Learning Itineraries to Work *Mathematic Probability* with Future Teachers in an Online Scenario with Deck.Toys Tool

Itinerarios de aprendizaje para trabajar *Probabilidad matemática* en futuros maestros en un escenario online con Deck.Toys

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ABSTRACT

The work of Probability from the Compulsory Secondary Education stage and during the Baccalaureate is not generally contextualised and is, mainly, based on the rote learning of formulas. Therefore, when students arrive at university, a significant lack of knowledge related to the calculation of probabilities is evident. Teachers have to advocate for classroom strategies that help students to achieve lasting and contextualized learning and, even more, in areas such as Probability. This paper presents the design of a didactic proposal based on the use of gamified learning itineraries utilizing Deck.Toys digital tool for the learning of Probability in a sample of students of the Primary Education Degree who worked on an online environment. For this analysis, the outcomes obtained in two tests, initial and final, are collected in an experimental group that has used the tool and compared with those of a control group that worked in a traditional way. Moreover, the data of a survey of the evaluation of the user experience was also analysed. The results gained have been very satisfactory, the tests of comparison of means in the post-test shows a significant difference of 2.704 points more in the experimental group, taking into account that both groups were homogeneous. Likewise, the results of the satisfaction survey have been positive in terms of improving the understanding of both the procedures and the concepts involved on time management since students have been able to work at their own rhythm in an efficient way.

Keywords: information and communication technologies; probability; teaching and training; higher level education.

RESUMEN

El trabajo de Probabilidad desde la etapa de Educación Secundaria Obligatoria y durante el Bachillerato no está generalmente contextualizado y se basa principalmente en el aprendizaje memorístico de fórmulas. Por tanto, cuando los estudiantes llegan a la universidad, se evidencia una importante falta de conocimientos relacionados con el cálculo de probabilidades. El profesorado debe abogar por estrategias en el aula que ayuden al estudiantado a lograr un aprendizaje duradero y contextualizado, más aún en áreas como la probabilidad. En este artículo se presenta el diseño de una propuesta didáctica basada en el uso de itinerarios de aprendizaje gamificados utilizando la herramienta digital Deck.Toys para el aprendizaje de la Probabilidad en una muestra de alumnos del Grado de Educación Primaria que trabajaban en un entorno online. Para el análisis, se recogen los resultados de dos pruebas, pretest y postest, en el grupo que ha utilizado la herramienta y en el que no forma online y se comparan los resultados obtenidos. Además, también se analizaron los datos de una encuesta de evaluación de la experiencia de usuario. Los resultados obtenidos muestran que la diferencia de medias en el postest es significativa de 2.704 puntos más en el grupo experimental, con un tamaño de efecto grande, aunque los grupos eran homogéneos. Asimismo, los resultados de la encuesta de satisfacción han sido positivos en cuanto a la mejora en la comprensión de los procedimientos y conceptos implicados y en la gestión del tiempo ya que han podido trabajar a su propio ritmo de forma eficiente.

Palabras clave: tecnologías de la información y de la comunicación; probabilidad; enseñanza y formación; enseñanza superior.

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INTRODUCTION

The constant advances in the technological field, together with the impulse of the governments and the opportunity that it represents both for teachers and institutions as well as for students, lead to the development of new educational software that allow the adaptation to the needs of students (Prendes & Cerdán, 2021). Studies in which different technologies are used in the classroom are increasingly frequent (Benavides et al., 2020; Stosic, 2015; Tuma, 2021; Young-Jin, 2011).

On the other hand, given the current situation caused by SARS CoV-2, a large part of educational institutions around the world had to adapt to the new situation and, thus, to design and to work in e-Learning scenarios (Biswas & Debnath, 2020; Krishnapatria, 2020; Radha et al., 2020; Ramaiah et al., 2021), having to ensure that students are learning the content. One of the branches that presents more difficulties is mathematics, due to the abstraction of the contents and the difficulties that students show in their learning. In addition, the difficulty of losing direct contact with the teacher and working in an online environment is added, in which the participation of students can be reduced for different reasons and this aspect leads, in many cases, to the abandonment of students and more at university levels, where class attendance is optional. Therefore, teachers must be able to attract the attention of students and encourage their participation and involvement in their own learning.

Learning itineraries are a trend in recent years (Campos & Hernández, 2020; Mor et al., 2018; Rivera & Lindín, 2019; Sánchez-Ruiz et al., 2017) and more authors are studying the benefits they offer in the learning process, both in face-to-face and in online environments. This study tries to show that, in the field of Probability, one of the branches that is most complex for students, this type of educational practices, in an online environment, can be very positive, both in the improvement of learning results compared to the traditional online class, as well as in the students' perception of their own learning and their relationship with mathematical contents.

THEORETICAL FRAMEWORK

Literature in area related to the use of software to design and develop learning itineraries is growing in the last decades (Agudelo & Ibáñez, 2015; Dettori et al., 2002; Nabizadeh et al., 2020). The learning of Probability with those learning itineraries is not shown in literature and there are not results neither quantitative nor qualitative about this fact, but precisely this field of mathematics is one of the most propitious for these practices so the development and use of learning itineraries can be seen as a challenge both for teachers and higher institutions.

