

<https://doi.org/10.23913/ride.v13i26.1421>

Artículos científicos

Estrategia de sistematización de experiencias educativas en la práctica docente

Systematization strategy of educational experiences in teaching practice

*Estratégia para a sistematização de experiências educativas na prática
docente*

Alma Lilia Sapién Aguilar

Universidad Autónoma de Chihuahua, México

lsapien@uach.mx

<https://orcid.org/0000-0001-7222-2612>

Laura Cristina Piñón Howlet*

Universidad Autónoma de Chihuahua, México

lpinon@uach.mx

<https://orcid.org/0000-0002-1176-2567>

Luis Antonio Molina Corral

Universidad Autónoma de Chihuahua, México

lmolin@uach.mx

<https://orcid.org/0000-0002-3217-6460>

Jorge Luis Márquez López

Universidad Autónoma de Chihuahua, México

jmarquezl@uach.mx

<https://orcid.org/0000-0002-4642-5296>

* Autor de correspondencia

Resumen

La sistematización de experiencias es una práctica que se ha desarrollado con el objetivo de mejorar las actividades realizadas en cualquier ámbito a través de la observación retrospectiva de lo que se ha realizado para identificar los aciertos y las oportunidades de cambio. De esta manera, el profesor puede observar su propio desempeño, así como las interacciones que existen en el aula, y ser crítico con su experiencia para mejorar continuamente su actividad docente.

Por tanto, el objetivo de esta investigación fue proponer una estrategia de sistematización de experiencias educativas en la práctica docente para la asignatura de Tecnologías y Manejo de la Información de la Facultad de Ciencias de la Cultura Física. Para ello, se desarrollaron andamios educativos que se aplicaron en los grupos del primer semestre. En una segunda intervención, se aplicaron encuestas a los estudiantes y se compararon los resultados con grupos en los que no se intervino con andamios, utilizando técnicas estadísticas como Anova, regresión lineal y K-medias.

Al aplicar la estrategia de sistematización de experiencias educativas, se determinó que la planeación con andamios realmente tuvo un impacto positivo en la percepción de los estudiantes. Los resultados muestran que existe una diferencia significativa entre los grupos con y sin intervención, siendo los grupos con intervención los que mejor evaluaron el curso y utilizaron una mayor variedad de medios y formatos de carácter tecnológico.

Se logró que, a través del pensamiento complejo, los alumnos pudieran tener una visión externa de la escuela de las problemáticas que existen en su comunidad. La incorporación de elementos innovadores, como la creación de grupos cerrados con los estudiantes de cada salón en la red social Facebook y las videograbaciones de las clases, fueron elementos que utilizaron en su favor para el aprendizaje de los temas de la materia.

La sistematización permitió adaptar y mejorar la clase al observar las fortalezas y debilidades del profesor en el proceso de enseñanza y las actitudes tomadas por los estudiantes. Esta observación permitió modificar las estrategias utilizadas para la materia y aplicar dichas estrategias en posteriores aplicaciones. En consecuencia, se recomienda la implementación de esta estrategia de sistematización de experiencias educativas en la práctica docente para mejorar el aprendizaje de los estudiantes.

Palabras clave: sistematización, andamio educativo, práctica docente, pensamiento complejo, tecnología.

Abstract

Systematizing experiences is a practice that has been developed with the goal of improving activities in any field by retrospectively observing what has been done in order to identify successes and opportunities for change. This allows teachers to observe their own performance, as well as the interactions that take place in the classroom, and be critical of their experiences in order to continuously improve their teaching activities.

The aim of this research was to propose a strategy for systematizing educational experiences in teaching practice, specifically for the subject of Technologies and Information Management in the Faculty of Physical Culture Sciences. Educational scaffolds were developed and applied in the first semester groups to achieve this goal. In a second intervention, surveys were conducted with the students, and the results were compared with groups in which scaffolds were not used, using statistical techniques such as ANOVA, linear regression, and K-means.

The results of applying the strategy of systematizing educational experiences showed that planning with educational scaffolds had a positive impact on student perception. There was a significant difference between the intervention and non-intervention groups, with the intervention groups rating the course better and using a greater variety of technological media and formats.

The incorporation of innovative elements, such as the creation of closed groups with students from each classroom on the Facebook social network and video recordings of classes, were elements that students used to their advantage for learning the subject matter. Through complex thinking, the students were able to have an external view of the problems that exist in their community.

Systematization allowed for the adaptation and improvement of the class by observing the teacher's strengths and weaknesses in the teaching process and the attitudes taken by the students. This observation allowed for the modification of the strategies used for the subject and the application of those strategies in subsequent classes.

Therefore, the implementation of this strategy of systematizing educational experiences in teaching practice is recommended to improve student learning.

Keywords: Systematization, educational scaffolding, teaching practice, complex thinking, technology.

Resumo

A sistematização de experiências é uma prática que vem sendo desenvolvida com o objetivo de aprimorar as atividades realizadas em qualquer área por meio da observação retrospectiva do que foi feito para identificar sucessos e oportunidades de mudança. Dessa forma, o professor pode observar o seu próprio desempenho, bem como as interações que existem em sala de aula, e fazer críticas à sua experiência de forma a melhorar continuamente a sua atividade docente.

Portanto, o objetivo desta pesquisa foi propor uma estratégia para a sistematização de experiências educativas na prática docente para a disciplina de Tecnologias e Gestão da Informação da Faculdade de Ciências da Cultura Física. Para isso, foram desenvolvidos andaimes educacionais que foram aplicados nas turmas do primeiro semestre. Numa segunda intervenção, foram aplicados inquéritos aos alunos e os resultados foram comparados com grupos em que não houve intervenção de scaffolding, utilizando técnicas estatísticas como Anova, regressão linear e K-means.

