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Micro-Videos as a Learning Tool for Professional Practice during the Post-COVID Era: An Educational Experience

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Abstract: With the arrival of the pandemic, many education students in higher education classrooms saw how their internships were cancelled, making it impossible for them to access real contexts that would let them know how their everyday professional life would be. Consequently, it was necessary to make a methodological change. To bridge the gap between theoretical and practical training, we conducted an educational experience at a private university where several educational videos were used to reflect the implementation of different educational methodologies in teaching mathematics by expert teachers. In the recorded practices, it was shown how four different methodologies were implemented in several contexts during the day-to-day classes: International Baccalaureate (IB), gamification, flipped classroom and project-based learning. We studied each methodology to measure their impact on primary students' learning and guarantee that higher education students had visualized effective practices through micro-videos. The results of our study show that, in certain aspects of mathematics, the students' own teaching capabilities have greater influence than the theoretical methodological instruction they generally receive in the classroom. Further, concerning students' perceptions, we can conclude that their motivation increased towards the use of micro-videos, since they became active agents of their own learning.

Keywords: professional practice; flipped classroom; IB; gamification; project-based learning

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1. Introduction

Teaching mathematics is associated with the transmission of complex and abstract concepts for which, due to students' teaching difficulties, they often need to make a greater effort. For that reason, teachers keep on looking for formulas that help students understand the subject better and can serve as a stimulus to show a positive attitude. This implies that the teacher is responsible for making a large number of decisions on what methodological aspects will allow them to draw up a route in their planning. In this respect, teachers can wonder: what do we need to teach? When can we do it? What knowledge should be prioritized? How does my proposal fit with my students' evolutionary development?

Whenever we implement any methodology in the classroom, it is therefore necessary to have prior reflection not only on how to structure the information, which roles are played by the student and the teacher, and what is the relationship between individual and group learning taking place in the class context, but also how to manage a combination of all these elements to generate significant mathematical knowledge [1]. Llinares et al. [2] have just referred to the necessary knowledge that should be considered for teaching mathematics by identifying what they call "knowledge of mathematics", "knowledge about learning mathematical notions" and "knowledge of the instructional process."

Additionally, we want to note that observation is one of the main sources for future teachers' learning in both the instructional process and the implementation of any new methodologies, that is, the real teaching process that can be carried out in real contexts, such as classrooms and educational centers. However, the COVID-19 pandemic completely changed this scenario and the periods of time or internships that the students could spend in the classrooms vanished and turned into online, rather than face-to-face curricular practices. This situation was in detriment of the observation period, and they could neither interact nor learn in real contexts, thus bringing about a change in higher education methodologies where digital resources were predominantly used to bridge the educational gaps presented at that time [3–5]. In the area of social sciences, and particularly within the respective Degrees of Education, we have found some difficulties when it comes to associating the theoretical concepts explained in class with those in real classroom life. In this sense, it is relevant to point out that one of the real challenges of the pandemic and post-pandemic times for teachers was to establish meaningful and interactive activities that made sense for students [6], and although internships can bridge this gap, the diverse number of methodological styles and organizational differences, among other factors between centers, do not always help to sort out this situation. Furthermore, we can affirm that this often causes students to develop theoretical methodological models that are meaningless to them.

The European Convergence of University Systems finds it essential to experience real educational situations in real contexts, therefore "what is important is that a graduate knows how to face the demands of their field of work" [7]. Likewise, at higher educational levels, we are no longer mere transmitters of contents to promote the skills of students [5]. From this perspective, professional practices could fall into the classification of Intercultural Environmental Education for Sustainable Development (IEESD), implying a new form of transformative education oriented towards sustainability. This approach goes beyond the critical analysis of unsustainable trends and focuses on the training of people to develop a responsible and decision-oriented citizenship in a global and complex world.

The aim of this study focuses on promoting primary students' skill development by visualizing practical cases that have been previously recorded in the real classroom and learn from their perception towards this methodology. In this way, those students being trained to become primary teachers can learn about the educational reality without being physically present at the schools. We also base our study on the importance and usability of information and communication technologies (ICTs), how indispensable they have been and will continue to be in such special circumstances and to what extent we depend on educational tools. Not only do they allow for students' higher flexible and autonomous learning, but they also promote working on more active constructivism-like methodologies or new educational models that foster changes in the student's role from receiver to entrepreneur student [8]. This methodology will allow students to carry out a more in-depth and systematic analysis of the methods applied in the classroom and will also help them grasp the real strategies and skills implemented in the real school environments.