E-learning and mathematics

Nowadays, several university educational programs include distance education for which the use of technologies is necessary as they condition the way in which the teaching-learning processes are developed (Bozkurt, 2019; Heedy & Uribe, 2008). In this sense, the term e-learning arises to encompass both methodologies, processes and applications (Arkorful & Abaidoo, 2015) in online environments that advocate for the acquisition of knowledge and allow the interaction between the student and the teacher. Under this paradigm, the Flip Learning methodology represents a great opportunity for online learning as it allows students to reach the content as the protagonists of their learning (Jordán et al., 2019). This methodology is based on the use of explanatory videos of the content that the students can watch at home at their own pace, so that classroom moments, whether in person or online, are used to solve doubts, problems, etc. (Lage et al., 2000).

In the specific case of mathematics, there is a tend to advocate for the use of these classroom methodologies, so students can take much more advantage of the classes (Love et al., 2014; McGivney-Burelle & Xue, 2013; Talbert, 2012). On the other hand, it is evident that the workload for the student is increased, as well as the effort and dedication (Jordán et al., 2019). When choosing a didactic resource that helps teachers in the online teaching paradigm in mathematics, there are several aspects to consider in terms of its suitability, such as (Godino et al., 2007):

- Epistemic suitability.
- Cognitive suitability.
- Interactional suitability.
- Mediational suitability.
- Affective suitability.
- Ecological suitability.

Consequently, these aspects have been considered in the selection of the software for the online classes and the development of the learning path and experience. Moreover, it is important to consider the teacher beliefs of the use and domain of ICTs (Casillas et al., 2020; Sosa & Valverde, 2020).

Main difficulties in Probability learning

Although mathematics is complicated due to its abstraction, something that students repeatedly show, one of the branches that stands out the most is Statistics and Probability. Many authors have stressed, for more than 40 years, the need for the inclusion of both Probability and Statistics from the early stages (Alsina, 2017; Alsina & Salgado, 2019; Cuida et al., 2021; Ortiz & Alsina, 2019; Rodríguez- Múñiz et al., 2020). One of the main problems with Probability is that there has been a historical trend that shows the lack of importance and work in the classes of this branch, which entails different difficulties associated with the fact that students are already tired at the end of course and with the textbooks, as shown by Cañizares et al. (1999), without offering sufficiently enriching and real situations that help them to reach a deep understanding. Batanero et al. (2004), analysed in detail the reasons why students have difficulties in learning Probability and, through their experience in a course within their own university, they gave possible answers to alleviate these problems through different examples, including probabilistic games. In addition, there are other studies (Cobb and Moore, 1997; Kapadia & Borovcnik, 2012) that already supported, for several decades, the need to reinforce Probability contents through enriching experiences.

Within Probability Theory, it is important the study of models to infer and one of the most studied is known as Normal Distribution, since many natural phenomena and day-to-day life situations can be modelled with a normal curve. Authors such as Godino et al. (2007) or Groth & Bergner (2006), said that it is important for the future teachers to have a deep knowledge about the statistical and probabilistic branch to lead the class. In this study, in relation to the Probability associated with the normal distribution, authors add the difficulty with formal writing and the systems of representation both verbal, symbolic, graphic and even manipulative that the problems require, as well as deep understanding of what Probability involves and the values it can take, when representing proportions with values that must range between 0 and 1, or equivalently between 0 and 100%. In this sense, this study is centred in the need of a deep knowledge of teachers without forgetting the pedagogical component, which is also important as Batanero et al. (2016) and Ortiz & Alsina (2019) comment.

Gamified learning itineraries: Deck.Toys tool

The use of gamification in the classroom has great potential, but it is a challenge for teachers, not only in terms of their training in digital competence, but also in ensuring that the student reaches knowledge through the tool used. The SARS-COV-19 pandemic has meant a before and after for the incorporation of this type of tools and more links on the web created by teachers of different educational levels can be found (Harper et al., 2021).

The combined use of games with technologies has a very positive impact on the achievement of learning objectives in mathematics by the student, as shown in the study of Divjak & Tomić (2011) based on a systematic review of 32 works carried out in 12 different countries of also different educational levels. There are many studies that collect experiences, especially in the stage of Secondary Education. Some recent ones that deal with the use of an Escape Room are that of Jiménez et al. (2020), based on the use of Genial.ly tool, and that of Fuentes-Cabrera et al. (2020). In the

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field of Higher Education, there are some like the one of Queiruga-Dios et al. (2020) to work calculation through a Breakout and that of López-Belmonte et al. (2020) with students of Primary Education Degree.

As Ibáñez et al. (2011) comment, a learning itinerary is a sequence that integrates several resources and, therefore, it is a way of organizing said learning. Considering the elaboration theory of Reigeluth (1999) that indicates that the teacher must make use of different cognitive strategies according to the characteristics of the students to reach knowledge more efficiently (Pérez et al., 2004) and Ausubel's principles of meaningful learning (Ausubel et al., 1968), learning paths must (Sánchez and Flores, 2010):

- Properly organize the concepts and learning objects.
- Properly show the steps to be taken.
- Present a navigation system as flexible as possible.

