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Learning statistics for doctoral students with digital teaching materials

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Abstract

The purpose of this research is to determine whether or not there are significant improvements with respect to the use of didactic materials in the learning by competencies (conceptual, procedural and attitudinal) of statistical topics in postgraduate students. The study used a quantitative, correlational and descriptive approach with a quasi-experimental design and a deductive hypothetical methodology. The sample consisted of 58 postgraduate students of the Enrique Guzmán y Valle National University of Education who were segregated into two groups: control and experimental. The survey technique was applied and a questionnaire validated by experts was used as an instrument for data collection. Finally, the results obtained were subjected to the normality test to select the appropriate statistical method, thus determining that the most appropriate test for the study is the nonparametric Mann-Whitney U test which shows that there is a significant improvement with respect to the use of digital didactic material in the learning of postgraduate students with the method of competencies (conceptual, procedural and attitudinal). The conclusion is that learning with digital didactic materials in the area of statistics should be implemented to improve academic quality in all areas for postgraduate and undergraduate students in order to obtain better academic results. The implications are immediate for the postgraduate students since they improved their academic performance and they will be able to perform the multiplier effect in some educational center since many of them are university teachers of different universities.

Keywords: Digital didactic material, Educational programs, ICT, Interactive software, Method by competencies, Postgraduate.

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1. Introduction

In recent years, there have been accelerated transformations at the educational level due to the development of information and communication technologies (ICT) and the challenge posed by the COVID-19 pandemic [1]. However, it is noted that education still lags behind technological progress as evidenced by the fact that many universities do not incorporate updated teaching materials or highly specialized educational software to strengthen and update their teaching and learning processes [2]. It is pointed out that current research has focused mainly on physical media or paper materials which has relegated the in-depth analysis of other media such as digital didactics to an environment of progressive incorporation in educational centers [3, 4].

However, the incorporation and development of appropriate digital didactic material for each subject within each institution not only demands the intention of its managers to implement and update it but additionally requires allocating resources to implement other complementary digital resources that allow its proper functioning. In this sense, some Latin countries such as Colombia report that they tripled their budget for science programs a resource that will be essential to incorporate ICT and digital teaching materials. It also indicates that 10% of the funds corresponding to royalties will be distributed to innovation projects which will intensify efforts in the development of new and more digital teaching materials [5]. However, this budget would be insufficient to cover the educational demand for this public service since a large number of students in public institutions require a greater effort by the Colombian government to equip their classrooms and subjects with ICT tools, teaching materials and educational software [2].

1.1. Literature Review

Public educational programs also require the establishment of teacher training programs regarding their function and usefulness. Therefore, although this teaching methodology is an advantage for any institution that chooses to implement it as it will allow it to remain competitive in the face of the dizzying transformations in the educational environment of today's society, it also involves the complex cooperation of actors who will have to carefully manage their resources, constantly train and adapt [6, 7]. There are currently issues with digital teaching materials' accessibility. As a result, there is a substantial gap in students' access to knowledge online which might adversely affect their ability to participate in job opportunities in the future [8].

On the other hand, another problem is that when there are teachers who demonstrate skills in the use of teaching materials and other ICTs, there is an evident difficulty in incorporating them into teaching practices. In this sense, the author suggests that the teacher training process should be channeled into technical, pedagogical, teacher management, ethical, legal, social and professional development areas [9]. Similarly, the absence of quality materials to implement in a particular field of study presents another obstacle to the integration of didactic material into pedagogical practices. Additionally, some teachers show a level of unwillingness in its application given that students frequently possess a greater capacity for resource management [10]. The increasing number of digital teacher training programmes has caused special concern among the country’s policymakers. Frequently, the process of acquiring digital competencies focused on the pedagogical field [11] is essential for the management of teaching materials where it represents a major barrier for some teachers [10].

