

Original article



The effect of the flipped classroom on critical thinking: A study from the perspective of self-regulated learning

Efecto del aula invertida en el pensamiento crítico. Un estudio desde la autorregulación del aprendizaje

O efeito da sala de aula invertida no pensamento crítico: Um estudo sob a perspectiva da aprendizagem autorregulada

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ABSTRACT

Critical thinking is a crucial competency in professional training today; however, its development remains limited in contexts where traditional methodologies still prevail. This study aimed to

determine the influence of the flipped classroom methodology on the development of critical thinking in nursing students at a higher education institute, integrating self-regulated learning as a framework for interpretation. The research employed a quantitative approach, an explanatory level, and a quasi-experimental design, with a total sample of 120 students divided into a control group (n=61) and an experimental group (n=59). Critical thinking was measured using a 24-item questionnaire based on the eight elements of reasoning proposed by Paul and Elder (2003), with a five-point Likert scale. The results of the Mann-Whitney U test show statistically significant differences between the two groups ($U=562.500$, $p=.000$), with the experimental group performing better at all levels assessed. It is concluded that the flipped classroom methodology significantly influences the development of critical thinking, as analyzed from the theoretical framework of self-regulated learning in higher education technological students.

Keywords: flipped classroom; self-regulated learning; higher education; nursing; critical thinking.

RESUMEN

El pensamiento crítico hoy en día representa una competencia muy importante en la formación de profesionales; en cuanto a su desarrollo sigue siendo limitado en contextos donde predominan metodologías tradicionales que siguen latentes. El presente estudio tuvo como objetivo determinar la influencia de la metodología de aula invertida en el desarrollo del pensamiento crítico de estudiantes de enfermería de un Instituto Superior, integrando el tema de la autorregulación del aprendizaje como marco para realizar las interpretaciones. La investigación referente a los métodos aplicados utilizó un enfoque cuantitativo, nivel explicativo y diseño cuasi experimental, con una muestra total de 120 estudiantes distribuidos en grupo control (n=61) y grupo experimental (n=59). El pensamiento crítico fue medido mediante un cuestionario de 24 ítems en total, basado en los ocho elementos parte del razonamiento propuestos por Paul y Elder (2003), con una escala de medición tipo Likert de cinco puntos. Los resultados de la prueba U de Mann-Whitney muestran diferencias estadísticamente significativas entre ambos grupos ($U=562,500$, $p=.000$), mostrando al grupo experimental superior en todos los niveles que se evaluaron. Se concluye que la metodología de aula invertida influye significativamente en el desarrollo del pensamiento crítico, analizado desde el marco teórico de la autorregulación del aprendizaje en estudiantes de educación superior tecnológica.

Palabras clave: aula invertida; autorregulación del aprendizaje; educación superior; enfermería; pensamiento crítico.

RESUMO

O pensamento crítico é uma competência crucial na formação profissional atual; no entanto, seu desenvolvimento permanece limitado em contextos onde ainda prevalecem metodologias tradicionais. Este estudo teve como objetivo determinar a influência da metodologia de sala de aula invertida no desenvolvimento das habilidades de pensamento crítico em estudantes de enfermagem de uma instituição de ensino superior, integrando a aprendizagem autorregulada como referencial teórico. A pesquisa empregou uma abordagem quantitativa, um nível explicativo e um delineamento quase-experimental, com uma amostra total de 120 estudantes divididos em um grupo controle (n=61) e um grupo experimental (n=59). O pensamento crítico foi mensurado por meio de um questionário de 24 itens baseado nos oito elementos do raciocínio propostos por Paul e Elder (2003), com uma escala Likert de cinco pontos. Os resultados do teste U de Mann-Whitney mostram diferenças estatisticamente significativas entre os dois grupos (U=562,500, p=0,000), com o grupo experimental apresentando melhor desempenho em todos os níveis avaliados. Conclui-se que a metodologia da sala de aula invertida influencia significativamente o desenvolvimento do pensamento crítico, conforme analisado a partir do referencial teórico da aprendizagem autorregulada em estudantes de cursos superiores de tecnologia.

Palavras-chave: sala de aula invertida; aprendizagem autorregulada; ensino superior; enfermagem; pensamento crítico.

INTRODUCTION

Currently, some innovative pedagogical models seek to address the challenges of 21st-century education, promoting more active, autonomous, and meaningful learning processes. Among these models is the flipped classroom. The classroom has solidified as a highly innovative methodological strategy that restructures learning times and places, allowing students to access content at home

and dedicate classroom time to practical, collaborative, and more cognitively oriented activities (Wong *et al.*, 2023).