Deck.Toys tool, on which this study is based, allows to create gamified tours in which there are challenges, questions, blackouts, word searches, flashcards, puzzles, etc. that the student must solve to reach a final goal. The tool has multiple templates that can be used, but the author can also make their own creations, embed videos or other links, etc.

"Deck.Toys is a tool that allows the teaching-learning process to be carried out by promoting student participation. It is based on gamified learning environments where the activity takes place in real time and in virtual contexts. It allows the teacher to see the progress of the students, permitting instant feedback. Puzzles, word searches, crosswords, images, etc. can be inserted to achieve the challenges" (Agreda et al., 2019, p. 1871).

Currently, there is not relevant published literature based on the use of Deck.Toys. Some examples of studies that can be highlighted are a report that gives examples of tools to do digital BreakOuts (Kroski, 2020) and a study of the application of the tool in clinical resident programs (Turner et al., 2021).

On the other hand, it is important to note that although on Deck.Toys page states (https://deck.toys/terms-of-service) that they use the Student Data just for providing the service and improving it. So, its use could cause damage due to this data processing, but this would only happen if the user wanted to work with the tool embedded in their learning management system. The choice of this platform has been enhanced considering that it is possible to work only through a link, and the platform does not collect student´s data, it allows the creation of personalized itineraries for the student and the creation of attractive interfaces. Thus, in this experience through the link, the only data needed by the students has been from the online questionnaires, where they had to put their name which have been collected by the teacher, not by the tool.

Study Objectives

In this work the design of a Probability learning itinerary for students of the Degree Primary Education using Deck.Toys tool (https://deck.toys/) is presented. In addition, the results of the analysis of the data obtained in test answered by a group of students who used the tool compared with group that did not use it and the results of a user experience questionnaire are also presented. Both groups worked on an online environment.

The objectives of this work, therefore, are:

- To design a gamified learning itinerary with Deck.Toys tool to work Probability contents.
- To analyse the data obtained in both initial and final evaluation tests in a sample of Primary Education Degree students and compare the results of the group who worked with the tool with those that worked in a traditional way.
- To analyse the data from a satisfaction survey of the sample of students who used the tool.
- To reflect on the potential of Deck.Toys as a learning tool in Higher Education.

METHODOLOGY

All previous issues converge towards the aim of contrasting the results obtained by both groups. Methodological aspects considered to achieve this goal are presented and discussed in the following subsections.

Context and participants

The sample of this study consisted of 60 students of the Degree in Primary Education in a Public University located in Spain. The university mainly welcomes students from the community itself. This University, due to COVID restrictions, run the course 2020/2021 in a blended way. From the sample, 30 students formed the experimental group, who used Deck.Toys tool in an online environment, and the other 30 formed the control group who worked the contents in a traditional way also in an online environment.

Research model

The methodological design chosen is quasi-experimental, which is one of the most used in education, since the investigation of certain phenomena, mainly due to the non-randomness of the subjects generally to the groups, cannot be carried out following experimental procedures (Campbell & Stanley, 2015).

Two measurements have been made both for the control and the experimental groups: a pre-test and a post-test carried out before and after the experience. The design is quasi-experimental due to the non-randomization of subjects to the groups, since these groups were composed from the beginning of the course.

The control group received the theory in a traditional way in an online environment combining theory and practical exercises. The experimental group work with Deck.Toys in an online environment where the teacher was also present online to help them, with the software, not with the subject. Finally, just after the experience, they were asked to answer a survey to know their perceptions about the experience.

Contents and learning itineraries

The contents worked encompass the entire topic related to the calculation of probabilities associated with a normal distribution:

- Normal distribution and its density function.
- Normal distribution $N(0,1)$.
- Calculation of probabilities associated with the normal distribution .
- Operations with k, k_1, $k_2 \geq 0$
  - $P(Z<k)$.
  - $P(Z>k)$.
  - $P(Z<-k)$.
  - $P(Z>-k)$.
  - $P(k_1<Z<k_2)$.
  - $P(Z<z)=k_1$.
  - $P(Z>z)=k_1$.
  - $P(Z<-z)=k_1$.
  - $P(Z>-z)=k_1$.
- Distribution $N(\mu,\sigma)$.
- Typifying.
- Calculation of probabilities associated with $N(\mu,\sigma)$.
- Solving problems involving real situations in which they need to use all the previous contents.

The itinerary had several videos explaining the theory involved, some examples and exercises to practice in which if the answer was right, they can continue with the next exercise, but when it was wrong a clue with explanation is shown until they give a right answer. In Figures 1-3 there is one of the tasks of the itinerary with an embedded video and a question that they need to answer correctly to continue.