On the other hand, many studies highlight that the incorporation of digital materials and other ICTs is significantly favorable for students because they acquire multiple skills that allow them to enhance their critical capacity, learn and strengthen their creativity and independence [12-14]. They also emphasize the Web as an emerging tool for the attainment of knowledge, networks as a suitable transmission environment, digital competence as an essential didactic goal for cooperative and permanent learning of any topic and the study of digital didactic materials as a suitable educational object for educational competency programs due to their pedagogical effectiveness [15, 16].

Otherwise, the inability to incorporate digital teaching materials, educational software and other ICT for every subject covered in the curriculum will have negative effects on students' digital divide. This will lead to discrimination in job environments and in society for those students who were unable to access these resources, thus increasing social disparities and inequality indices [10].

1.2. Justification and Objectives of the Research

The present research has made an important contribution to university pedagogical studies through the use of digital teaching materials. The purpose of this research is to demonstrate the benefits that digital resources offer in education at the postgraduate level. In this sense, this research has theoretical justification in the sense that it reflects the importance of the implementation of digital teaching materials as part of the pedagogical model for the teaching-learning process in postgraduate students (doctorate) depending on their influence on conceptual, procedural and attitudinal aspects. As a result of the research, the knowledge is at a social level because it provides information regarding the hypothesis that there is a significant improvement with the use of digital teaching material with respect to conceptual, procedural and attitudinal knowledge. This information can be used as a reference by the scientific community in scientific articles, theses and other research. At a methodological level, the study is adapted to other educational contexts such as secondary education centers.

Therefore, the objective of this research is to determine whether or not there is a significant improvement with respect to the use of digital teaching material in the conceptual, procedural and attitudinal learning of statistical topics within a doctoral program. It is crucial to provide continuity in the training of students, maintaining active, experiential, student-centered learning experiences relevant to the development of their competencies despite their distance interaction and frequent deficiencies in technological and educational resources to ensure quality education [17, 18]. Therefore,

determining the influence of digital teaching materials on learning will allow progress towards the democratization of quality educational services.

2. Methodology

2.1. Methodology

The research presents a quantitative approach because the approaches presented in the research are specific in nature and the proposed hypotheses were subjected to statistical contrast using numerical bases and deductive reasoning [19]. The study is descriptive and correlational since it tries to explain whether there is a significant improvement in the use of digital didactic material in the conceptual, procedural and attitudinal learning of statistical topics by doctoral students at the National University of Education "Enrique Guzmán y Valle" [20, 21].

2.2. Instrument

A quasi-experimental design was followed since two groups were established, one control and the other experimental to which a pre-and post-test were applied [22]. The research follows a hypothetic-deductive methodology, since the hypotheses are constituted as a starting point for new deductions. The predictions were also contrasted and in the case of correspondence, we proceeded to the validation of the hypothesis [23]. Non-probabilistic sampling was performed, since a probabilistic exercise was not carried out and the sample selection criteria were based on the researcher's criteria [24]. A survey was used that measured the capabilities of doctoral students. These capabilities are three: the first capability contained questions concerning conceptual knowledge which contained 15 questions and these questions had four alternatives, i.e. they were multiple choice questions with only one true answer and the other three served as distracters, second capability is about procedural knowledge which also contained 15 questions with four alternatives whose multiple options were only allowed to be answered and the third capability is conceptual knowledge which contained 10 questions.

2.3. Sample

In this sense, the sample consisted of 58 students of the Seminar of Applied Statistics of the Doctorate of the National University of Education "Enrique Guzmán y Valle". 30 students belonged to the experimental group and 28 students belonged to the control group. For data collection, the survey was applied as a technique and 3 tests as an instrument (1 test of conceptual knowledge, 1 test of procedural knowledge and another test of attitudinal knowledge). The experimental group was shown 13 digital materials in video format while the control group followed the traditional methodology of learning.

2.4. Procedure and Data Analysis

The three tests were validated by expert judgment, the reliability of the procedural and conceptual knowledge tests was estimated using the Kuder-Richardson statistic and the reliability of the attitudinal knowledge test was determined using Cronbach's alpha. The normality analysis was performed with the Shapiro-Walk statistic (since the sample was less than 60) determining that it does not follow a normal distribution to determine the most appropriate statistical test according to the data obtained. Therefore, inferential results were estimated using the Mann-Whitney U statistic. Finally, descriptive results were processed with Excel and inferential results with SPSS.