The pandemic has revealed how necessary it is to use technology for more flexible teaching, which will enable the teacher to use and teach through it [9]. The digitalization of higher education in the post-pandemic era is a fact and has turned into a teaching model that incorporates technology as an instrument for students to acquire and develop their teaching skills. Such competences need to develop as they will allow students to respond to the demands that as professionals will be placed on them in the labor market and specifically in early childhood and primary education classrooms [10,11]. If we become knowledgeable of students' perceptions, it will allow us to carry out a better implementation of the methodology and understand how integrating technology has helped them develop their main teachers' competences.

One of the differentiating elements of the present study is the empirical analysis of the educational experiences shown, since it shows the educational practices tested and provides the undergraduate student with relevant information on how the educational intervention impacts on their students' learning. For this reason, it is important to make sure that the learning situations that occur in the infant and primary classrooms respond to what is called good educational practices, since they can certainly help future teachers to develop appropriate models and methodologies which will help develop their own professional skills.

2. Videos as a Learning Tool

The Research and Multimedia Group of the Autonomous University of Barcelona [12] defines good teaching practices as educational interventions that facilitate the development of learning activities in which the planned training objectives and other learning are efficiently achieved. The following is the series of indicators they find the most relevant:

- Significance for students;
- Student's involvement;
- Dealing with diversity both in the contents that are presented and in the implied action strategies;
- Level of cognitive operations involved;
- Social participation and collaborative work.

As suggested by De la Cruz et al. [13], in order to upgrade the educational practice, it is necessary for teachers to be able to explicitly state and contrast the conceptions that underlie the different teaching practices. It will open any possibility of students' transformation, since "it is one thing to know what we conceive, another is to transform those conceptions and yet another is to take these changes to a practical dimension" (p. 360).

When we create didactic videos, we need to consider two differentiated approaches: the transmission approach and the transformational approach [14,15]. In this respect, Mayer is the most outstanding researcher regarding the first approach [16] and, following cognitive theories, when multimedia material contains a lot of essential and extraneous content, the cognitive capacity that allows for the processing of information is overloaded, a condition that is considered to be an extraneous, unnecessary, or irrelevant overload (p. 183).

In relation with the transformational approach, its focus lies on knowing how to integrate information into long-term memory as opposed to the transmission that occurs with viewing. In order to structure the video, some authors such as Ou et al. [17] talk about "learning through reflection", and others such as Hung and Chen [18] suggest that it is very likely that an interactive video promotes deeper learning.

For Koumi [19], who is committed to focusing more on the pedagogy of the video as opposed to the more formal aspects, a good video must contain a narrative structure that engages the viewer. In the same way, reflection strategies could be used to incorporate interactive elements such as questions.

Another issue that has been widely studied and is still a contentious topic, is how long a didactic video should last. According to some authors, the recommended video duration ranges from 5 to 20 min [20,21]. In this sense, Thomson et al. [22] say that the duration is really related to the expectations of the audience, and Harrison [23] further argued that the positive effects of the video are not really related to the duration but to the teacher's style, the students' learning motivation and the use of the video they make. However, it is also interesting to emphasize that students do not always watch videos as planned because they stop at unexpected places by randomly fast-forwarding and rewinding.

The video's format aspects are of great importance to make the video simple, attractive, agile and structured, but when its viewing is intended to make an impact on learning, the transformational approach advocates for a focus on the content selection. Koumi [24] suggests that a strict adoption of streaming principles will lead to potentially bland videos that fail to engage the viewer. However, not only is it necessary to consider what the content of the videos is as an educational tool, but also their use in higher education classrooms. Therefore, visualizing a selected set of good practices in certain fields, such as in mathematics teaching, seeks to develop professional skills that will allow us to effectively manage students' learning in the classroom and improve the educational practice.

One of the advantages that videos provide over real-world observation is that, as Brophy [25] pointed out, "teachers have to respond immediately to what is happening while they are teaching, but video viewers can take their time for reflection, analysis and consideration of alternative strategies" (p. 299).