Ao aplicar a estratégia de sistematização de experiências educativas, determinou-se que o planejamento com scaffolding realmente teve um impacto positivo na percepção dos alunos. Os resultados mostram que existe uma diferença significativa entre os grupos com e sem intervenção, sendo os grupos com intervenção os que melhor avaliaram o curso e utilizaram maior variedade de mídias e formatos de natureza tecnológica.

Conseguiu-se que, por meio do pensamento complexo, os alunos pudessem ter uma visão externa da escola dos problemas existentes em sua comunidade. A incorporação de elementos inovadores, como a criação de grupos fechados com os alunos de cada turma na rede social Facebook e as gravações em vídeo das aulas, foram elementos que utilizaram a seu favor para aprender os temas da disciplina.

A sistematização permitiu adaptar e melhorar a aula observando os pontos fortes e fracos do professor no processo de ensino e as atitudes tomadas pelos alunos. Essa observação possibilitou modificar as estratégias utilizadas para o assunto e aplicar essas estratégias em aplicações posteriores. Assim, recomenda-se a implementação dessa estratégia de sistematização de experiências educativas na prática docente para melhorar o aprendizado dos alunos.

Palavras-chave: sistematização, andaime educacional, prática docente, pensamento complexo, tecnologia.

Introduction

Barragán and Torres (2017) They have pointed out that the beginnings of systematization date back to the 1960s with the first investigations in different areas, such as adult education and social work. Pérez de Maza (2016), for his part, indicates that at first systematization was only considered as a set of reflections about the scope of this discipline, which was sought to give a scientific, technical and humanistic approach.

In Mexico, it developed and participated in the Community Networks for the Renewal of Higher Education teaching-learning (RECREA) project, whose purpose is to form communities of innovation in educational practice, basing its activities on complex thinking and carrying out research on systematization of educational experiences of innovative communities of practice. This initiative was developed by the Undersecretary of Higher Education and technically supported by nine Normal Schools and eight public state universities (Innova-Cesal, 2011).

The systematization of educational experiences of communities of innovative practice seeks to find new forms of professional development for higher education teachers to facilitate the renewal of their teaching practices and, thus, achieve greater and better student learning (Innova-Cesal, 2011).

This led to the implementation of the systematization within the Autonomous University of Chihuahua, within the framework of the subject of Technologies and Information Management (TyMI), which is taught during the first semester of all the university's careers.

The intention of the subject is that the student understands the importance of information and communication technologies (ICT) to identify social problems. This is achieved through the development of skills that contribute with social and ethical responsibility to the management of tools, computer equipment and digital resources to generate projects that lead to the solution of problems in their environment through assertive communication and a collaborative process. For this, a cognitive scaffolding or instructional design proposal was used, which includes the main elements necessary for students to acquire the ability to learn and address, by themselves, advanced situations and problems in the contemporary world.

The purpose of building educational scaffolding is that they serve as a guide for both the teacher and the student and that allow the programming of academic activities that not only integrate what has been learned in a particular subject, but are also put into practice in other subjects of the university career and outside the classroom. The question that guided the present investigation was the following: how to develop a strategy of educational experiences in the teaching practice for the subject of Technologies and Information Management?

Consequently, the objective of this research was to propose a strategy for the systematization of educational experiences in teaching practice for the subject of Technologies and Information Management of the Faculty of Physical Culture Sciences.

Systematization of educational experiences

A review of the current literature on systematization indicates that it is a process in which the people who participate should be the main protagonists of their own systematization, although they may require support or advice from other people to carry it out (Jara, 2018). In the educational field, the systematization of experiences is considered a research activity determined by the experience of the teaching practice and of the students as subjects of the action (Ortiz, 2012).

Systematization is about learning from experience and allowing others to learn from it. It is necessary to recognize the value of educational experiences to produce knowledge from pedagogical strategies and practices that have shown a significant effect on learning. Each experience is unique, so systematization does not consist in replicating experiences, but in promoting what has been learned among educational communities, allowing other teachers to use it, adapt it, and improve their educational work (Fondo Nacional de Desarrollo de la Educación Peruana, 2014).

The recovery of the process lived through the narration and the documentation of experiences are not enough to systematize, although they are activities of systematization. If reference is made to ordering, cataloging or classifying data and information, one speaks of data or information systematization. Experiences must be interpreted critically, which is why the term systematization of experiences is always used, and not just systematization (Expósito and González, 2017).

The process of systematizing experiences involves actions such as observing, listening, asking, recording, interpreting, and writing process reports and final reports. It is a form of research of a qualitative nature that provides spaces for teachers to be the systematizers of their own practice and reporters of their own experience (Messina and Osorio, 2016).

Systematization has an educational function, since by sharing experiences, others can learn to recover and value their own practices, as well as build new knowledge to improve them. (Unesco, 2016a).

Complex thinking

According to Morín (2017), complexity is made up of heterogeneous components that are interconnected, like a fabric of events, actions, interactions, feedbacks, determinations and chances, which constitute the world. Complexity presents itself as disorder, ambiguity and uncertainty. It is then when the need arises to order, rule out the uncertain, eliminate ambiguity, clarify, distinguish and rank.

When talking about complex thinking, you are part of a larger system, so you are in constant interaction with other elements of the system, as well as elements of microsystems and macrosystems. (Pereira, 2010).