This approach has clearly shown the potential to promote higher-order skills, such as those included in critical thinking, by reversing some of the traditional roles of teacher and student and promoting active participation during face-to-face sessions (Alpat & Görgülü, 2024).

Similarly, some recently published research has indicated that the implementation of methodologies such as flipped classrooms can generate some strengthening in self-regulation of learning, because students must strategically manage their time, resources and cognitive processes to prepare the content outside the classroom (Samadi *et al.*, 2024).

Likewise, some research presented has indicated that the use of the flipped classroom strategy is associated with some significant improvements in the critical analysis processes that are part of knowledge, by offering students a space to enter content early and focus class time on other cognitively more complex activities (Viteri Salazar *et al.*, 2024).

Recently published literature has highlighted that the flipped classroom model is a powerful and effective pedagogical strategy for enhancing critical thinking by reorganizing teaching time and promoting active dynamics within the classroom.

In this approach, students can access theoretical content in advance and use the face-to-face setting to apply analysis, as well as discussion and problem-solving, which stimulates more complex cognitive processes. In this sense, it has been shown that the systematic application of the flipped classroom contributes to strengthening skills such as analysis and argumentation, and, moreover, reflection at different educational levels (Vasquez Moscoso *et al.*, 2023).

Furthermore, recent studies investigating the important phenomenon of flipped classroom use in higher education show positive results regarding the development of critical thinking skills among students. A study at a private university in Lima, Peru, demonstrated that using this teaching methodology improved critical thinking abilities.

By reorganizing learning activities and focusing on tasks that foster analysis and reflection, students learn the advanced cognitive skills necessary for their professional training more effectively.

Therefore, this evidence supports the need for further research that systematically analyzes how the flipped classroom model affects aspects such as critical thinking in current university education (Chero-Santisteban *et al.*, 2025).

In higher education, the flipped classroom has emerged as a pedagogical alternative aligned with current technological demands. Recent studies report a positive student perception of the use of digital materials and participatory activities, highlighting greater integration between theory and practice. However, challenges related to methodological adaptation and technological limitations have also been identified, underscoring the need for a planned and contextualized implementation.

Similarly, research in higher education has indicated that the flipped classroom model fosters the development of critical thinking and autonomy in each student, as it aims to promote more active and reflective participation during face-to-face sessions. In this sense, by shifting content review outside the classroom and focusing class time on analysis and discussion activities, this methodology contributes to strengthening higher-order cognitive skills relevant to professional training (Mejía & Reyna, 2022).

In the university setting, the implementation of this innovative flipped classroom methodology has revealed positive effects on practical training and the strengthening of critical thinking. In this sense, by moving theoretical review outside the classroom and dedicating in-person time to hypothesis formulation, collaborative discussion, and laboratory experimentation, a more active and reflective form of learning is promoted (Peña *et al.*, 2025).

Similarly, recent research on teaching topics related to Genetics shows that this methodology increases factors such as motivation, engagement, and critical thinking skills among students. Furthermore, it also fosters the acquisition of essential practical and attitudinal competencies for their professional development. Consequently, these findings support the relevance of the flipped classroom as an effective teaching strategy in university contexts with a strong practical component (Castellano Pozo, 2025).

A systematic review was able to confirm that the model based on this flipped classroom methodology in higher education has a good effect because it promotes the theme of active learning in students, increasing participation and, in turn, contributes to the development of higher-level cognitive skills, including critical thinking and student autonomy (Bosch *et al.*, 2024).

Regarding self-regulated learning, this is understood as an active and constructive process through which students establish their goals and, at the same time, monitor, regulate, and control their cognitions, motivation, and behavior in accordance with those goals (Pintrich, 2000). In this sense, this variable is relevant as an interpretive framework, since the flipped classroom methodology demands planning, autonomy, and conscious learning management. Consequently, its inclusion allows us to understand how students' internal processes mediate the development of critical thinking in higher technological education contexts.

The phenomenon of self-regulated learning represents one of the most relevant constructs within psychology in the contemporary educational context. From Zimmerman's (2000) perspective, it is a cyclical process through which students must carry out actions such as planning, monitoring, and reflecting on their own learning, strategically adjusting their actions according to their established goals. This active and self-referential nature distinguishes the self-regulated learner from one who depends primarily on the direction of the teaching staff, positioning them as the central agent of their own learning process.