There are two differentiated approaches to define the impact that video viewing has on the development of teaching skills. One approach focuses on identifying important moments in the teaching-learning process [26], and the second investigates how the teacher interprets this educational situation to make it their own [27]. Both paradigms derive from three fundamental aspects [28], as follows:

1. "It involves identifying what is important in teaching situations" (p. 573);
2. "It involves making connections between specific events and broader teaching and learning principles" (p. 574);
3. "It involves using what one knows about the context and then reason about a situation" (p. 574).

In order to deal with learning methodological strategies through the viewing of videos, we need to establish a perspective that allows for the contextualizing of the analysis of learning situations. In such cases, some of the key pedagogical principles should be identified in order to design an effective learning video so that students can take advantage of its potential.

3. Methodologies in the Field of Mathematics

Another important objective of the present investigation is to find out which educational practices have a positive impact on learning. Although the teaching of mathematics has been studied and analyzed from different perspectives, currently a new joint perspective from both researchers and teachers together is striving to find new formulas that allow the teaching-learning process to become more significant, motivating and playful for students. They all aim for the student to participate in the process and become its active agent, although the implementation of this role will greatly differ depending on the methodology chosen. Each methodology is described below in terms of how this role is developed.

Concerning the International Baccalaureate (IB) methodology and the Primary Years Program (PYP) as part of its IB educational continuum, it originated in the International Schools Curricular Project to allow students, who are not from the school's country of origin and must reside in different countries throughout their childhood, to find a similar method in these schools regardless of the geographical location in which they reside. This methodology follows a multidisciplinary approach to the organization of the curriculum based on three main elements: the objectives defined based on the skills that the student should develop to help them make up their IB profile, the organization of the curriculum and the teacher [29]. The IB student's profile is defined by several principles to become a world-wide citizen, such as informed, principled, inquirers, thinkers, supportive and open-minded [30]. The organization is based on a 6×6 matrix that organizes the planners. Each planner is a curricular inquiry unit that lasts 6 weeks and covers topics such as "how things are connected", "where we are in time and space", "how we express ourselves", "how the world works" and others intended for constructing a transdisciplinary curriculum.

Each planner is organized in six stages beginning with the central idea and followed by other sections such as Teacher Questions, Activities, Assessment, Materials and Reflection. The planner is the tool used to create a curricular unit whose central idea is "[a] concise and true statement of a broad understanding or important expertise embedded in the disciplines" (p. 49). The planner makes up half the curriculum and the rest contains skills and knowledge that do not fit into the matrix but are worked globally [31].

Another methodology chosen for our study is gamification, which provides the student with an opportunity for active participation since the game allows a transmission of content in a participatory, interactive way. Kim et al. [32] pointed out that games intended for gamification should be governed by a series of elements: (a) the story that reflects both the situation in which the characters are presented and the objectives to be achieved by the players; (b) the dynamics made up of the socio-emotional processes that the student will experience during gamification; (c) the mechanics, which include all the rules, missions, rewards and status indicators that are present in the game; and (d) technology, which comprises all of the specific technological materials used. Although the presence of all these elements cannot guarantee that the gamification methodology has been implemented correctly, it would allow us, by adjusting the essential elements of the process, to set a grounding basis. In addition, Kim et al. [32] also highlighted that in using gamification the educational content should be created according to the analysis of such essential elements as objectives, design, development, implementation and evaluation improvement.

The gamification teaching model, such as the one proposed by Zeyber and Saygı [33], has solved various problems such as the creation of content based on the idiosyncrasy of mathematics itself and the methodology associated with it. Although empirical studies in this regard have shown very different results in terms of learning and motivation, the teacher uses gamification as the axis of their methodology. Even if some works show the positive effects not only on the content worked in video games such as programming, mathematics, etc., but also on such processes as motivation [34–36], others conclude that the impact on learning is more mediated by other aspects such as the implementation of this methodology in the classroom [37,38]. A possible explanation for the diversity of results we can find could stem from the conceptualization basis of what gamification means, since not all games used in the classroom are necessarily part of the gamification methodology.