Educational innovation

The term innovation refers to three interrelated uses. First, innovation is seen as an invention, second, it is described as the process by which an existing innovation becomes part of people's cognitive and behavioral state, and third, it refers to an idea that has been invented and is considered new. When referring to educational innovation, this last meaning described is the most relevant, such as group work as a teaching strategy and the use of ICT, respectively (Margalef and Arenas, 2006).

Innovation must be present in all educational centers, in order to modernize teaching and learning processes and adapt to modern times. (Unesco, 2016b).

Technology

In schools, ICTs are becoming more and more present in order to make learning processes more efficient. In this way, the participation of teachers in the incorporation of technological tools is of great relevance, since they are the means through which knowledge reaches the student from the different teaching strategies (George and Trujillo, 2018).

Granados (cited by Hernández, 2017) indicates that students have adopted technologies to facilitate learning. Technology has been incorporated into education as a resource to enhance learning.

Investigation action

This type of research relates the study of problems in a given area with social action programs, which allows the simultaneous achievement of knowledge and social changes (Vidal and Rivera, 2007).

In teaching, it is considered that the teaching process does not consist only in imparting knowledge, but in analyzing and reflecting on teaching experiences and making action research an integral part of educational activity. The main objective of this methodology is not to solve problems, but rather the retrospective analysis that teachers carry out of their practice in order to introduce improvements in their professional activity. (Elliott, 2000).

Method

The present investigation had a quantitative nature, in which a survey was applied to two groups of the first semester. The type of research was considered analytical, since, with the implementation of scaffolding in the classroom, behaviors, performances, and moments of evaluation in the classroom were described through videos, with the focus on improving teaching practice.

The research work was carried out at the Faculty of Physical Culture Sciences during the years 2018 and 2019, with the aim of proposing a strategy for the systematization of educational experiences in teaching practice for the subject of Technologies and Information Management. .

The study variables were the following: teaching practice (dependent variable) with the indicators of students, course and environment. As an independent variable: educational

scaffolding with the indicators complex thinking, technology and innovation, students, teachers, teaching environment and course.

The population under study were 60 students of the first semester of the degree course in Physical Education of the Faculty of Physical Culture Sciences of the Autonomous University of Chihuahua.

The sampling technique used was non-probabilistic for convenience. The sample corresponded to two groups to which the educational scaffold was applied and two groups to which it was not applied.

Instrument

The instrument used to measure the influence of the application of educational scaffolding consisted of a survey addressed to students and consisted of 17 questions grouped into three dimensions: seven questions about complex thinking, five about technology, and five about innovation. A Likert scale of 0 to 10 was used, where 0 represented never or nothing, and 10 represented always or everything.

To validate the survey, Cronbach's alpha was determined with a reliability level of 0.861. Reliability represents the consistency of a measurement and, in research, refers to how much measurement error exists in a measurement instrument. Depending on the degree to which measurement errors occur in a measurement instrument, it will be little or more reliable (Quero, 2010).

The processing and interpretation of the information were carried out through the statistical program Statistical Package for the Social Sciences (SPSS) version 21. In this study, the analysis of variance was used in order to compare the means in the results of the students to whom the educational scaffolding was applied, against the results of the survey of the students to whom the educational scaffolding was not applied. In this way, the term a factor referred to in this study is the characteristic that distinguishes the students of the groups with and without intervention through the educational scaffold.

Linear regression analysis was used in this study to determine the influence of the application of educational scaffolding on the development of the dimensions of complex thinking, technology, and innovation in students.

The cluster technique (K-means) was used to group the results of the survey and thus be able to compare the frequencies of the results between the groups that did have intervention through educational scaffolding and the groups without intervention. For

purposes of said analysis, a nomenclature was assigned to the Likert scale, as follows: 1 = never, 2 = almost never, 3 = regular, 4 = almost always, 5 = always.

The Delphi method was used to validate the strategy, which allowed it to be approved through the experience and knowledge of the experts. Therefore, impartiality, consistency and coherence of ideas (creativity and imagination) are required, but, above all, that they act ethically and morally in their collective assessments of building the future.

Results

The results show significant differences in Complex Thought [$F(7,47) = 6.092$, $p = .000$, $\eta^2 = .48$], Technology [$F(5,49) = 7.23$, $p = .000$, $\eta^2 = .42$] and Innovation [$F(3,51) = 20.195$, $p = .000$, $\eta^2 = .54$]. Tables 1, 2 and 3 present the descriptive statistics by group and the results of the unifactorial analysis of variance by question for Complex Thought, Technology and Innovation, respectively (table 1).

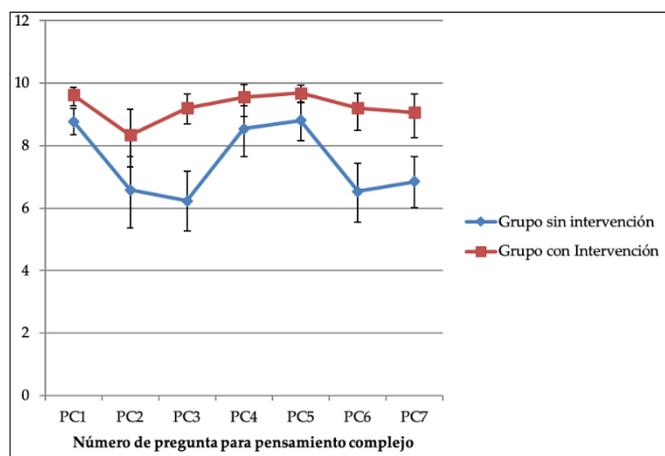
Table 1. Descriptive statistics and results of an Anova factor for Complex thinking