Over time, it has become quite clear that self-regulation and new teaching methods go hand in hand. For example, Broadbent and Poon (2015) found that students who are able to organize themselves and control their own learning benefit more from more flexible methods such as the flipped classroom, because they manage their time better and make good use of the resources available to them. This implies that self-regulation not only fits with these methodologies, but also makes them work better, because if the student does not self-regulate, no matter how good the methodology is, the learning often falls short of expectations.

At the Higher Technological Institute of Cusco, in the Nursing program, it was observed that students have some difficulty developing critical thinking skills and actively participating in class. This is primarily because professors continue to use traditional teaching methods where they are the only ones speaking and the students are the only ones listening. Since more dynamic and innovative strategies, such as the flipped classroom, are rarely implemented, it becomes difficult to connect theoretical learning with practical experience, something crucial when training to work in healthcare.

If this situation is not addressed, students may continue to struggle to analyze clinical situations, make sound decisions, and solve problems when they are actually working in a healthcare setting.

This, in turn, affects their training and performance as future nurses, because they would lack the preparation to handle complex situations that arise in patient care.

For all the reasons mentioned, the main question of this research is: how does the use of the flipped classroom help students to better develop their critical thinking, considering that they also learn to self-regulate their own learning?

In this sense, the main objective of this research is to determine the influence of the flipped classroom methodology on the strengthening of critical thinking, integrating self-regulated learning as an interpretive framework, in order to have concrete results that support the use of more innovative methodologies in higher technological education.

MATERIALS AND METHODS

This research was developed during the months of November to December 2025 and is framed within the quantitative approach, since it seeks to objectively measure and analyze the influence of the flipped classroom methodology on critical thinking, using statistical procedures to test the hypothesis.

The study is of an explanatory level, since it aims to determine the causal relationship between the independent variable (flipped classroom) and the dependent variable (critical thinking), considering the self-regulation of learning as a conceptual framework.

The study design is quasi-experimental, with non-equivalent experimental and control groups, as participants will not be randomly assigned but rather will be grouped in pre-existing groups. The pedagogical intervention will consist of implementing the flipped classroom methodology for a specific period, while the control group will continue with the traditional methodology.

On the other hand, the research is of an applied type, since it sought an immediate solution in a practical way aimed at improving the teaching and learning processes in the specific context of the aforementioned career.

The study population consisted of all students enrolled in the Nursing professional career of the Higher Technological Institute of Cusco during the academic period 2025.

For the purposes of the research, a non-probabilistic, intentional sample was used, made up of students from the 1st, 2nd, 3rd and 4th cycles, due to their availability and homogeneous academic characteristics.

In the present case, the first and second cycles represent the control group made up of 61 students, who continued with their study program developing the sessions under the traditional methodology, while the third and fourth cycles represented the experimental group to which the intervention was applied which was based on the flipped classroom methodology, for this study carried out which was made up of 59 students.

Regarding the intervention, it was based on the four fundamental pillars of the Flipped model The Learning Network of 2014. With the first pillar, students could review public health videos and readings from home, at their own pace. With the second, in-person classes were no longer just for listening to the professor, but for debating and analyzing cases together. With the third, content was chosen that was truly relevant to their training as nurses. And with the fourth, the professor went from being someone who only explains to someone who accompanies, guides, and provides constant feedback to the students.

The intervention program was designed for the Public Health course in the Nursing program at the Higher Technological Institute and lasted four weeks, comprising eight 45-minute sessions. It was organized according to the four pillars of the Flipped Classroom model. Learning Network: flexible environment (F), learning culture (L), intentional content (I) and professional educator (P).

The program's main idea was to change how learning time was used. Before each class, students reviewed the theoretical content independently at home using digital resources such as YouTube videos, readings from the Ministry of Health and international organizations, Google Forms, and interactive quizzes on Quizizz. This allowed them to use class time for more complex and dynamic activities, such as analyzing real-world cases, participating in group discussions, conducting simulations, designing health intervention proposals, and peer evaluation.

The first week, encompassing sessions one and two, focused on the pillars of a flexible environment and a learning culture, addressing the topics of social determinants of health and basic epidemiology applied to Andean communities. Students analyzed epidemic outbreaks and reflected on the factors that influence health in their local environment.

The second week, corresponding to sessions three and four, prioritized the intentional content pillar, addressing prevalent diseases in Peru such as tuberculosis and child malnutrition, as well as maternal and child health in rural areas, topics directly linked to the professional profile of Nursing in the Cusco context.