3. Results

3.1. Reliability

10 doctoral students with the same characteristics were randomly evaluated to determine the level of reliability. Similarly, the sessions were developed using the digital material. The measurement instruments used were pre- and post-tests. The statistical method applied to estimate reliability was the Kuder-Richardson method since the items present a dichotomous characteristic.

Table 1
Estimation of the reliability of the instruments.

Instruments	Kuder-Richardson 20	Number of items
Conceptual knowledge test	0.750	15
Procedural knowledge test	0.780	15

Table 1 illustrates the level of reliability of the two instruments, each with 15 items through the Kuder - Richardson statistic which on average was 0.760 suggesting that the instruments applied are reliable.

3.2. Presentation and Analysis of Results

The following are the ranges in which the students place themselves with respect to the different types of knowledge (conceptual, procedural and attitudinal) based on the results obtained in the post-test:

Table 2
Ranges of conceptual knowledge in the control group.

Levels	Range	Frequency	Frequency %
High	[12, 16]	8	26.67
Regular	[8, 12[	12	40.00
Low	[4, 8[	10	33.33
Very low	[0, 4[	0	0.00

Table 3
Ranges of conceptual knowledge in the experimental group.

Levels	Range	Frequency	Frequency %
High	[12, 16]	9	32.14
Regular	[8, 12[	16	57.14
Low	[4, 8[	3	10.71
Very low	[0, 4[	0	0.00
Full		28	100.00

Tables 2 and 3 show the ranges of conceptual knowledge presented by the students of the control and experimental groups from the application of the post-test. Based on this, it is observed that in the case of the control group, the majority of its population is between the high and regular ranges with 26.67% and 33.33% respectively. However, this trend changes favorably in the group that was exposed to the incorporation of digital didactic material, since they showed that only 3. 57% are within the low range while the vast majority was positioned in the high range with 32.14% and regular with 57.14% which would suggest that there is indeed a significant improvement in the conceptual knowledge section due to the incorporation of digital didactic material.

Table 4.
Ranges of procedural knowledge in the control group.

Levels	Range	Frequency	Frequency %
High	[12, 16]	8	26.67
Regular	[8, 12[	15	50.00
Low	[4, 8[	5	16.67
Very low	[0, 4[	2	6.67
Full		30	100.00

Table 5.
Ranges of procedural knowledge in the experimental group

Levels	Range	Frequency	Frequency %
High	[12, 16]	7	25.00
Regular	[8, 12[	19	67.86
Low	[4, 8[	2	7.14
Very low	[0, 4[	0	0.00
Full		28	100.00

Tables 4 and 5 show the ranges of procedural knowledge presented by the students of the control and experimental groups after the application of the post-test. Based on these, it is observed that in the case of the control group, the majority of the population is between the high and regular ranges with 26.67% and 50.00% respectively. However, this tendency changes positively in the experimental group since they showed that only 7. 14% are within the low range while the vast majority is in the high range with 25.00% and regular with 67.86% which implies that there is a significant improvement in the procedural knowledge section through the use of digital didactic material in the learning work.

Table 6
Ranges of attitudinal knowledge in the control group.

Levels	Range	Frequency	Frequency %
High	[25, 30]	8	26.67
Regular	[20, 25[	8	26.67
Low	[15, 20[	13	43.33
Very low	[10, 15[	1	3.33
Full		30	100.00

Table 7.
Attitudinal knowledge ranges in the experimental group.

Levels	Range	Frequency	Frequency %
High	[25, 30]	8	26.67
Regular	[20, 25[	8	26.67
Low	[15, 20[	13	43.33
Very low	[10, 15[	1	3.33
Full		30	100.00

Tables 6 and 7 show the ranges of attitudinal knowledge of the students in the control group and the experimental group after the application of the post-test. In this sense, it is evident that with respect to the control group, the majority of its population is in the low, regular and high ranges with 26.26% and 26.67% respectively. However, this propensity changes positively in the experimental group since it was found that only 3.57% are within the low range while the vast majority was positioned in the regular range with 50.00% and high with 39.29% which would suggest that there is indeed a significant improvement in the attitudinal knowledge section by the incorporation of digital didactic material.