Figure 1
Lesson path made with Deck.Toys

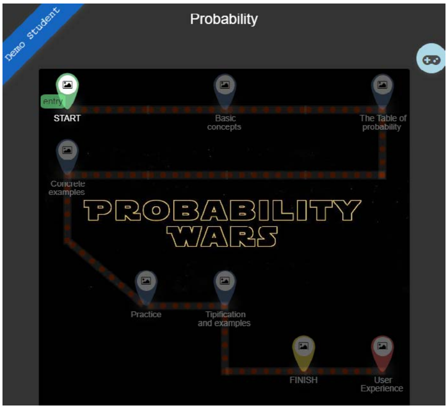

Figure 2
Video embedded in the itinerary

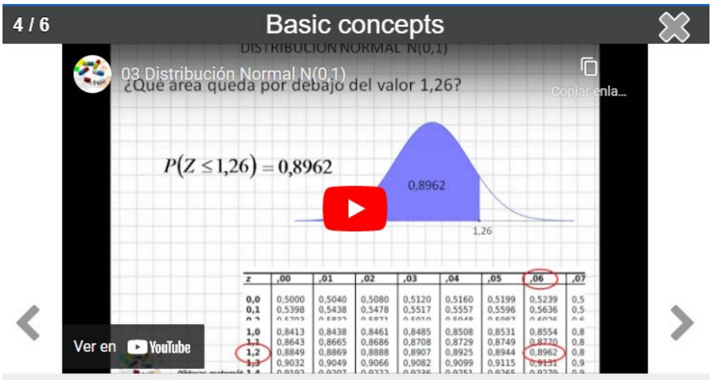

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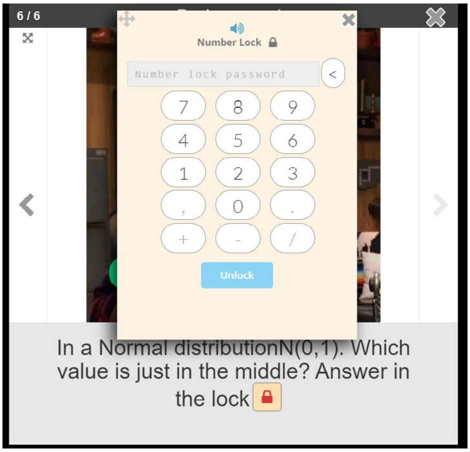
Figure 3

Question embedded in the Deck.Toys learning itinerary



The itineraries were personalized for each student, since the answers they were giving to the questions were considered to follow one route or another and whether they understood the processes used and the practical applications, and if they did not answer correctly, they were referred to a video or extra explanatory material that would help to understand the content. Moreover, each student could also go back through the itinerary whenever there was a need to refresh or remember any previous element. All the material, at the end of the experience, was provided to all the students.

Information collection tools

The information collection instruments were:

- A pre-test, which consisted of 7 simple selection questions about basic concepts related to the probability of the normal distribution and its operations.
- A post-test, which was composed of 9 open-ended questions about basic concepts related to the probability of the normal distribution and its operations.
- A satisfaction questionnaire, which can be seen in Figure 4, from which a part (Q9-Q20) has been adapted from of validated instrument collected in Sacristán et al. (2017).

Figure 4
Satisfaction questionnaire used

Likert-type questions: 6 options: Totally disagree, Disagree, Partially disagree, Partially agree, Agree, Totally agree:
▪ Q1: the experience has made the learning Probability easier
▪ Q2: the experience has increased my interest in mathematics
▪ Q3: the experience has helped me to better understand the procedures
▪ Q4: using the program has helped me to better internalize Probability contents
▪ Q5: the program used is a good tool to work on mathematics
▪ Q6: the program used is a good complement in the math classes
▪ Q7: I would like to carry out similar experiences with other contents
▪ Q8: I would like to carry out similar experiences in other subjects
Scoring questions: 1 is "did not like it at all" and 10 "liked it a lot":
▪ Q9: my learning results have increased
▪ Q10: I have improved my learning process
▪ Q11: I have increased my motivation
▪ Q12: I liked this class more than the "traditional" one
▪ Q13: I think that learning is more active and experienced
▪ Q14: I have had more possibilities to participate in problem solving and develop my critical thinking
▪ Q15: I have more possibilities to work at my own pace
▪ Q16: It was easy for me to access the learning materials and content
▪ Q17: I have been able to self-assess my learning process
▪ Q18: I have fun while learning
▪ Q19: my creativity has increased
▪ Q20: how much did you like the experience?
Yes / No Questions:
▪ Q21: did you know the program before the class?
▪ Q22: have you done any similar experiences in class before?
▪ Q23: would you like to have another class like this?
Another type of questions:
▪ Q24: how much have you learned/remembered in class?
▪ Q25: any other comments you want to do?

Data analysis and research questions

A descriptive analysis of the scores obtained in both tests is carried out for control and experimental groups. In addition, a comparison test of means under parametric assumptions is made with the Student's T statistic for independent samples, with critical value for significance 0.01, establishing:

- Hypothesis of the pre-tests results of the control and experimental groups:
  - HPre_0: There are no significant differences.
  - HPre_1: There are significant differences.
- Hypothesis of the post-tests results of the control and experimental groups:
  - HPost_0: There are no significant differences.
  - HPost_1: There are significant differences.