Another methodology under consideration for our research is *flipped classroom* or "inverted classroom" [39]. As Bishop and Verleger [40] explain, the flipped classroom is an educational method that consists of two different parts: an instruction outside the classroom by means of videos displayed on a computer and the practice of group learning activities inside the classroom. According to the methodology itself, students are free to interact with the content according to their learning pace [41], and if a student wants to clarify or deepen their learning of concepts, they can investigate on their own through different sources of information. As this leads to investing less time to explain the simplest concepts, it would let us invest a longer time in explaining difficult concepts, carrying out applied activities, and solving problems or tasks that are always performed with the teacher's guidance [42]. Some authors maintain that the benefit of this methodology depends on the nature of the subject matter itself and, more importantly, for other authors, pedagogical skills such as implementation and evaluation will determine their success [43–47].

As far as mathematics is concerned, it is considered as a complex subject that works with abstract concepts and requires a longer time to achieve a deep understanding. For this reason, it was thought at first that this methodology would provide students with a longer application time, which would allow the student greater organization and understanding of the concepts [48]. The repeated practice and peer learning that are encouraged from this methodology should have a significant impact on it.

Finally, for the present study of mathematics learning, we found it appropriate to deal with project-based learning (PBL) methodology, because it helps focus on students experiencing problems similar to the real world and establishing a collaboration between peers to solve them [49]. The projects or tasks proposed provide the student with the opportunity to select the most suitable strategy for solving it and such an opportunity makes students apply different concepts acquired in the area of mathematics, thus promoting their intrinsic motivation [50]. The work process in PBL is based on the following steps: planning, practices, presentation and evaluation. The interaction established between the students must be bidirectional, that is, they must influence each other [51] since learning will rely on their participation in the construction of the project. Projects should be worked on in small groups, since interactions take place during the discussion process, which fosters the definition of roles for each member and group cohesion [52].

4. Educational Experience

This project has been carried out at Camilo José Cela University (UCJC) during the academic year of 2021–2022, and it was implemented within two subjects: Development of Mathematical Thinking and Didactics of Mathematics I in the 2nd and 3rd courses of the Degree of Infant and Primary Education, respectively.

This educational experience sought to shorten the distance between theory and practice in the didactic and methodological aspects of mathematics teaching, showing the implementation of various methodologies and highlighting the main strengths and shortcomings that they present in the classroom. It also attempted to demonstrate that using micro-videos as a learning tool favored the analysis of the implementation process and students' critical thinking. It has also allowed us to analyze the relevance of this tool and its methodological application in the different subjects, by carrying out an analysis of the contributions, innovation, and improvements that they offer.

Regarding the development of this experience, the researchers were in charge of selecting as school that were as homogeneous as possible for their students' practices, and systematically work the methodology indicated in the area of mathematics. All the students are at a medium-high socioeconomic level, except the school working on PBL methodology, whose average is at a medium-low level. The schools chose to work on the following methodologies: IB, gamification, flipped classroom and project-based learning (PBL). All of them belong to the community of Madrid, except the one applying the flipped classroom methodology that is located in Zaragoza.

The selected good practices were agreed upon with the educational schools' principals and teachers, and the researchers decided to choose those that were most representative of the methodology they were implementing. All the videos were recorded in the respective schools, which Hooker [53] calls site-based TPD (teacher professional development), that is, those recordings carried out in schools, resource centers or teachers' colleges. In these situations, school educators work as expert teachers that participate in gradual learning processes. TDP focuses on the specific situational problems that the teacher encounters when trying to implement new techniques in their classroom practices. This model tends to encourage individual initiative and collaborative approaches to the implementation of a methodology.

With the creation and use of these videos we sought to show how teachers can work and correct erroneous concepts with the students, how to work mathematics with the indicated methodology, the strengths and weaknesses of their day-to-day methodology, what activities they take part in and their influence on learning, as well as how and what instruments they use to assess and evaluate.

5. Aim of the Study

For the present study, we pursue two distinct objectives:

The first objective is to promote primary students' skill development by visualizing practical cases and find out students' perceptions towards this methodology. This will impact on their professional development since they will learn how to implement different didactic methodologies when teaching mathematics and shorten the distance between theory and practice, a situation that has been evidenced especially during the COVID pandemic.

The second objective is concerned with the empirical analysis of the educational practices themselves. We seek to know the impact each of the methodologies has had on student learning, which will foster time for reflection with scientific evidence and the validation of the practices themselves.