Complex thinking	Students to whom the educational scaffolding was not applied		Students to whom the educational scaffolding was applied		difference	
	M	DS	M	DS	F(1, 53)	η^2
1. I was presented with the study plan, as well as the objectives of the subject of TyMI	8.769230 77	1.210212 95	9.620689 66	0.862462 96	9.17**	.15
2. The contents of the subject of TyMI are related to other subjects of the career	6.576923 08	2.886840 17	8.344827 59	2.482450 72	5.96*	.10
3. I was presented with different strategies to be able to understand the contents of TyMI according to my learning needs	6.230769 23	2.566050 54	9.206896 55	1.319613 32	30.16** *	.36
4. I had the opportunity to work as a team with my classmates from TyMI	8.538461 54	2.158346 95	9.551724 14	1.525642 88	4.10*	.07
5. I can use what I learned in TyMI class inside and outside the university	8.807692 31	1.600480 7	9.689655 17	0.760800 72	7.04**	.12
6. The subject of TyMI helped me to reflect on current global issues	6.538461 54	2.387145 06	9.206896 55	1.780435 55	22.38** *	.30
7. With what I learned in the subject of TyMI I was able to investigate and propose a solution to a problem in my community	6.846153 85	2.148344 62	9.068965 52	1.907336 11	16.53** *	.24

* $p < .05$, ** $p < .01$, *** $p < .001$

Source: Authors.

Figure 1. Differences Between Groups of Students for Complex Thinking



Source: Authors.

In figure 1, regarding question 1 on complex thinking, the students considered that the study plan was presented to them. However, in the case of the group without intervention, the average is below the group with intervention, which used scaffolding to introduce the students to the activities and the form of evaluation of the course.

In the second question, the analysis of the means indicates that the students of the group without intervention consider that there is little relationship between the subject of technologies and information management and other subjects of the physical education major, while the students of the group with intervention believe that there is a greater transdisciplinarity between the subject of technologies and information management and other subjects of the career.

The third question consisted of reviewing the variety of teaching techniques applied by teachers. The analysis indicates that the students without intervention had little variety of teaching strategies and that these were not adapted to individual learning needs. In contrast, students in the intervention group indicate that they were offered strategies that were tailored to their individual way of learning.

The fourth question consisted of discovering how much the students worked as a team. The students in the group without intervention indicate that they had the opportunity to work as a team, although the results show that this was not always the case. In the case of the intervention group, from the beginning it was indicated that all the activities would be carried out as a team. However, the statistical analysis and graph 1 show that the maximum score of 10 was not obtained in the survey because some students dropped out and affected their classmates who finished the course working individually.

The fifth question of the survey measured how much the students consider that what they learned in the classroom helps them to apply it inside and outside the university. In both cases, the results were similar. The students in the group without intervention consider that what they learned will be useful to apply outside the classroom, while the students in the group with intervention believe that they can use what they learned in class outside the university, with an average that is 0.8 tenths higher. what the students in the group without intervention consider.

The sixth question consisted of seeing how much they were able to reflect on current global issues. The results of the students in the group without intervention indicate that they had few opportunities to analyze problems and situations that arise in their environment. On the contrary, the students in the intervention group indicate that they did have that advantage. This was possible since news information sources were analyzed, as well as the strengthening of critical thinking through a debate in which a topic of global relevance was exposed.

In the seventh question, in which it was evaluated whether the students were able to solve any community problem, the analysis shows that the scaffolding used in the intervention group indicates that one of the objectives of the subject is precisely to find solutions to social problems of community. In this case, the general theme was childhood obesity and the students were able to carry out research on this phenomenon, approaching it from the perspective of their career (physical education) and using information technologies.

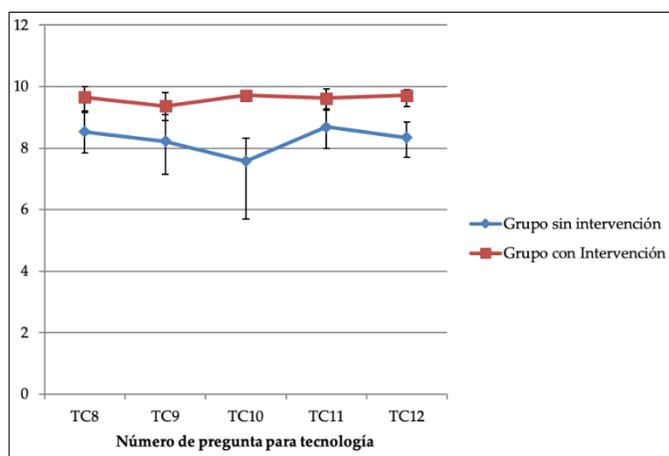
Table 2. Descriptive statistics and results of an Anova factor for technology

Technology	Students to whom the educational scaffolding was not applied		Students to whom the educational scaffolding was applied		difference	
	M	DS	M	DS	F(1,53)	η^2
8. I was provided with technological tools that allow the proper development of the subject of TyMI (use of computer laboratory)	8.53846154	1.74884577	9.65517241	1.11085109	8.16**	.13
9. The information of the subject was presented to me through different means and formats (videos, presentations, etc.)	8.23076923	2.518852	9.37931034	1.29321839	4.66*	.08
10. I learned new concepts related to technology	7.57692308	2.11986937	9.72413793	0.45485883	28.35** *	.34
11. I am able to use the internet more efficiently	8.69230769	1.64363574	9.62068966	1.01467071	6.5*	.10
12. I can use the technologies learned in the subject of TyMI in other subjects of the career	8.34615385	1.52163879	9.72413793	0.95978241	16.48** *	.23

* $p < .05$, ** $p < .01$, *** $p < .001$

Source: Authors.