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- Effect sizes: as it is a well-known fact, it is not enough to compare means, so it is necessary to know the differences in terms of magnitude and effect size "is a quantitative measure of the magnitude of the experimental effect" (McLeod, 2019, p. 1).

The satisfaction questionnaire data is analyzed descriptively and highlighting some of the considerations made by the students in the open questions.

RESULTS AND DISCUSSIONS

Data resulting from both tests and the survey, and their analysis are presented in this section. The discussion is focused on the qualifications obtained in each group as well as on the perceptions shown by students in the survey.

General results

The general data of the 60 students, without considering the group in which they belong to, are in Table 1.

Table 1

Descriptive statistics associated to the tests

	Mean	Standard Deviation
Pre-test	2.92857	1.86773
Post-test	6.72222	2.98160

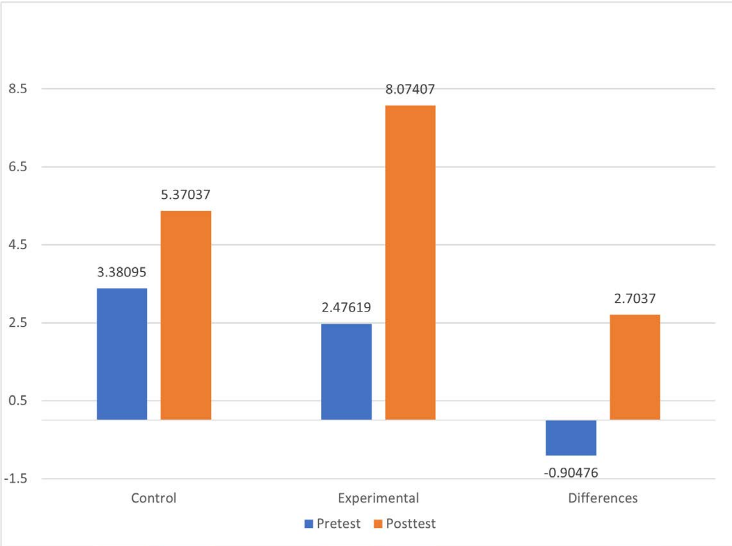
From the data shown in Table 1, there exists a clear increase in the post-test qualification compared with the pre-test, but it is desired to know if the gain is the same in both groups or not.

Descriptive statistics for each group

The mean qualifications obtained by the control and experimental groups in both tests are shown in Figure 5.

Figure 5

Qualifications and the differences obtained in both test in the control and experimental groups



From the data in Figure 5, the qualifications obtained in the pre-test in the control group are higher, 0.90476 points, while the marks obtained in the post-test are clearly higher in the experimental group, 2.7037 points, so both groups should be considered separately.

Comparison of means between both groups

To check if there have been differences in the pre-test between the two groups, Student's T test for independent groups is used and its associated values are shown in Table 2.

Table 2

Student's T test for independent groups

	Mean difference	Value of t	Sig. (bilateral)
Pre-test (Experimental-Control)	-0.91476	-1.918	0.060

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From Table 2, the differences between the pre-test are no significant between both groups, and the previous knowledge about Probability is homogeneous, although the control group has better qualifications in the pre-test, but not significant. Student's T test for the comparison of the post-test, shown in Table 3, reveals that the differences in the post-test are significant, with critical value 0.01. Moreover, the effect size associated is considered big and significant (McLeod, 2019), which means that the difference is not trivial, it is statistically significant and the percentage of control group below the mean of experimental group is greater than the 80%.

Table 3

Student's T test for independent group

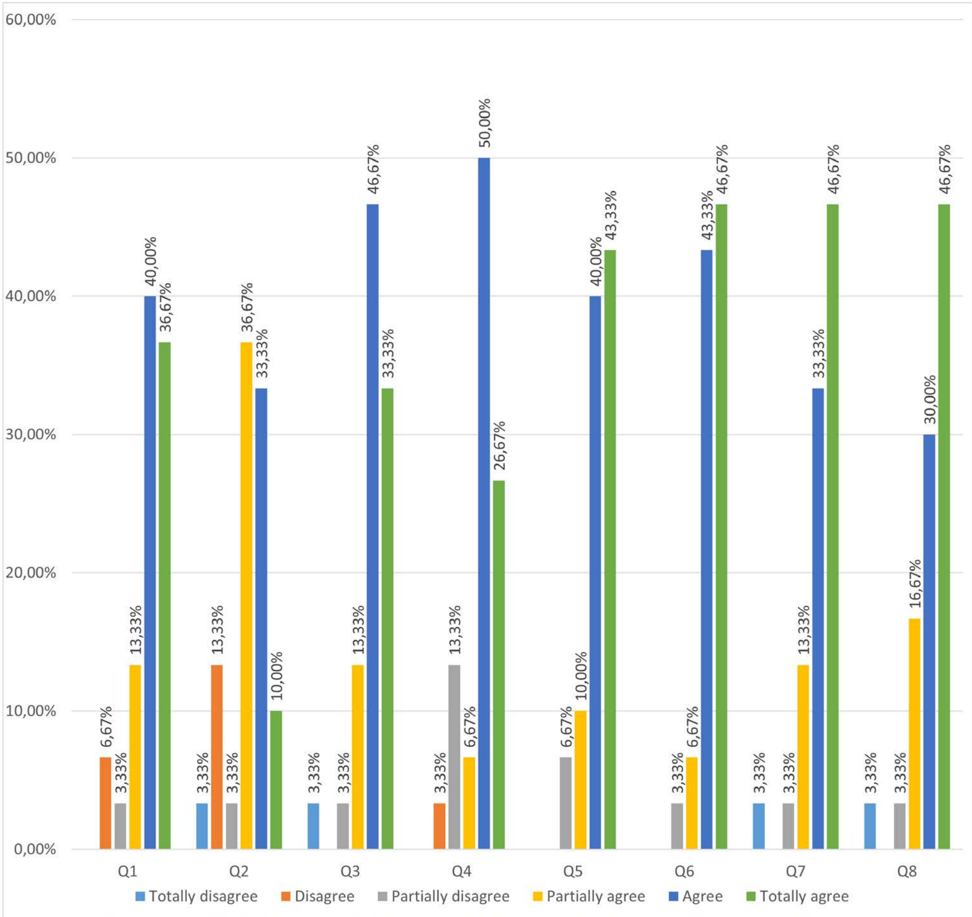
	Mean difference	Value of t	Effect size (Cohen's d)	Sig. (bilateral)
Post-test (Experimental-Control)	2.7037037	-0.915	0.906796	0.000