6. Method

This research has followed a mixed method. In order to analyze the perception of undergraduate students in regard with viewing didactic videos, and subsequently finding out how was their experience of integrating theoretical and practical contents of the subject with this tool, we used an ad hoc instrument with closed and open questions in which it was possible to collect their assessments by performing a descriptive analysis from a qualitative approach. To determine the impact that each of the methodologies had on the learning of mathematics, a quasi-experimental method was carried out with a post-test design only [54]. This methodology was considered adequate since the objective was to study the instructional impact on primary school students' learning in order to select relevant educational practices that have been empirically tested.

6.1. Participants

For the analysis of undergraduate students' perception, 85 infant and primary education degree students participated (71 girls and 14 boys). In total, 74 students were in the third course of the Degree in Infant Education (66 girls and 8 boys), and 11 were in the second course of the Degree in Primary Education (5 girls and 6 boys).

For the analysis of educational practices, the sample consisted of 186 students from the 3rd (n = 90) and 4th grades of primary education (n = 96), including 94 girls and 92 boys. The mean age of the 3rd grade group is 7.90 with S.D. of 0.33 and the average of the 4th grade students is 8.87 with S.D. of 0.39. See Table 1 on the distribution by group and course.

Table 1. Distribution by methodology.

Group	Course	N
IB	3°	25
	4°	26
Gamification	3°	26
	4°	25
Flipped classroom	3°	18
	4°	22
Projects	3°	21
	4°	23

Table 1 Distribution of participants by methodology and academic course.

6.2. Instruments

For the analysis of the undergraduate students' perceptions, an ad hoc questionnaire was used to refer to the following dimensions: application of active methodologies in the classroom, content deepening, continuous evaluation, and motivation. Each dimension consisted of 4 closed questions (from 1 to 5), where 1 represents 'strongly agree' and 5 'strongly disagree'. An open question about the dimension itself was also included.

For the analysis of the recorded educational practices and the impact of the methodologies on primary students, we used Badyg E2 test which was aimed at assessing whether there were significant differences in the areas of mathematics. All measurements were done during May.

6.3. Results

For the validation of the questionnaire performed ad hoc, the calculation of the competence coefficient (K) [55] was carried out: the mean of K was 0.76, so it can be deduced that it is of a high level of competence on the topic. Subsequently, a formulation form was provided to the experts where a validity box and a coherence box appeared for each item. After analyzing it, adjustments were made to four grammatical questions. Cronbach's alpha is calculated, which gives us 0.82 as a result, so we can say that the questionnaire would be validated.

The viewing of videos contributes to the use of active methodologies. In this sense, we can observe how most of the students perceive the viewing and analysis of the videos as a methodology that allows for the highlighting of the role of student, and thus ceasing to be a mere receiver (Figure 1).

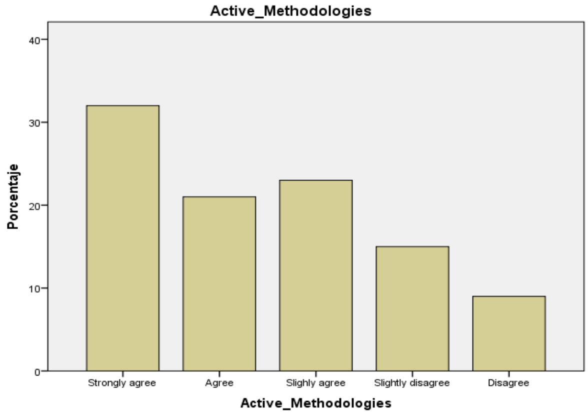

Figure 1. Percentages of perceptions towards the video as an active methodology.

The students recognize that watching videos allows them to delve into the contents of the subject as a positive experience, since many of these videos serve as models for their future professional life. They also highlight that they could use these resources anywhere for an unlimited number of times, and that they are highly adaptable to their learning pace, a circumstance that has contributed to focusing on aspects that sometimes go unnoticed. They affirm that it has been a very useful tool during the process of acquiring knowledge and developing skills (Figure 2).