3.3. Normality

A normality analysis was applied to 58 students based on the data obtained in the post-test of both groups. The results are shown in Table 8.

Table 8.
Normality of the data.

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Groups	Statistics	gl	Sig.	Statistics	gl	Sig.
Post conceptual and experimental	0.181	28	0.019	0.895	28	0.009
Post procedural and experimental	0.186	28	0.015	0.922	28	0.038
Post conceptual and control	0.218	28	0.001	0.903	28	0.014
Post procedural and control	0.169	28	0.040	0.919	28	0.033
Post experimental and attitudinal	0.150	28	0.0109	0.919	28	0.032

Note: a. Lilliefors significance correction.

According to the results in Table 8, the p-values obtained in the Shapiro-Will and Kolmogorov-Smirnov tests are less than 0.05. Therefore, it is affirmed that the values do not conform to a normal distribution. Consequently, the non-parametric Mann-Whitney U test was applied to test the hypothesis.

3.4. Hypothesis Test 1

H0: The use of digital didactic material does not significantly improve conceptual learning of statistical topics.

H_1: The use of digital didactic material significantly improves conceptual learning of statistical topics.

Considering a significance level □ equal to 0.05.

Table 9.
Mann-Whitney U test of conceptual knowledge learning.

N°	Null hypothesis	Test	Sig.	Decision
1	The rationale for conceptual is the same among the group categories.	Man-Whitney U-test for independent samples	0.000	Reject the null hypothesis

According to the results of the Mann-Whitney U test shown in Table 9, a p-value of 0.000 was obtained which is lower than the significance level (0.05) allows accepting the alternative hypothesis. Therefore, it can be asserted that the use of digital didactic material significantly improves the conceptual learning of statistical topics which agrees with the perception of the descriptive results described in Tables 2 and 3.

3.5. Specific Hypothesis Test 2

H0: The use of digital didactic material does not significantly improve procedural learning of statistical topics.

H_1: The use of digital didactic material significantly improves the procedural learning of statistical topics.

Table 10.
Mann-Whitney U-test of procedural learning.

N°	Null hypothesis	Test	Sig.	Decision
1	The rationale for procedural is the same among the group categories.	Man-Whitney U-test for independent samples	0.000	Reject the null hypothesis

According to the results of the Mann-Whitney U test shown in Table 10, a value of 0.000 was obtained which is below the significance level (0.05) allows the acceptance of the alternative hypothesis. Therefore, it is affirmed that the use of

digital didactic material significantly improves the procedural learning of statistical topics. This result agrees with the observation based on the descriptive results in Tables 4 and 5.

3.6. Specific Hypothesis Test 3

H0: The use of digital didactic material does not significantly improve the attitudinal learning of students enrolled in statistical topics.

H_1: The use of digital didactic material significantly improves the attitudinal learning of students enrolled in statistical topics.

Table 11.
Mann-Whitney U test of attitudinal learning.

N°	**Null hypothesis**	**Test**	**Sig.**	**Decision**
1	Attitudinal justification is the same between group categories.	Man-Whitney U-test for independent samples	0.000	Reject the null hypothesis.

According to the results of the Mann-Whitney U test shown in Table 11, a value of 0.000 was obtained which is below the significance level (0.05) allows accepting the alternative hypothesis. Therefore, it is affirmed that the use of digital didactic material significantly improves the attitudinal learning of students enrolled in statistical topics. This is consistent with the perception based on the descriptive results in Tables 6 and 7.