Answers to the questionnaire related to the perception of the experience

As part of the experience, students also answered a questionnaire, with different parts, the first one related to its experience with Deck.Toys and its relationship with the learning of mathematics. The results of the first part can be seen in Figure 6.

Figure 6

Responses to questions Q1-Q8 of the questionnaire



The responses to Q1 in Figure 6 revealed that 90% of the students consider that the learning of the Probability through the experience was easier than in the traditional way. Moreover, most students consider that the experience has increased their interest in mathematics, from Q2 responses, which is one of the main tasks of mathematics teachers. Therefore, with the use of the tool, it has been achieved that the perception of the students is that it is easier to learn in this way and that their interest in mathematics increases. Therefore, the experience can be considered as a good element to attract their attention and to maintain their interest in the subject, fact which is most of the time complicated.

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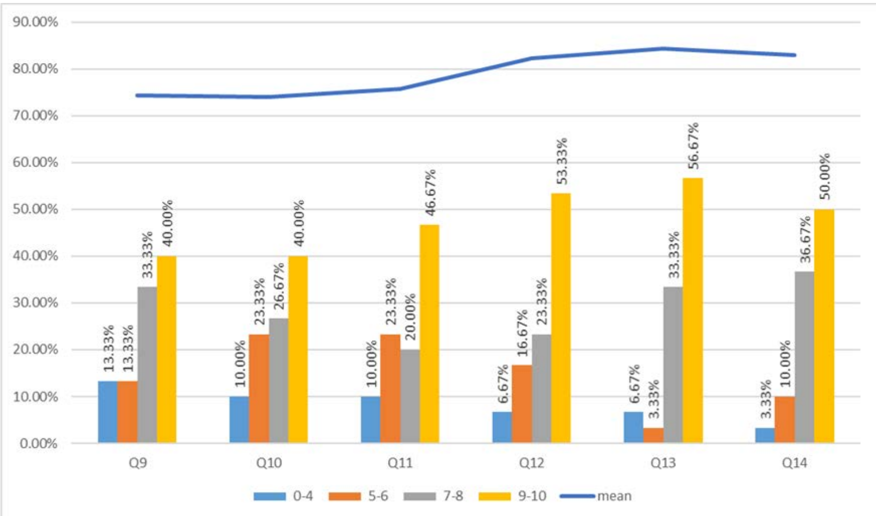
Furthermore, from responses to Q3 and Q4, related to the understanding of the procedures and the internalization of the contents, respectively, most of the students feel that they have increased in both terms, and consequently, using Deck.Toys they understand better the probability concepts. Moreover, the students have the feeling that they have acquired the necessary knowledge in a deeper way and that they have managed to internalize all the necessary concepts and procedures related to the calculations involved, which was one of the objectives of this work.

Finally, related to the quality of the tool in class, from Q5 and Q6 responses, it can be concluded that almost all students think that the tool is interesting for classroom and from Q7 and Q8 responses that they would like to repeat similar experiences both in mathematics and other subjects. Thus, students demand more experiences using the learning paths using DeckToys, since they consider it an appropriate tool for learning mathematics and a good help in their learning. In addition, they make it clear that they consider it a good tool both for other contents and subjects.

The responses to the second part of the questionnaire, also show that the main perceptions of the students about the experience are positive.