The third week, which included sessions five and six, emphasized the role of the professional educator, where the teacher acted as a facilitator and active feedback provider, observing the performance of the groups during simulations of community visits and role plays on vaccination.

Finally, in the fourth week, the four pillars were integrated simultaneously in sessions seven and eight, addressing occupational health and closing the program with the application of the post-test, the socialization of integrative conceptual maps and a metacognitive reflection in which the students themselves evaluated their learning process throughout the four weeks of intervention.

The technique used was the survey, which allowed information to be collected systematically on the level of critical thinking of the students at a single moment after the application of the pedagogical intervention.

Regarding the measurement of the dependent variable, an *ad hoc* instrument was applied, consisting of a five-point Likert scale questionnaire, developed from the eight elements of reasoning proposed by Paul and Elder (2003). It was made up of 24 items distributed across eight dimensions: D1, purpose; D2, question at hand; D3, information; D4, interpretation and inference; D5, concepts; D6, assumptions; D7, implications and consequences; and D8, point of view.

Regarding the validity of the instrument, it was submitted and reviewed through expert judgment and reinforced through a pilot test that was carried out in a smaller population; regarding its reliability, it was supported by McDonald's Omega coefficient, which is a more robust method than Cronbach's alpha.

These positive results obtained were the following: for the control group, an Omega coefficient of M of 0.88 was obtained for the control group and 0.93 for the experimental group, which guarantee good internal consistency and can be applied.

As for the starting point of the execution, it had as its starting point respect for the integrity and confidentiality of the data, as well as the respective authorizations, respecting the codes of ethics.

RESULTS

From this point onwards, the results of the present study are presented.

Table 1. Descriptive statistics of critical thinking by groups

Groups	N	Minimum	Maximum	Average	Standard deviation
GC_PC	61	49.00	96.00	62,3443	10,18477
GE_PC	59	59.00	111.00	92,6610	14,44563

Note: Descriptive statistics calculated in SPSS

The descriptive results show a notable difference between the two groups. The control group (CG) obtained a mean of 59.00 points, with moderate dispersion ($SD=11.59$) and scores ranging from 49 to 96. The experimental group (EG), on the other hand, achieved a mean of 90.00 points, with scores between 59 and 111 ($SD=14.70$). These results suggest that students exposed to the flipped classroom methodology developed substantially superior critical thinking skills compared to those who followed the traditional methodology (Tables 1 and 2).

A range of values was established for score categorization, using the method of equitable division. This was achieved by dividing the total score range (24 points) by the desired number of categories (3 levels). The resulting ranges were: beginning, competent, and outstanding, ensuring a fair distribution of the measurement scale (Figure 1).

Table 2. Control group estimate

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	Start	20	32.8	32.8	32.8
	Competent	40	65.6	65.6	98.4
	Outstanding	1	1.6	1.6	100.0
	Total	61	100.0	100.0	