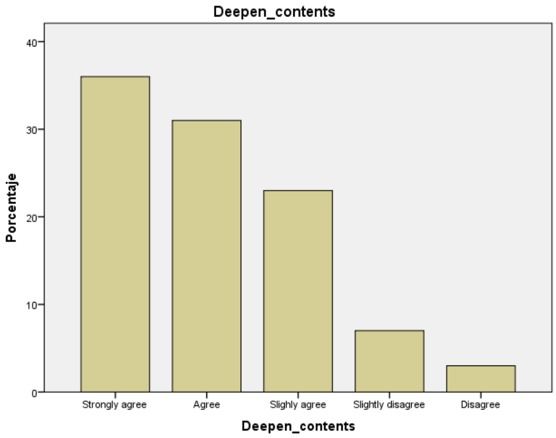

Figure 2. Percentages of their perception towards video as a tool to deepen content.

In Figure 3 we can see how the students indicate that the integration of the videos has not contributed in a clear way to adjusting the subject's continuous evaluation to the process itself. They indicate that a methodological change has taken place, however it has not had an impact on any direct modifications to the subject's continuous evaluation.

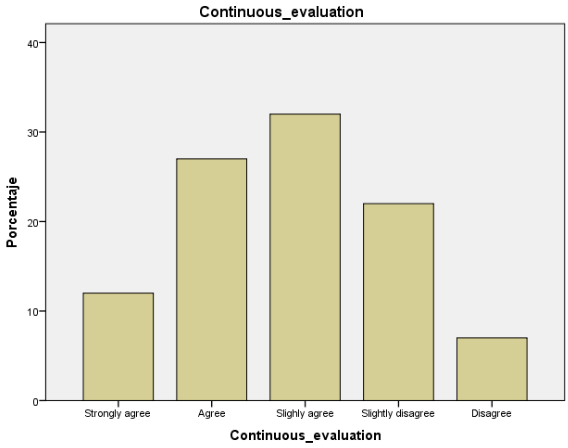

Figure 3. Percentages of their perception towards video as a tool to continuous evaluation.

In Figure 4, we can see how the element that students mostly appreciated has been the motivation involved in using this tool in the classroom. They emphasize that it has promoted more collaborative and cooperative work, boosting the motivation towards the tasks proposed in the subject. They feel that they are protagonists of their own learning.

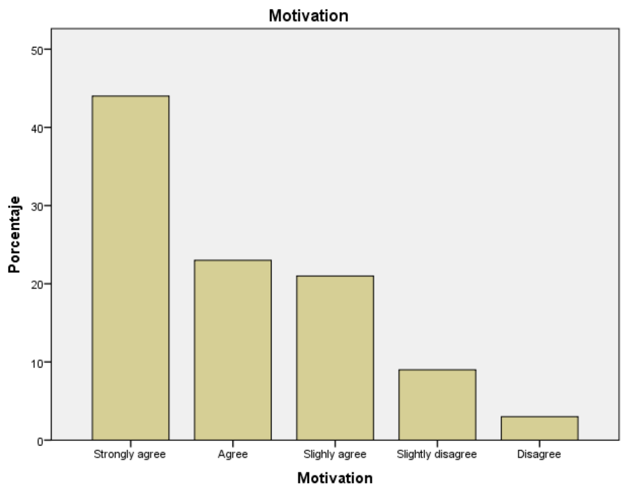

Figure 4. Percentages of their perception towards using the video as a motivating tool.

Regarding the results of the students in primary education, Table 2 shows the means and standard deviations of the scores obtained in the calculation and problem-solving evaluations.

Table 2. Means and Ds with regards to problems and calculations.

	Group	Course	Problems_Badyg	Calcul_Badyg
N	IB	3rd	25	25
		4th	26	26
	Gamification	3rd	26	26
		4th	25	25
	Flipped classroom	3rd	18	18
		4th	22	22
	Projects	3rd	21	21
		4th	23	23

Table 2. Means and Ds with regards to problems and calculations.