Figure 7

Responses to questions Q9-Q14 of the questionnaire



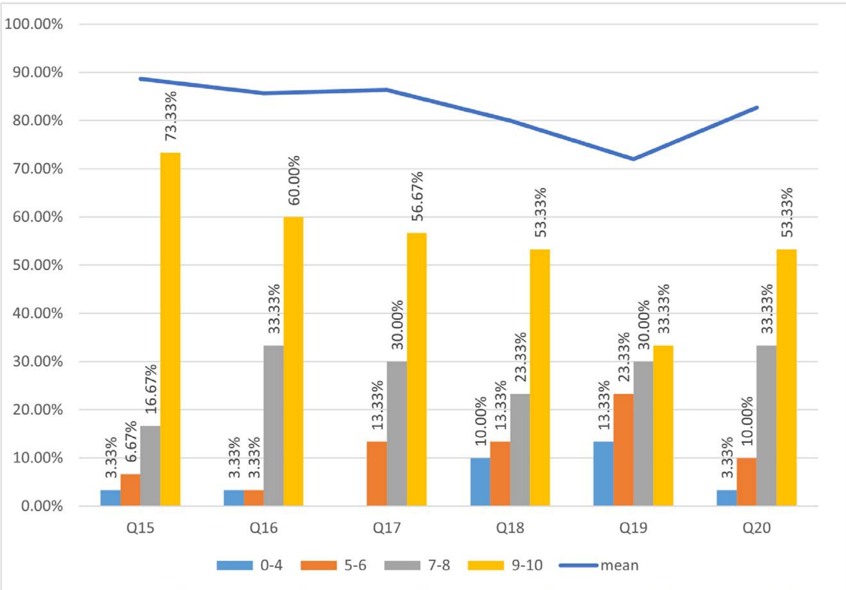
From responses to questions Q9, Q10 and Q11, related to learning results, process and motivation, respectively, shown in Figure 7, students think that their learning results have increased, their learning process has been improved and their motivation has increased. Moreover, the mean value of the responses obtained, shown in dark blue line, is greater than 70%, which encourages teachers to continue using this tool, since the result obtained show that it has been enriching, for the students as they have increased their self-learning perception, a fact that has been corroborated by the grades in the post-test.

Then, from responses to Q12, related to their perception of the experience compared to the traditional class, students show that they really liked this experience, and they prefer it to the traditional class, which is not attractive to them and, therefore, the experience using Deck.Toys have managed to keep their attention, a fundamental aspect in the teaching-learning process.

Moreover, from responses to Q13 and Q14, associated to the type of learning and about the critical thinking, students showed that the learning is more active and experienced and that they have more possibilities to develop critical thinking and problem-solving skills, two of the skills in which studies, including those related to the PISA test (González-Merino, 2020), is suggested that teachers should place special emphasis, since they are desirable qualities for both adults and children.

Figure 8

Responses to questions Q15-Q20 of the questionnaire



From the responses shown in Figure 8, to Q15, Q16 and Q17, related to the self-work, the ease of access to the material and the ability to self-assess their learning, it is clear, that students consider both the experience, and the tool are useful in

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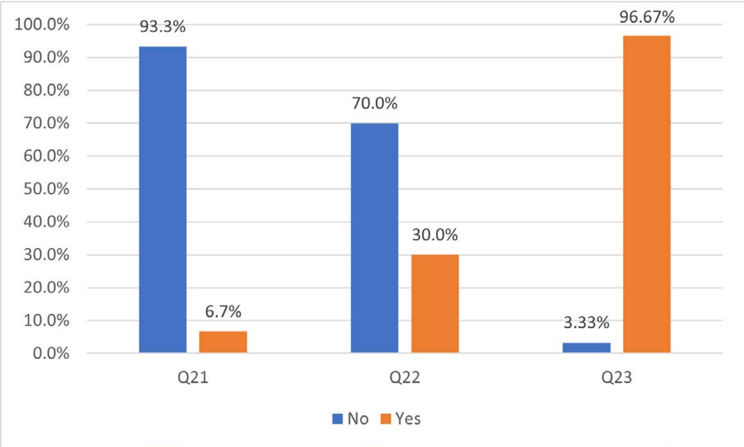
these areas, indicating that perception as positive, as well as the desire to implement more proposals like the one presented in this study. Furthermore, considering the responses to Q18, their principal thought is that learning mathematics with Deck. Toys was more enjoyable and fun than in the traditional way, while they think the experience increased their creativity (Q19).

Finally, from responses to Q20, related to their perception of the experience, more than 85% of the students gave at least a 7, and more than the half of the class give at least a 9. So, they liked the experience, since they had fun while learning and felt that they had understood and internalized the content in a deeper way.