4. Discussion

It was determined that digital teaching material significantly improves conceptual learning of statistical topics. This result is consistent with similar studies that analyzed the use of digital teaching materials and resources inside and outside of a bilingual classroom in the town of Seville [25]. For this purpose, they evaluated teachers [7] and students from eight educational centers in said province through interviews and questionnaires to collect opinions regarding the incorporation of these digital resources in their classrooms, determine the way in which they affect the classroom and analyze the type of digital material used in these rooms determining that although there is a slightly discrepant opinion regarding the use of digital resources in classrooms between students and teachers [11]. It was evident that these significantly favor the teaching and learning process in the classroom. They also observed that the use of these resources by some students outside the classroom depends directly on the use they make of them inside the classroom [26]. In this way, it is proven how didactic and digital materials contribute significantly to the conceptual learning process which in the aforementioned cases were the subjects of statistics and languages [27].

Similarly, the present study concluded that digital teaching material significantly improves procedural learning of statistical topics a result that agrees with the research carried out by other researchers [28]. Then, the "Agroforestry World" educational program was analyzed in an educational center with students from a rural area determining that after the implementation of this educational software, significant learning was achieved in the area of agroforestry. Furthermore, it was proven that this program facilitates the understanding of the different topics in this subject that generated motivation in the students. This reaffirms that the software "Agroforestry World" generates didactic materials in digital form and these materials that generate very significant learning achievements in procedural learning [29].

Finally, it was determined that digital teaching material significantly improves attitudinal learning of statistical topics which is related to a study carried out by other researchers who analyzed the impact of the Ludos software for recreation, physical education and sports courses with the aim of providing an outcome to the lack of use of ICT in school sports subjects. Their conclusions confirmed that the use of educational software positively influences the development of psychomotor skills which demonstrates that it is feasible to establish educational processes mediated by software. In this way, it was found that relevant indicators of the pedagogical aspect such as interaction, goal achievement and digital materials among others influence student learning [2]. Practical learning such as attitudinal learning stands out for research in early statistics requiring attention to the progression of statistical learning especially the ability of primary school students to create representations that involve data in real contexts [30].

5. Conclusion

This research was developed with the aim of informing managers, directors and teachers about the great potential that digital teaching materials generate or influence university teaching at the level of doctoral students in order to serve as a reference and support for the process of educational modernization and in the face of society's demand for professionals increasingly integrated into the 4.0 revolution. In this sense, the verification of the significant improvement that these digital tools offer in conceptual, procedural and attitudinal learning highlights the need to shape education towards this model of learning and teaching as well as the need to provide teachers and students with the necessary skills to face a more virtualized society with greater dependence on technology. The ultimate goal is to enable students to improve their cognitive skills as there are now tools like forums, self-assessments, podcasts, simulators, etc. that were not available a few years ago and have the potential to help university students promote their postgraduate skills and competencies.

The new implications of this research at the level of education will be to experiment with undergraduate students and even more professional careers that have more practices than theories. For that reason, it should be implemented in university classrooms and laboratory centers with good and powerful computers for use and exclusive management of students and university teachers but the implementation will limit many teachers who are not good at information and

communication technologies or simply are not at the forefront of digital skills. On the other hand, students will enjoy the classes as if they were in a totally digitalized world and will have to seek new skills in digital competencies in order to overcome their university studies.

References

[1] Y. Huamán-Romaní, T. Jara-Alarcón, E. Becerra-Celiz, E. Román-Castillo, and E. Martínez-Huamán, "Use of ICT for the evaluation of university activities | Use of ICT for the evaluation of university activities," *RISTI-Revista Iberica de Sistemas e Tecnologias de Informacao*, vol. 2022, no. E51, pp. 110-126, 2022.

[2] A. M. S. Monsalve and L. F. M. Sanchéz, "Psychomotor learning in the area of physical education, recreation and sports mediated by the use of educational "software"," *RETOS: Nuevas Tendencias en Educación Física, Deporte y Recreación*, vol. 36, pp. 302-309, 2019. https://doi.org/10.47197/retos.v36i36.67131

[3] J. C. B. Martínez and J. C. C. Rubio, "Theory and research methodology on textbooks: Didactic analysis of activities, images and digital resources in the teaching of Social Sciences," *Revista Brasileira de Educação*, vol. 23, 2018. https://doi.org/10.1590/S1413-24782018230082

[4] J. A. N. Bravo, J. J. P. Vargas, and C. J. M. Guzmán, "Narrative methods in social and educational research," *Revista de Ciencias Sociales*, vol. 29, no. 1, pp. 215-226, 2023. https://doi.org/10.31876/rcs.v29i1.39747

[5] Departamento de Planeación, "Government of Colombia," Retrieved: https://www.dnp.gov.co/. 2018.