	Group	Course	Problems_Badyg	Calcul_Badyg
Mean	IB	3rd	70.1	75.9
		4th	81.3	75.5
	Gamification	3rd	64.7	64.8
		4th	84.8	73.0
	Flipped classroom	3rd	64.4	34.8
		4th	66.1	44.5
	Projects	3rd	36.9	31.6
		4th	47.0	27.9
Standard deviation	IB	3rd	29.0	31.2
		4th	21.8	28.8
	Gamification	3rd	23.1	28.4
		4th	16.8	26.9
	Flipped classroom	3rd	20.7	29.5
		4th	20.4	31.7
	Projects	3rd	33.5	31.8
		4th	28.8	38.9

In order to analyze the existence of individual differences as a function of teaching method and school course, two univariate ANCOVA were carried out. First, an ANCOVA regarding math problem solving with Badyg Problems score as a dependent variable, group and course as teaching method (IB methodology, gamification, flipped classroom and PBL) and school course as inter-subject factors, and intelligence (CI) as covariate. Secondly, an ANCOVA regarding numerical calculation with Badyg Calculation score as a dependent variable, group and course as teaching method (IB methodology, gamification, flipped classroom and projects) and school course as inter-subject factors, and intelligence (CI) as covariate. The results of our first analysis (see Table 3) show a significant main effect of Group F (3, 177) = 3.2, p = 0.022, ηp^2 = 0.053, and a significant interaction of Group × Course F (3, 177) = 3.035, p = 0.031, ηp^2 = 0.049. The subsequent analysis revealed that the students with higher scores were those using a flipped classroom in 3rd grade, and those using gamification in 4th grade when intelligence was controlled for.

Table 3. ANCOVA: Problems_Badyg.

	Sum of Squares	df	Mean Square	F	p	η^2	$\eta^2 p$
Overall model	43,042	8	5380	22.744	<0.001		
Group	4142	3	1381	3.294	0.022	0.035	0.053
Course	290	1	290	0.691	0.407	0.002	0.004
IC	34,793	1	34,793	82.994	<0.001	0.297	0.319
Group * Course	3817	3	1272	3.035	0.031	0.033	0.049
Residuals	74,203	177	419				

In relation to our second analysis (see Table 4), the results of the ANCOVA show a significant main effect of Group F (3, 177) = 11.9, $p < 0.001$, ηp^2 = 0.16, in which the subsequent analysis revealed that the IB methodology group outperformed the other methodologies regardless of course group. No other significant results were found.

Table 4. ANCOVA: Calculation_Badyg.

	Sum of Squares	df	Mean Square	F	p	η^2	$\eta^2 p$
Overall model	77,852	8	9731	21.921	<0.001		
Group	24,569	3	8190	11.941	<0.001	0.123	0.168
Course	1661	1	1661	2.422	0.121	0.008	0.013
CI	49,641	1	49,641	72.381	<0.001	0.249	0.290
Group * Course	1981	3	660	0.963	0.412	0.010	0.016
Residuals	121,393	177	686				

7. Discussion and Conclusions

As the results show, concerning the visualization and analysis of videos as a method for the implementation of methodologies in the classroom, the perception of university students is positive. The application of this methodology has sought to enhance the active and autonomous role of the student, where teachers play an accompanying role to guide and clarify the concepts that are derived from the analysis. This methodology has also allowed for the suppression of other types of activities that are more mechanical or have more abstract applications and did not help university students to specify aspects or develop the skills necessary for their professional career.

The videos were manipulated by the teachers who added questions, comments and audios when it was appropriate and thought it would be essential for the implementation of the methodologies shown to provide students with a basis for reflection. They also consider as an important factor the students' possibility of carrying out a more autonomous use outside the classroom or in class, depending on their learning process.

Since the implementation of all the methodologies can hardly be carried out in a university classroom far from the real context, working with these tools allows for the clarification, deepening, and resolving of doubts about certain contents that otherwise would not be possible [56,57]. Additionally, this allows us to bring primary classrooms to university, thus bridging the eternal distance between theory and practice.

The innovative nature of this work lies in approaching the didactic part of the subject in a visual and concrete way, thus allowing the student to work with less abstract and more concrete aspects of real life in the classroom and enhancing their reflection and critical analysis. This also fosters the achievement of didactic proposals that are more adjusted to the reality of the classrooms since students already know the facilitating points and the difficulties of implementation. Bearing in mind that most of the time it is not the teacher who chooses the methodology that they would like to implement, but rather the school that sets the pedagogical line in accordance with their ideology, it is important for students to be aware of as many methodologies as possible along with their implementation, which will facilitate the future teacher with greater control and security. Visualizing good educational practices in specific didactic areas can help students develop appropriate models and methodologies that can favor the development of their own professional skills.