Figure 2. Differences between groups of students for technology



Source: Authors.

Table 2 shows that questions 8 to 12 correspond to the use of technology in class. In this section, a greater closeness between the two professors is evident because it deals with the subject of technologies and information management. However, Figure 2 shows that the group with the intervention makes a greater use of resources compared to the group without the intervention.

In question 8, which evaluates whether technological tools were provided for the development of the class, it is observed that the average for the group without intervention indicates that, in most cases, electronic resources were provided. However, in the group with intervention, the score was higher, reaching almost all the cases in which some technological tool was used for the development of the class.

Question 9 indicates that the intervention group used a greater variety of media and formats of a technological nature to present the course, which reinforces the third question on complex thinking, in terms of the variety of teaching techniques adapted to the different learning styles.

In question 10, which corresponds to learning new concepts about technology, students in the intervention group indicated that most of the course learned new concepts. This is relevant in teaching, as it keeps students interested and expectant during the development of the course.

In question 11, students in the intervention group indicated that there was an improvement in their academic use of the Internet. For the group without intervention, the students consider that they are able to use the Internet better, but below the perception of the students in the group with intervention.

In question 12, it can be seen that the students in the group without intervention consider that they can use what they have learned regarding information technologies in other subjects, while the students in the group with intervention indicate that the use of technologies learned in class can be used in other subjects of the physical education career, which reinforces the concept of transdisciplinarity of the subject.

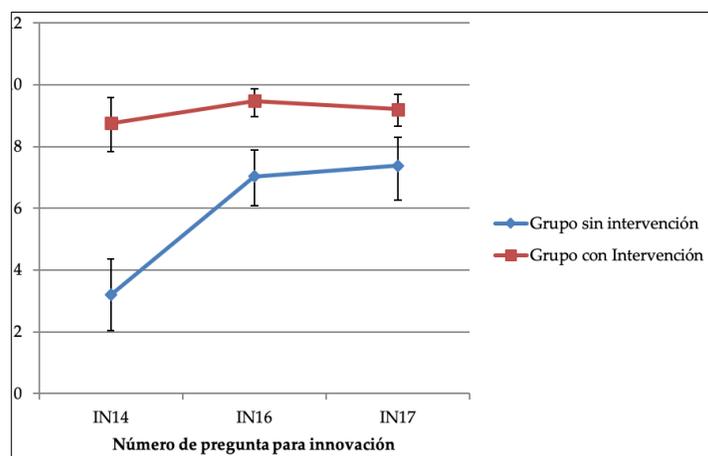
Table 3. Descriptive statistics and results of an Anova factor for innovation

Innovation	Students to whom the educational scaffolding was not applied		Students to whom the educational scaffolding was applied		difference	
	M	DS	M	DS	F(1,53)	η^2
14. The social network Facebook was a didactic support for the subject of TyMI	3.192307 69	2.912308 1	8.758620 69	2.66800049	54.72** *	.50
16. The evaluations of the objects of study of the subject of TyMI were of various forms	7.038461 54	2.374544 49	9.482758 62	1.27112688	23.31** *	.30
17. I consider that the subject of TyMI was developed differently from the other subjects of the course	7.384615 38	2.714065 93	9.206896 55	1.42376037	10.01**	.15

*p<.05, **p<.01, ***p<.001

Source: Authors.

Figure 3. Differences between groups of students for innovation



Source: Authors.

Questions 14, 16 and 17 of the innovation section of the survey were not applicable for the students in the group without intervention. However, the students in the group without intervention were allowed to answer question 14, which refers to the academic use of the social network Facebook.

In question 16, which refers to the diversity of evaluation of the objects of study, the students of the group without intervention indicate that there was some diversity in the way of evaluating the course, while the students of the group with intervention perceive a greater breadth in this diversity in the way of evaluating the activities and performances (table 3 and figure 3).

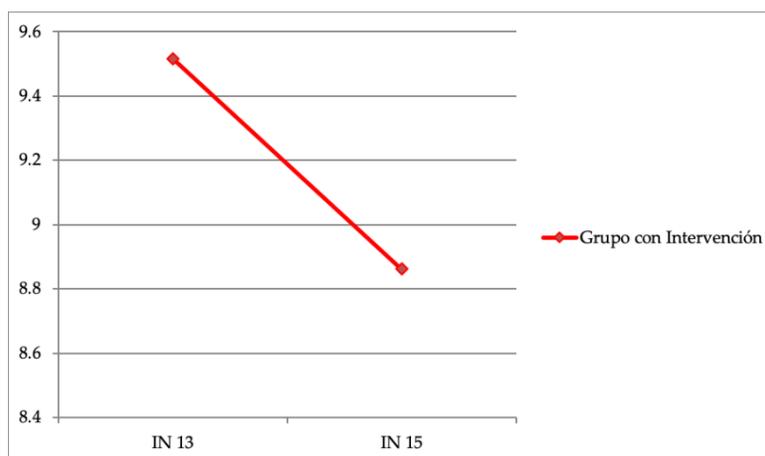
For the students in the intervention group, the development of the technology and information management subject was different from that of other subjects that were taken simultaneously. The students in the group without intervention considered that there was not much difference between the subject of Technologies and Information Management and the other subjects that they took during the first semester, in terms of the way in which the class was taught (table 4).

Table 4. Descriptive statistics of a factor for innovation 13 and 15 for group of students to whom the educational scaffolding was applied.