Note: Instrument estimation

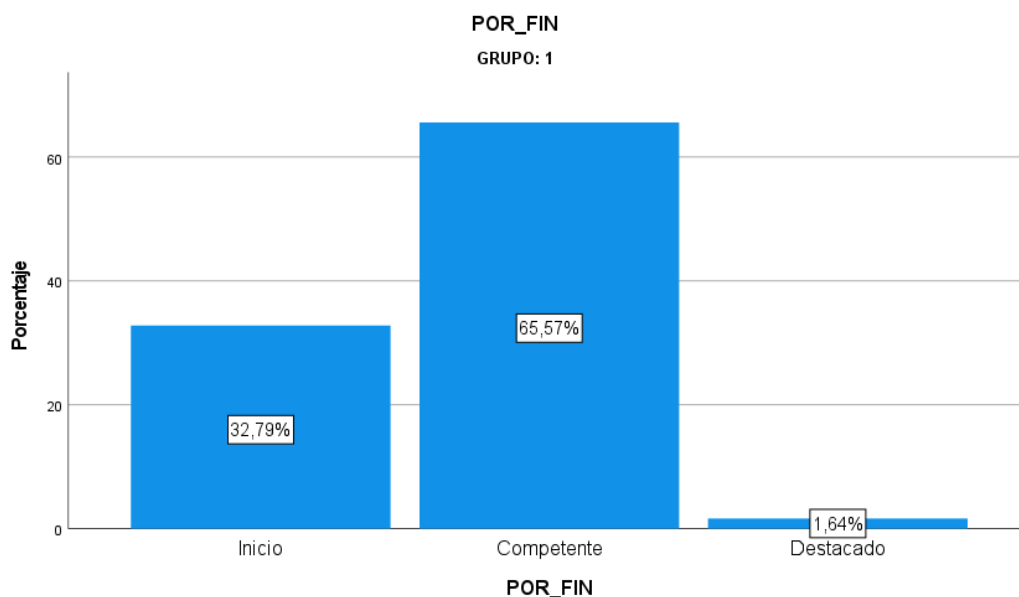


Figure 1. SPSS results

In the control group, the predominant level was Competent, with 65.6% of the students ($n=40$), followed by the Beginning level, with 32.8% ($n=20$), while only 1.6% ($n=1$) reached the Outstanding level. These results reveal that the vast majority of students exposed to the traditional methodology achieved a partial development of critical thinking, without consolidating reasoning skills at their highest level (Table 3).

From the interpretive framework of self-regulation, these findings suggest that traditional methodology, by concentrating control of learning in the teacher, limits students' opportunities to consciously plan, monitor, and manage their own cognitive processes. This external dependence restricts the development of the autonomy necessary to reach higher levels of critical reasoning, demonstrating that without environments that demand active self-regulation, critical thinking tends to remain at an intermediate level, without progressing toward its full consolidation.

Table 3. Information by dimensions of the critical thinking variable control group

Level of critical thinking	D1		D2		D3		D4		D5		D6		D7		D8	
	Nº	%	Nº	%	Nº	%	Nº	%	Nº	Nº	%	Nº	%	Nº	%	Nº
Start	18	29.5	14	23.0	17	27.9	19	31.1	14	23.0	19	31.1	17	27.9	11	18.0
Competent	43	70.5	43	70.5	38	62.3	39	63.9	43	70.5	37	60.7	41	67.2	48	78.7
Outstanding	0	0	4	6.6	6	9.8	3	4.9	4	6.6	5	8.2	3	4.9	2	3.3
Totals	61	100	61	100	61	100	61	100	61	100	61	100	61	100	61	100

Note: Estimate by dimensions

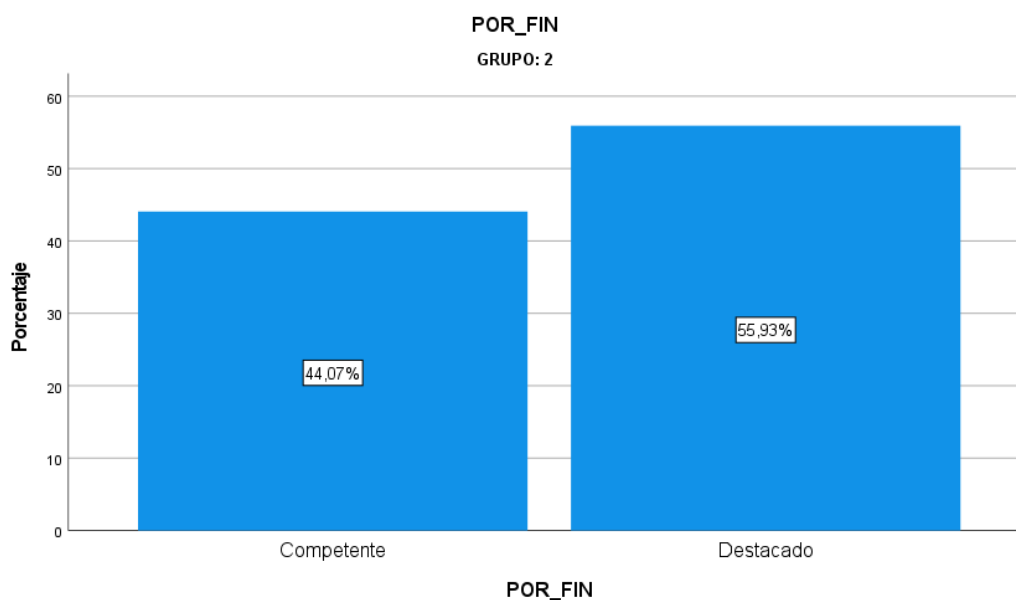
In the analysis by dimensions within the control group, the results showed that the majority of students were at the competent level in all dimensions. The dimensions with the highest percentage at this level were Viewpoint (D8) with 78.7%, and Purpose (D1), Question at Hand (D2), and Concepts (D5), all with 70.5%. Very few students reached the advanced level, with Information (D3) at 9.8%, Assumptions (D6) at 8.2%, and Question at Hand (D2) at 6.6% being the most representative. On the other hand, the dimensions where the most students were at the beginning level were Interpretation and Inference (D4) and Assumptions (D6), each with 31.1%, followed by Purpose (D1) with 29.5% and Implications and Consequences (D7) with 27.9%, showing that students had more difficulty in the dimensions requiring more complex thinking. One fact that is quite striking is that in the Purpose dimension (D1) no student reached the outstanding level, which indicates a total absence of mastery in the ability to clearly identify the objective of one's own reasoning (Table 4).