Another important contribution of the present work is the empirical analysis carried out in the practices shown in the videos. Knowing not only the application of the methodology but also its impact on learning will allow students to promote more effective practices in their development as educators.

As the results indicate, there are no significant differences in problem-solving tasks depending on the methodology used, but it is otherwise determined in terms of the ability of the students. This may be due to the fact that all of the methodologies shown herein can be framed as active methodologies, so the active role of the student is present in all of them, even if each student's application is different. This study shows that planning is essential in each of inquiry, gamification, flipped classroom or project resolution, a fact that makes it possible to generalize and apply this cognitive process when solving verbal problems [58]. The results are in line with the literature on active methodologies, since they encourage students to confront and agree on ideas, in addition to allowing them to structure knowledge based on their own cognitive processes, integrating their own ideas that have, in turn, been generated from those discussed with their peers. The benefits provided by peer work have been demonstrated all along the stages of primary education [59,60].

Nevertheless, other aspects such as calculation that require more systematic and repetitive practice have shown that there are significant differences depending on both the methodology and the student's ability, even if the effect size is very small. We could, subsequently, say that these differences are minimal, and they can be established in the methodologies themselves, being IB and gamification the ones that have the best performance compared to flipped classroom and project-based learning. This may be due to the fact that complex aspects work more systematically in the latter, relegating more systematic tasks to more autonomous learning by the student.

These results are also consistent with the literature, since we found some authors [61–64] who point out the need to study the causes that make the improvement in the mathematics performance of students, who work through the flipped classroom, very weak or less than expected, compared to groups working under other methodologies. Meta-analysis studies demonstrate that three out of five reviews show how the activities done in class were inconsistent, which would make these results weaker and not very comparable [65,66]. Therefore, it would be necessary to carry out an analysis of calculation tasks proposed in the classroom that could give an explanation for this result. In addition, the studies that reveal results about the students' mathematical performance through learning by projects differ depending on the participation of these in the elaboration of the project [67]. From this point of view, it would be necessary to analyze each student's participation, the number of interactions that have taken place and their own motivation.

We can conclude that flipped classroom methodology, which arose from the need to bring the primary classroom closer to the university classroom at a time when face-to-face activity was very difficult because of the pandemic, has allowed for the renewal of the pedagogical perspectives in the area of specific didactics. This methodology has also encouraged students to work more actively and autonomously, favoring more continuous work on the subject themes and more critical thinking, while enhancing their professional skills.

Furthermore, it has allowed a greater deepening and expansion of the content, which previously was worked on in a more abstract way and used to have real difficulties at the time that they had to implement it in the classrooms of educational centers in a more concrete way, and that from the visualization and video analysis, have acquired a series of models and strategies that allow for a more realistic and context-adjusted implementation.

The experience has additionally served university students as an integrated model where theory and practice go hand in hand, allowing them to make sense of their learning and questioning their own skills in the classroom, which serves as the basis for a process of improving their own.

Regarding the measurement of educational practices, we highlight that we compared students' performance in very specific procedures within the learning of mathematics, which can lead us to research proposals in which effective practices that impact student's learning are sought. The cause-effect relationship of the instruction that is carried out in the classroom will increasingly drive us to more effective methodological designs.

This type of research may have some limitations, as it is the case of the present study, when comparing groups with different variables such as socio-demographics, or the different implementations carried out by educational centers applying the same methodology, when no school is similar. However, in this case and taking into account its complexity and the number of variables that intervene in learning, it is necessary to provide methodologies with empirical analysis that permit us to progress and find out methodologies' potential strengths and weaknesses.

Another limitation is the number of students surveyed, since they represent a high percentage of face-to-face students, but the number of students who enroll in blended format degrees decreased, so it would be necessary to continue implementing the experience in subsequent courses to obtain some more robust data.

One of our main prospects is keeping on working in applied methodologies that allow for drawing more general conclusions from the perspective of the students about the videos as a micro learning tool, as well as creating more educational videos that allow laying the foundation of a platform for the dissemination of empirically contracted experiences. These resources would be used both for continuous training and future teachers.

To conclude, it could finally be said that educational videos favor the application of active methodologies in the university classroom, allowing for more flexible, reflective, motivating and autonomous contexts, which allow us to draw closer to the real context and adapt to the learning pace of each student.

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