Innovation	Students to whom the educational scaffolding was applied	
	M	DS
13. Having two teachers in class helped me to better understand the topics of the TyMI subject by having two different points of view.	9.51724138	1.08958346
15. The video recordings were useful for me to understand the subject of TyMI.	8.86206897	1.88460185

Source: Authors.

Figure 4. Innovation result 13 and 15 for group of students to whom the educational scaffolding was applied.



Source: Authors.

In the innovation section, questions 13 and 15 of the survey were analyzed separately (Table 4) because these techniques were only used in the group with intervention, so they could not be compared with the group without intervention in terms of activities. Within the classroom activities of the group with intervention, a second teacher was present, which was an advantage over the other Technology and Information Management courses, since when working as a team, the two Teachers coordinated their experiences in their respective subject areas within classroom activities. This can be seen in figure 4, where the statement of the innovation section IN13, which says "Having two teachers in class helped me to better understand the topics of the TyMI subject because I had two different points of view", obtained an average score of 9.5 out of 10 points, which indicates that having both teachers was of great help to the students.

To retrieve information about the behavior of the group and the experience of the teacher of the intervention group, the classroom sessions were videotaped. However, this activity had an innovative variant, since at the same time that the activities were recorded on video, they were transmitted through Facebook in a closed group specially created for this purpose. Therefore, question 15 refers to this activity, where it is stated that "The video recordings were useful for me to understand the subject of TyMI", and an average score of 8.8 was obtained, which indicates that the video recordings They were an extraclass support for the students during the Technology and Information Management course.

Linear regression analysis

To carry out the analysis of the regression equation, the information obtained from the survey of the groups with and without intervention through educational scaffolding was used. The influence of the intervention on the development of the three variables was analyzed: complex thinking, technology and innovation in the students, and the results of the equation were compared with the groups in which there was no intervention through scaffolding.

In the origin ordinate, a negative value equivalent to -1×10^{-13} was obtained, which, due to its small magnitude, is considered practically zero and is neglected as a negative number.

The observed trend indicates that there is a direct relationship between the application of educational scaffolding and the development of complex thinking and the implementation of innovation in the classroom. When compared with the groups in which there was no application of scaffolding, it is observed that these elements were developed to a lesser extent. Therefore, it is verified through the regression equation that the implementation of educational scaffolding is effective to improve the development of these variables within the classroom.

Table 5 shows a summary of the linear regression equation in the groups with and without intervention through the educational scaffolds.

Table 5. Summary of the linear regression equation

Educational scaffolding	Sorted to origin	Complex thinking	Technology	Innovation
Students to whom the educational scaffolding was not applied	1x10-13	0.340	0.355	0.467
Students to whom the educational scaffolding was applied	-1x10-13	0.376	0.289	0.490

Source: Authors.

Cluster analysis (K-means)

The K-means analysis allowed, in this case, to group the results that occurred most frequently in the cases of groups with intervention through educational scaffolding and groups without intervention through educational scaffolding presented by each of the elements that make up the scaffolds, which are complex thought, technology and innovation.

The results show that, in the case of the groups with intervention, the trend groups the maximum result in a first conglomerate, which is "always" in the three constituent elements of the scaffold, while in the groups without intervention there is an irregular grouping. Therefore, it was shown that for complex thought, the grouping was left with a "regular" result, for technology its result was "almost always" and for innovation, the majority of cases was "almost never". Table 6 shows a summary of the cluster analysis for each of the elements that make up the educational scaffolding and the student groups.

Table 6. Summary of cluster analysis (K-means)

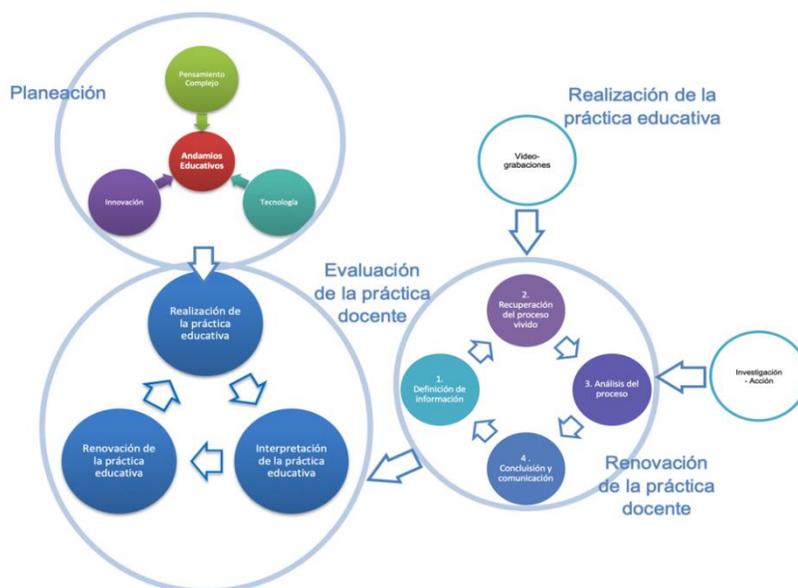
Students to whom the educational scaffolding was applied	Conglomerate		Students to whom the educational scaffolding was not applied	Conglomerate	
	1	2		1	2
Complex thinking	Always	Regular	Complex thinking	Regular	Almost always
Technology	Always	Almost always	Technology	Almost always	Always
Innovation	Always	Regular	Innovation	Almost never	Almost always

Source: Authors.

Strategy for the systematization of educational experiences in the proposed teaching practice

The strategy for systematizing educational experiences in teaching practice consists of four stages. Each of them is described below in Figure 5.