From the interpretive framework of self-regulation, these difficulties in the more complex dimensions reflect the absence of monitoring and metacognitive reflection processes that the traditional methodology does not promote, limiting the student to operate at intermediate levels, without achieving a conscious regulation of their own reasoning.

Table 4. Estimate of experimental group

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	Competent	26	44.1	44.1	44.1
	Outstanding	33	55.9	55.9	100.0
	Total	59	100.0	100.0	

Note: Instrument estimate

**Figure 2.** SPSS results

In the experimental group, the results show that 55.9% of the students (n=33) reached the Outstanding level, while the remaining 44.1% (n=26) reached the Proficient level, with no students at the Beginning level. This demonstrates that all 59 students exposed to the flipped classroom methodology developed critical thinking skills above the minimum threshold, with more than half consolidating reasoning skills at the highest level (Figure 2).

From the interpretive framework of self-regulation, these results are consistent with what was expected, since the flipped classroom methodology requires that the student plan their prior access

to the content, monitor their understanding and actively manage their participation in the face-to-face sessions.

These self-regulatory processes, practiced systematically during the eight intervention sessions, fostered the development of higher cognitive skills that characterize the Competent and Outstanding levels of critical thinking.

Table 5. Information by dimensions of the critical thinking variable experimental group

Level of critical thinking	D1		D2		D3		D4		D5		D6		D7		D8	
	Nº	%	Nº	%	Nº	%	Nº	%	Nº	%	Nº	%	Nº	%	Nº	%
Start	43	72.9	3	5.1	2	3.4	0	0	0	0	2	3.4	3	5.1	2	3.4
Competent	16	27.1	20	33.9	23	39.0	24	40.7	13	22.0	15	25.4	15	25.4	14	23.7
Outstanding	0	0	36	61.0	34	57.6	35	59.3	46	78.0	42	71.2	41	69.5	43	72.9
Totals	59	100	59	100	59	100	59	100	59	100	59	100	59	100	59	100

Note: Estimation by dimensions

The analysis by dimensions of the experimental group shows a clear predominance of the Outstanding level in almost all dimensions. The most outstanding were D5 (Concepts) with 78.0%, D8 (Point of View) with 72.9%, D6 (Assumptions) with 71.2%, and D7 (Implications and Consequences) with 69.5%, demonstrating that the students were able to identify and apply concepts, question assumptions, consider diverse perspectives, and identify the consequences of their reasoning. Dimensions D4 (Interpretation and Inference) with 59.3 % and D3 (Information) with 57.6% also reached a majority at the Outstanding level, while D2 (Question at Hand), with 61.0%, likewise reflected a high level of mastery in the precise formulation of problems.

However, dimension D1 (Purpose) shows a very particular case, since 72.9% of the students were at the beginning level, with none at the advanced level, which suggests that, despite the general progress, the ability to identify and clearly express the purpose of one's own reasoning posed a greater difficulty for the experimental group.

From a self-regulation perspective, the fact that students improved in seven of the eight dimensions demonstrates that the flipped classroom did lead them to plan, monitor their learning, and reflect on

their own reasoning. However, dimension D1 remains a weak point, indicating that recognizing the purpose of one's own thinking is not something that can be addressed solely through the methodology, but rather requires more specific and consistent attention within lesson planning (Table 5).

Table 6. Normality test

Shapiro-Wilk			
	Statistical	gl	Next.
Control group	,657	61	,000
Experimental group	,631	59	,000

Note: SPSS results

The Shapiro-Wilk normality test applied to both groups revealed that neither distribution conformed to normality. The control group obtained a statistic of .657 ($p = .000$) and the experimental group .631 ($p = .000$), both significance values being less than .05. Consequently, the assumption of normality in both groups is rejected, which determines the use of a non-parametric test for hypothesis testing, with the Mann-Whitney U test being the most appropriate for comparing two independent groups under these conditions (Table 6).

Regarding the formulation of hypotheses, the study proposes the following:

Ho: The application of the flipped classroom methodology does not significantly influence the development of critical thinking in nursing students at the Higher Technological Institute of Cusco.

