and measures for the delivery of sustainable gameful experiences. Sustainability (Switzerland), 13(16), 9121. doi:10.3390/su13169121.

[34] Calongne, C., Sheehy, P., & Stricker, A. (2013). Gemeinschaft Identity in a Gesellschaft Metaverse. The Immersive Internet, 180–191. Palgrave Macmillan UK. doi:10.1057/9781137283023_16.

[35] Tarouco, L., Gorziza, B., Correa, Y., Amaral, E. M. H., & Muller, T. (2013). Virtual laboratory for teaching Calculus: An immersive experience. IEEE Global Engineering Education Conference, EDUCON, Berlin, Germany, 774–781. doi:10.1109/EduCon.2013.6530195.

[36] Choi, H-soo, & Kim, S-heon. (2017). A content service deployment plan for metaverse museum exhibitions—Centering on the combination of beacons and HMDs. International Journal of Information Management, 37(1), 1519–1527. doi:10.1016/j.ijinfomgt.2016.04.017.

[37] Díaz, J. E. M., Saldaña, C. A. D., & Avila, C. A. R. (2020). Virtual world as a resource for hybrid education. International Journal of Emerging Technologies in Learning, 15(15), 94–109. doi:10.3991/ijet.v15i15.13025.

[38] Nurhidayah, N. N., Halim, N., & Basri, M. (2020). Analyzing Student's Learning Outcome Using Systemic Approach. Asian EFL Journal, 27(41), 230–247.

[39] Schaf, F. M., Paladini, S., & Pereira, C. E. (2012). 3D AutoSysLab prototype. IEEE Global Engineering Education Conference, EDUCON, Marrakech, Morocco. doi:10.1109/EDUCON.2012.6201192.

[40] Ayén, F., & José, F. Qué es la gamificación y el ABJ? Iber: Didáctica de las ciencias sociales. Geografía e Historia, 86, 7–15. Available online: http://hdl.handle.net/11162/189552 (accessed on September 2022).

[41] Erenli, K. (2013). The impact of gamification: Recommending education scenarios. International Journal of Emerging Technologies in Learning, 8(SPL.ISSUE), 15–21. doi:10.3991/ijet.v8iS1.2320.

[42] Karl M. Kapp, (2012). The Gamification of Learning and Instruction: Game-Based Methods and Strategies for Training and Education, John Wiley & Sons, New Jersey, United States.

[43] Lee, J. J. C. U., & Hammer, J. C. U. (2011). Gamification in Education: What, How, Why Bother? Academic Exchange Quarterly, 15(2), 146–151.

[44] Lee, J., Park, T., & Davis, R. O. (2022). What affects learner engagement in flipped learning and what predicts its outcomes? British Journal of Educational Technology, 53(2), 211–228. doi:10.1111/bjet.12717.

[45] Pintrich, P., & Schunk, D. (2006). Motivación en contextos educativos: Teoría, investigación y aplicaciones. Pearson: Madrid, Spain.

[46] Zichermann, G., & Cunningham, C. (2011). Gamification by Design Implementing Game Mechanics in Web and Mobile Apps. O'Reilly Media, Inc.: Sebastopol, CA, USA.

[47] Phurikultong, N., & Kantathanawat, T. (2022). Flipping the Undergraduate Classroom to Develop Student Analytical Thinking Skills. Emerging Science Journal, 6(4), 739-757. doi:10.28991/ESJ-2022-06-04-06.

[48] Hsia, L. H., Hwang, G. J., & Lin, C. J. (2022). A WSQ-based flipped learning approach to improving students' dance performance through reflection and effort promotion. Interactive Learning Environments, 30(2), 229–244. doi:10.1080/10494820.2019.1651744.

[49] Polat, E., Hopcan, S., & Arslantaş, T. K. (2022). The Association between Flipped Learning Readiness, Engagement, Social anxiety, and Achievement in Online Flipped Classrooms: a Structural Equational Modeling. In Education and Information Technologies. Education and Information Tech-nologies. doi:10.1007/s10639-022-11083-8.

[50] Tang, T., Abuhmaid, A. M., Olaimat, M., Oudat, D. M., Aldhaeebi, M., & Bamanger, E. (2020). Efficiency of flipped classroom with online-based teaching under COVID-19. Interactive Learning Environments, 1–12. doi:10.1080/10494820.2020.1817761.

[51] Salas-Pilco, S. Z., Yang, Y., & Zhang, Z. (2022). Student engagement in online learning in Latin American higher education during the COVID-19 pandemic: A systematic review. British Journal of Educational Technology, 53(3), 593–619. doi:10.1111/bjet.13190.

[52] Alajlan, H. A. (2022). Performance, Participation and Perception of Computer Education Students Toward Flipped Learning. Technology, Knowledge and Learning, 1–23. doi:10.1007/s10758-022-09590-1.

[53] Sankova, M. V., Kytko, O. V., Vasil'ev, Y. L., Aleshkina, O. Y., Diachkova, E. Y., Darawsheh, H. M., ... & Dydykin, S. S. (2021). Medical students' reactive anxiety as a quality criterion for distance learning during the SARS-COV-2 pandemic. Emerging Science Journal, 5(Special Issue), 86-93. doi:10.28991/esj-2021-SPER-07.

[54] Ortega-Rodríguez, P. J. (2022). From Extended Reality to The Metaverse: A Critical Reflection on Contributions to Education. Teoria de La Educacion, 34(2), 189–208. doi:10.14201/teri.27864.

[55] Mystakidis, S. (2022). Metaverse. Encyclopedia, 2(1), 486–497. doi:10.3390/encyclopedia2010031.

[56] Hernández, R., Fernández, C., & Baptista, M. P. (2014). Metodología de la Investigación. McGraw Hill, New York, United States.

[57] Chou, P. N., & Feng, S. T. (2019). Using a tablet computer application to advance high school students' laboratory learning experiences: A focus on electrical engineering education. Sustainability (Switzerland), 11(2), 1–14. doi:10.3390/su11020381.

[58] Yılmaz, A., & Soyer, F. (2018). Effect of physical education and play applications on school social behaviors of mild-level intellectually disabled children. Education Sciences, 8(2), 1–8. doi:10.3390/educsci8020089.

[59] Parra-González, M. E., López-Belmonte, J., Segura-Robles, A., & Moreno-Guerrero, A. J. (2021). Spanish adaptation and validation of the teaching and learning experiences questionnaire. International Journal of Environmental Research and Public Health, 18(7), 3518. doi:10.3390/ijerph18073518.

[60] Jöreskog, K. G. (2001). Analysis of ordinal variables 2: Cross-Sectional Data. Text of the workshop "Structural equation modelling with LISREL 8.51.", Friedrich-Schiller-Universität Jena: Jena, Germany.