Figure 5. Strategy for systematization of educational experiences in teaching practice



Source: Authors.

Planning

In the systematization strategy, planning consists in the construction of educational scaffolding, based on three key aspects: complex thinking, technology, and innovation. This stage involves planning what will be taught in class through the scaffolds, which will contain the skills that the students will develop, the tasks and projects, the contents and activities of the course, the expected products, the theoretical, strategic, procedural and the practices required for the execution of the task, the evaluation and qualification criteria, the calendar of activities and deliveries of products and basic and complementary bibliography. The scaffolds are presented to the students at the beginning of the activities that will be analyzed in the third stage of the strategy.

Realization of the educational practice

In the stage of carrying out the educational practice, everything planned in the classroom is carried out. It is important to previously establish the strategies for the collection of information, which can be video recordings, which are efficient to capture what is experienced during the practice, in this way they will become the basis for the evaluation of the teaching practice.

Teaching practice evaluation

The evaluation of the teaching practice consists of four sub-processes with which the interpretation of what has been experienced in the activities that must be transformed or reaffirmed for the next cycle is sought. The first is the definition of the information, where the teacher defines which aspects of his practice he is going to recover and evaluate. The second is the recovery of the process lived, for which the strategy to carry it out was previously defined and that can be through the support of video recordings. The third sub-process is the analysis of the process, where the teacher analyzes his practice based on action research, being the same research teacher and research subject. The fourth and last thread is the conclusion and communication of the process, where it is important to determine what works and what must be changed for the next cycle, in addition to communicating the results so that others can learn from the experience.

Renewal of teaching practice

Once the practice has been analyzed and the conclusions about it have been reached, the fourth stage of renewal of the teaching practice begins, where the practice is redesigned based on the results to restart a new cycle with planning through educational scaffolding, modifying the strategies, contents, activities, etc., and thus continue with the systematization cycle.

Discussion

Inciarte *et al.* (2017) found that the systematization of educational experiences influences the training and performance of research teachers, since they are part of the learning processes and the successful achievement of the assumed goals, and are committed to the quality of the research. According to the results, the recovery of the experience lived through the video recordings allowed the observation of the researcher as the investigated subject, which objectively improves the attitudes and activities within the classroom, leading the teaching practice towards the achievement of objectives with educational quality. .

For his part, Calderón (2006) proposes as an objective the formation of a network of teacher trainers to systematize experiences in the field of educational research didactics. Although there were some difficulties in consolidating the network, such as unfavorable institutional conditions, difficulty in making optimal use of time, attention to numerous issues in institutional spaces, academic overload, the process of this network is on track to achieve its goals and has managed to change their educational practices.

By applying the educational scaffolds and systematizing the experience of their implementation in the TyMI subject, it has been possible to observe the strengths and weaknesses in teaching practice, as well as the reactions of the students. This has made it possible to change some of the activities that were not being efficient and reinforce those that had positive effects on the teaching-learning process.

Canales and Araya (2017) carried out an analysis of the teaching function and its interrelation with the usefulness and relevance of ICT, and observed that its use as a teaching resource in the university classroom is conditioned by several factors, such as willingness and interest. of the teaching staff in training in the use of new educational technologies, the financial resources and the time spent by the institution or the teaching staff themselves in training, the willingness to change and to take new risks.

Although technology as a daily tool is implicit in the TyMI subject, the construction of educational scaffolds based on complex thinking, technology, and innovation made it possible to incorporate innovative technological elements into teaching practice, which significantly supported the teaching-learning process. The live transmission of the sessions through the social network Facebook and the consequent video recording of them allowed the students to relive the sessions in the classroom for review purposes, all at their fingertips through mobile devices.

Zárate (2010) showed the complexity in three dimensions: 1) the teaching exercise as an act in which knowledge is not only built, but from which society is made; 2) the knowledge that is elaborated to the extent that reality is thought and analyzed by an individual, which shows multiple knowledge about the same event; and 3) complexity as the theoretical foundation of systematization, which addresses the factors that give rise to various situations and that allow, through constant feedback, a permanent transformation of the teaching task and, thus, a disciplinary contribution.

This is how complex thinking is included in the construction of the scaffolding for the TyMI subject, with which students, who are complex subjects in themselves who carry and integrate the various knowledge built from their own experience, and in turn carry this complexity beyond the classroom and the University itself, through a research process in which they not only learn the use of information technologies, but also solve problems related to their career and that affect the society where they coexist and transmit what they have learned to the same society through social networks and video platforms such as YouTube.

In this research, it was possible to highlight as a strength the ability and skill of teachers to change the way of teaching and learning, through the systematization of educational experiences. One of the opportunities was the development of educational scaffolds that helped students learn differently. One weakness is that only one subject was used as a pilot.

Conclusions

By applying the strategy of systematization of educational experiences in the field of Information Technologies and Management in the Faculty of Physical Culture Sciences of the UACH, it was possible to determine that planning with scaffolding had a positive impact on the perception of students regarding the forms and activities of the class. With respect to complex thinking, it was possible for the students to have a vision external to the school of the problems existing in their community and, from the perspective of the sciences of physical culture and information technologies, they were able to make interventions that resulted in contributions both to the community and to themselves.

The systematization made it possible to adapt and improve the Information Technologies and Management class by choosing four key moments in the development of the subject for its subsequent analysis. This allowed observing the strengths and weaknesses of the teacher in the teaching process and the attitudes taken by the students. The observation of what happened in the classroom allowed to modify the strategies used for the subject and to apply these strategies for later applications.

Study limitations

This research has some limitations, including the sample used, which belongs to a single institution and only worked on one subject.