Ha: The application of the flipped classroom methodology significantly influences the development of critical thinking in nursing students at the Higher Technological Institute of Cusco.

Table 7. Test statistics

	Critical thinking
Mann-Whitney U	562,500
Wilcoxon's W	2453,500
Z	-7,231
Sig. asin. (bilateral)	,000

Note: Statistical results

The statistical test applied in this study, the Mann-Whitney U test, yielded a U value of 562.500 and a Z statistic of -7.231, with a two-tailed asymptotic significance of $p = .000$, a value well below the established significance level of 0.05. Consequently, the null hypothesis was rejected and the research hypothesis was accepted, concluding that the application of the flipped classroom methodology significantly influences the development of critical thinking in the group of nursing students at the Higher Technological Institute of Cusco.

It is worth highlighting that the value obtained of $Z = -7.231$ is considerably high in terms of magnitude, indicating a difference that is significantly greater and statistically compelling between both groups, solidly reinforcing the evidence of the positive effect of the pedagogical intervention.

From the interpretive framework of self-regulation, this statistically significant difference is not accidental, since the flipped classroom methodology required students in the experimental group to plan their learning in advance of each session, monitor their understanding using digital resources, and actively self-regulate their participation during face-to-face activities. These internal processes, systematically practiced throughout the eight intervention sessions, acted as mediating mechanisms that enhanced the development of critical thinking, demonstrating that the difference between the two groups is not solely due to the methodology itself, but rather to the self-regulatory capacity that this methodology activates and demands in the student (Table 7).

DISCUSSION

The results obtained are consistent with those found by Wong *et al.* (2023), who mention that the flipped classroom model leads to more active and deeper learning among students, which explains the notable difference between the experimental and control groups. This also aligns with the findings of Alpat and Görgülü (2024), who demonstrated that when the teacher shifts from being the center of the classroom to giving students a more prominent role, skills such as critical thinking are developed, as observed in the face-to-face sessions of the intervention.

These results also align with those of Viteri Salazar *et al.* (2024) and Vasquez Moscoso *et al.* (2023), who found that using class time for analysis and reflection helps strengthen critical thinking at different educational levels. Similarly, Chero-Santisteban *et al.* (2025) obtained comparable results at a private university in Lima, confirming that this methodology works well within the context of Peruvian higher education, including technological institutes such as the one in Cusco.

The systematic review by Bosch *et al.* (2024) also supports these results, confirming that the flipped classroom fosters active learning and the development of more complex cognitive skills. Additionally, Castellano Pozo (2025) and Peña *et al.* (2025) demonstrated that this methodology also increases motivation and critical thinking in university programs with a strong practical component, which is precisely the case in Nursing, where this study was conducted.

From the interpretive framework of self-regulation, the results align well with the ideas of Pintrich (2000) and Zimmerman (2000), who argued that for students to learn effectively, they must be aware of and responsible for their own learning processes. The fact that the experimental group achieved better results suggests that the flipped classroom activated precisely these processes, which also supports the findings of Samadi *et al.* (2024), who demonstrated that this methodology strengthens self-regulation because it requires students to plan and organize themselves outside of class. This also coincides with Broadbent and Poon (2015), who showed that more flexible learning environments benefit those who are better at self-regulation.

The application of the flipped classroom methodology significantly influenced the development of critical thinking in Nursing students at the Higher Technological Institute of Cusco, which allowed us to reject the null hypothesis and accept the research hypothesis.

The experimental group that was taught the flipped classroom methodology clearly outperformed the traditional group in all dimensions of critical thinking, demonstrating that when the way of teaching is reorganized and class time is used to analyze and reflect, it generates a real impact on the development of higher cognitive skills.

From the perspective of self-regulated learning, it can be concluded that the flipped classroom did not work simply because it was a different methodology, but because it activated something within each student: they learned to plan, to monitor their own progress and to be more aware of how they learn, and this had an impact that helped to better develop their critical thinking throughout the intervention.

Finally, the results collected provide solid empirical evidence that supports the implementation of this important method, the flipped classroom, as a strategy for the innovative pedagogical aspect of Peruvian higher technological education, especially in careers with a high practical component such as Nursing, where critical thinking constitutes an essential professional competence.