Figure 9

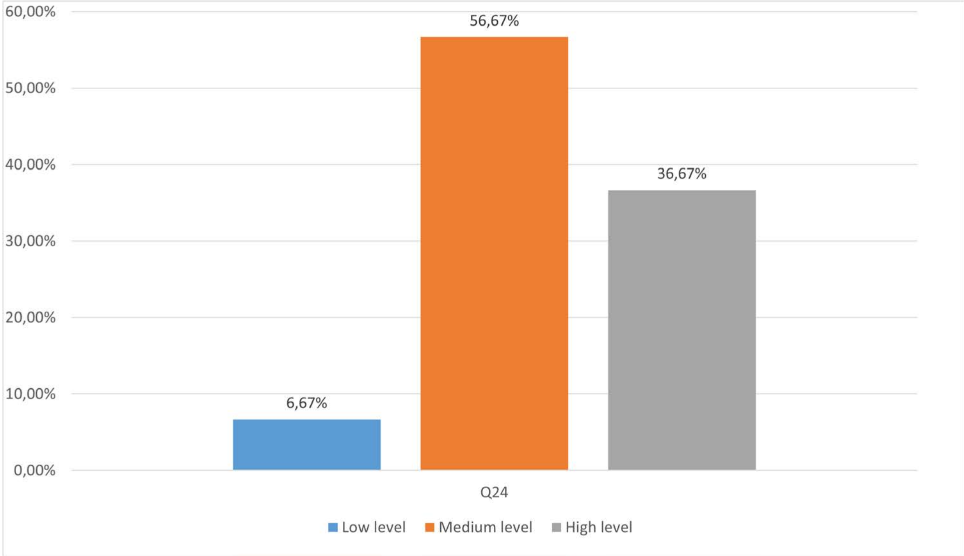
Responses to questions Q21-Q23 of the questionnaire



From responses of Q21, Q22 and Q23, related to knowledge of the tool, the previous user experience and if they want to have similar classes, shown in Figure 9, only 2 students knew the tool before the class, the 70% of students haven't received any class like this and a 96,67% of students want to have more classes like this.

Finally, the answers given to question Q24, shown in Figure 10, regarding how much they think they have learned, highlights that 93.3% of the students consider that quite a lot or a lot, which is why they have found it to be a useful tool for working Probability contents.

Figure 10
Answers to question Q24 of the questionnaire



Regarding the answers given by the students to question Q25, two of them are attached show the increase in motivation, also shown in question Q11, in which more than 90% of the class affirmed that their motivation had increased and the application in their future teaching work.

I thought it was a very good idea and I think it is something that should be done more often, since it allows each student to go at their own pace and not be left behind if they don't understand something since they can refresh the theory and then do exercises, and I will use this tool as a future teacher.

I did not remember anything about probability and with this experience and with the videos I have learned a lot and I have already remembered everything and my motivation with the subject has increased. I found it a very good tool both for teachers and students.

LIMITATIONS

Regarding the limitations of this study, one of them is that it involves just the work of Probability contents with a sample of 60 students in control and experimental groups, therefore, conclusions can only be drawn from these groups and consider this study as a pilot study. Thus, in this sense, the possible work will be related with the application of similar strategies both to larger groups and to the complete agenda

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of a year to contrast the good results that have been glimpsed in this first work. In addition, both the methodological design and the design of the experience itself can be applied to future scenarios as well as in blended scenarios, and to extend the study to other groups.

The findings of this study indicate that most of the participants would like to carry out similar experiences to this one in class, therefore, as possible future work, a proposal is that students generate the own learning itineraries they consider appropriate to deal with other topics, which could help them get even more involved in the process.

CONCLUSIONS

One of the objectives of this study has been the design and implementation of a learning itinerary to work Probability contents with students of the Degree in Primary Education. The objectives have been achieved and Deck.Toys tool has been used to guarantee a gamified learning itinerary that, in addition, has been personalized for each student and has allowed to work the contents independently and at their own pace, confirming the premises of Godino et al. (2007) on the adequacy of tools in online environments in mathematics classes in terms of interest and motivation, adequacy of content, among others. It is evident that Deck.Toys has provided a clear way of organizing the content for students (Ibáñez et al., 2011) and that it has been achieved effectively, making clear the aspects highlighted by De Benito et al. (2010).

On the other hand, the objectives related to the statistical study have shown that the students who worked, all online, with the learning paths through Deck.Toys have achieved higher marks than those obtained by the group, who received the classes in a traditional way. In addition, it has been seen that there are statistically significant differences, and it has been verified that the differences have a large effect size, which implies that more than 80% students of the control group obtained a qualification lower than the mean of the experimental group. On the other hand, the generalized mean gain is almost the triple in the experimental group than in the control group, which further supports the idea that the group that worked with Deck.Toys has had an acquisition of content and concepts much higher than the control group, a fact also supported by the results obtained in the comparison test of means of related groups.

From the survey evaluations, results show that students of the experimental group assure that they would like to have more classes like this, and they indicate that their performance, motivation, interest in mathematics and understanding have increased with the use of Deck.Toys. It can be concluded that Deck.Toys tool has made possible to work on the contents in a very satisfactory way and that it is a tool of interest to work in the classroom, both in face-to-face and in online environments and, although the development of these itineraries implies more work for the teacher, it is worthy, since the students value it in a very positive way and agree that it is a work that they take advantage of.

Finally, it should be noted that from the good results obtained by the experimental group and the feelings of the students themselves, as students and future teachers, they consider the tool a powerful ally in the classroom. If the possibility of creating different personalized itineraries for the student is also taken into account, Deck. Toys is a very good tool that allows to consider different levels that the student have and allows to work on the inclusion of all students, regardless of their level or their physical conditions, since it allows the use of video, images or sound, so this tool can be very helpful both in practice and in educational research.

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