Future lines of research

It is recommended to develop scaffolds for each of the subjects and apply the systematization of educational experiences in teaching practice.

References

- Barragán, D. y Torres, A. (2017). *La sistematización como investigación interpretativa crítica*. Editorial El Búho.
- Calderón, J. (2006). La red de didáctica de la investigación educativa. Sistematización de una experiencia de innovación educativa. *Revista Interamericana de Educación de Adultos*, 28(2), 98-116. <https://www.crefal.org/rieda/images/rieda-2006-2/exploraciones2.pdf>
- Canales, A. y Araya, I. (2017). Recursos didácticos para el aprendizaje de la educación comercial: sistematización de una experiencia en educación superior. *Revista Electrónica Educare*, 21(2), 1-23. <https://doi.org/10.15359/ree.21-2.7>
- Elliott, J. (2000). *La investigación-acción en educación*. Morata.
- Expósito, D. y González, J. (2017). Sistematización de experiencias como método de investigación. *Gaceta Médica Espirituana*, 19(2), 1-6.
- Fondo Nacional de Desarrollo de la Educación Peruana (2014). *En el corazón de la escuela palpita la innovación. Una propuesta para aprender a sistematizar experiencias de innovación y buenas prácticas educativas*. Ministerio de Educación.
- George, C. y Trujillo, L. (2018). Aplicación del método Delphi modificado para la validación de un cuestionario de incorporación de las TIC en la práctica docente. *Revista Iberoamericana de Evaluación Educativa*, 11(1), 113-135.
- Hernández, R. (2017). Impacto de las TIC en la educación: retos y perspectivas. *Propósitos y Representaciones*, 5(1), 325 - 347.
- Inciarte, A., Camacho, H. y Casilla, D. (2017). Sistematización de experiencias formativas en competencias docentes investigativas. *Opción*, 33(82), 322-343.
- Innova-Cesal. (2011). *Estrategias para el desarrollo de pensamiento complejo y competencias*. Universidad Veracruzana.
- Jara, O. (2018). *La sistematización de experiencias: práctica y teoría para otros mundos políticos*. CINDE.
- Margalef, L. y Arenas, A. (2006). ¿Qué entendemos por innovación educativa? A propósito del desarrollo curricular. *Perspectiva Educativa, Formación de Profesores*, (47), 13-31.
- Messina, G. y Osorio, J. (2016). Sistematizar como ejercicio eco-reflexivo: la fuerza del relato en los procesos de sistematización de experiencias educativas. *Revista e-Curriculum*, 14(2), 602-624.

- Morín, E. (2017). *Introducción al pensamiento complejo*. Gedisa.
- Ortiz, S. (2012). Sentido de la práctica sistematizadora en la educación superior. *Praxis & Saber*, 3(5), 127-142.
- Pereira, J. M. (2010). Consideraciones básicas del pensamiento complejo de Edgar Morín en la educación. *Revista Electrónica Educare*, 14(1), 67-75.
- Pérez de Maza, T. (2016). *Guía didáctica para la sistematización de experiencias en contextos universitarios*. Ediciones del Vicerrectorado Académico.
- Quero, M. (2010). Confiabilidad y coeficiente Alpha de Cronbach. *Telos: Revista de estudios interdisciplinarios en ciencias sociales*, 12(2), 248-252.
<https://doi.org/10.37536/TELOS.12.2.277>
- Unesco (2016a). *Herramientas de apoyo para el trabajo docente. Sistematización de experiencias educativas innovadoras* (vol. 3). Editora y Comercializadora CARTOLAN E.I.R.L.
- Unesco (2016b). *Herramientas de apoyo para el trabajo docente. Innovación Educativa* (vol. 1). Editora y Comercializadora CARTOLAN E.I.R.L.
- Vidal, L. y Rivera, M. (2007). Investigación-acción. *Educación Médica Superior*, 21(4), 1-9.
http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S0864-21412007000400012&lng=es&nrm=iso
- Zárate, L. (2010). La complejidad como referente teórico en la sistematización de experiencias educativas. *Revista Virtual Universidad Católica del Norte*, (29), 1-16.

Rol de Contribución Autor (es)	Autor (es)
Conceptualización	Alma Lilia Sapién Aguilar «principal» Laura Cristina Piñón Howlet «igual» Jorge Luis Márquez López «igual» Luis Antonio Molina Corral «que apoya»
Metodología	Laura Cristina Piñón Howlet
Análisis Formal	Alma Lilia Sapién Aguilar «igual» Jorge Luis Márquez López «igual»
Investigación	Laura Cristina Piñón Howlet
Recursos	Alma Lilia Sapién Aguilar
Curación de datos	Jorge Luis Márquez López
Escritura - Preparación del borrador original	Alma Lilia Sapién Aguilar «igual» Laura Cristina Piñón Howlet «igual» Jorge Luis Márquez López «igual»
Escritura - Revisión y edición	Alma Lilia Sapién Aguilar «igual» Laura Cristina Piñón Howlet «igual» Luis Antonio Molina Corral «que apoya»
Visualización	Alma Lilia Sapién Aguilar «igual» Laura Cristina Piñón Howlet «igual» Jorge Luis Márquez López «igual»
Supervisión	Alma Lilia Sapién Aguilar «igual» Laura Cristina Piñón Howlet «igual» Luis Antonio Molina Corral «que apoya»
Administración de Proyectos	Alma Lilia Sapién Aguilar
Adquisición de fondos	Alma Lilia Sapién Aguilar «igual» Laura Cristina Piñón Howlet «igual» Luis Antonio Molina Corral «igual»