REFERENCES

- Alpat, M. F., & Görgülü, E. (2024). Transformative learning: Flipped classroom and its impact on writing skill and critical thinking level. *Open Praxis*, 16(3), 396–409.
<https://doi.org/10.55982/openpraxis.16.3.704>
- Bosch-Farré, C., Cicres, J., Patiño-Masó, J., Morera Basuldo, P., Toran-Monserrat, P., Lladó Martínez, A., & Malagón-Aguilera, M. del C. (2024). Efectividad de la metodología de aula inversa en el ámbito universitario. Una revisión sistemática. *Educación XX1*, 27(1), 19–56.
<https://doi.org/10.5944/educxx1.35773>
- Broadbent, J., & Poon, W. L. (2015). Self-regulated learning strategies & academic achievement in online higher education learning environments: A systematic review. *The Internet and Higher Education*, 27, 1–13. <https://doi.org/10.1016/j.iheduc.2015.04.007>
- Castellano Pozo, M. (2025). Impacto del uso del aula invertida y pensamiento crítico en la formación práctica de genética: Metodologías y resultados. En R. Barragán Sánchez, A. Palacios Rodríguez, A. León Garrido & V. Fernández Scagliusi (Coords.), *Acciones educativas*

innovadoras en el ámbito universitario (pp. 733-749).

<https://dialnet.unirioja.es/servlet/articulo?codigo=10065337>

Chero-Santisteban, Y. A., Moreno-Núñez, P. J., Saldaña-Taboada, H. J., & Nina-Cuchillo, E. E. (2025). Impacto del aula invertida en el pensamiento crítico de estudiantes en una universidad privada de Lima (Perú). *Formación Universitaria*, 18(2), 11–24.

<https://doi.org/10.4067/s0718-50062025000200011>

Flipped Learning Network (FLN). (2014). The four pillars of F-L-I-P. <https://flippedlearning.org/wp-content/uploads/2016/07/PilaresFlip.pdf>

Mejía Velázquez, P. M., & Reyna Lara, G. P. R. (2022). Use of the flipped classroom for the development of autonomy and critical thinking. *HUMAN REVIEW. International Humanities Review*, 12(3), 1–13. <https://historicoeagora.net/revHUMAN/article/view/3952>

Paul, R., & Elder, L. (2003). *La mini-guía para el pensamiento crítico: conceptos y herramientas*. Fundación para el Pensamiento Crítico.

Peña Maldonado, A. A., Llanes Castillo, A., Amador Ramírez, C. L., & Guerra Cárdenas, J. E. (2025). Percepción de estudiantes universitarios sobre el uso de aula invertida en el aprendizaje activo. *Revista De Ciencias Sociales*, 31(Número Especial 11), 425-435. <https://doi.org/10.31876/rcs.v31i.44010>

Pintrich, P. R. (2000). The role of goal orientation in self-regulated learning. En M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 451–502). Academic Press. <https://doi.org/10.1016/B978-012109890-2/50043-3>

Samadi, F., Jafarigohar, M., Saeedi, M., Ganji, M., & Khodabandeh, F. (2024). Impact of flipped classroom on EFL learners' self-regulated learning and higher-order thinking skills during the Covid19 pandemic. *Asian-Pacific Journal of Second and Foreign Language Education*, 9(1). <https://doi.org/10.1186/s40862-023-00246-w>

Vasquez Moscoso, C. C., Menacho Rivera, A. S., Contreras Espinola de Becerra, J. M., & Meneses Vasquez, D. V. (2023). Utilidad del aula invertida en el pensamiento crítico. *Revista RELEP-Educación y Pedagogía en Latinoamérica*, 5(2).

<https://doi.org/10.46990/relep.2023.5.2.972>

Viteri Salazar, O. J., Cumbicus Jiménez, M. de L. Á., Lozada Lozada, R. F., López Benalcázar, M. I., & Quilumba Rodríguez, A. M. (2024). El Aula Invertida Como Estrategia Para Fomentar El Análisis Crítico En Los Estudiantes. *Ciencia Latina Revista Científica Multidisciplinar*, 8(5), 7235–7248. https://doi.org/10.37811/cl_rcm.v8i5.14135

Wong, K. E., Din, R., & Othman, N. (2023). Flipped classroom's impact on critical thinking, active learning and motivation: A critical review. *International Journal of Academic Research in Business and Social Sciences*, 13(12). <https://doi.org/10.6007/ijarbss/v13-i12/20278>

Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. En M. Boekaerts, P. R. Pintrich & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 13–39). Academic Press.

Conflict of interest

Authors declare no conflict of interests.

Authors' contribution

The authors participated in the design and writing of the article, in the search and analysis of the information contained in the consulted bibliography.



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