[6] R. Chugh, D. Turnbull, M. A. Cowling, R. Vanderburg, and M. A. Vanderburg, "Implementing educational technology in higher education institutions: A review of technologies, stakeholder perceptions, frameworks and metrics," *Education and Information Technologies*, vol. 28, no. 12, pp. 16403-16429, 2023. https://doi.org/10.1007/s10639-023-11846-x

[7] S. Cuellar-Quispe, Y.-L. Huaman-Romani, N.-V. Sarmiento-Campos, E.-N. Silvera-Alarcon, and E. Nolasco-Carbajal, "Perspectives on teaching performance after COVID-19," *International Journal of Innovative Research and Scientific Studies*, vol. 6, no. 4, pp. 826-834, 2023. https://doi.org/10.53894/ijirss.v6i4.2038

[8] J. J. Mayol, F. P. López, F. Negre, and G. F. Nadal, "Accessible web design and documentation in university learning," *Revista De Educación a Distancia*, vol. 19, no. 60, 2019. https://doi.org/10.6018/red/60/06

[9] J. C. Almenara, "The challenges of integrating ICTs in educational processes. Limits and possibilities," *Educacional Perspectiva*, vol. 49, no. 1, pp. 32-61, 2010.

[10] J. C. Almenara, *Reflections on the digital divide and education, SOTO, FJ and RODRÍGUEZ, J.(coords.): Technology, education and diversity: Challenges and realities of social inclusion*. Murcia: Ministry of Education and Culture, 2004.

[11] Y.-L. Huamán-Romaní, J. P. P. Garay, E. G. Gómez, P. E. Z. Pupuche, M. O. F. Atho, and A. N. Fernandez, "perspectives on digital competencies in university: What's ahead for education?," *Human Review International Humanities Review*, vol. 21, no. 1, pp. 189-200, 2023. https://doi.org/10.37467/revhuman.v21.5046

[12] M. L. M. Mínguez, "Tutored learning projects and self-assessment of professional skills in initial teacher training," *Retos: Nuevas Tendencias En Educación Física, Deporte Y Recreación*, vol. 29, pp. 242-250, 2016.

[13] M. Area, A. Bethencourt, and S. Martín, "HyFlex: Hybrid and flexible teaching and learning in higher education," *Revista Iberoamericana de Educación a Distancia*, vol. 26, no. 1, pp. 141-161, 2023. https://doi.org/10.5944/ried.26.1.34023

[14] E. G. Estrada Araoz, Y. Paredes Valverde, R. Quispe Herrera, N. A. Gallegos Ramos, and J. Mori Bazán, "Perception of Peruvian university students about virtual education in the context of the covid-19 pandemic," *Revista Universidad y Sociedad*, vol. 15, no. 1, pp. 101-107, 2023.

[15] M. Á. M. García and E. Cruz, "Gaming as an educational material for digital competences in education from academic skills centres," *Revista General De Informacion y Documentacion*, vol. 28, no. 2, pp. 489-506, 2018. https://doi.org/10.5209/RGID.62836

[16] A. Palacios, V. Pascual, and D. Moreno-Mediavilla, "The role of new technologies in STEM education," *Bordon, Revista De Pedagogia*, vol. 74, no. 266, pp. 11-21, 2022. https://doi.org/10.13042/Bordon.2022.96550

[17] D. E. Salinas-Navarro, D. Silva-Ovando, A. Clarice, C. Mejía-Argueta, and M. Chong, "Reflections from teaching practice: Learning experiences for industrial engineering education in the post-pandemic," *Apuntes*, vol. 49, no. 92, pp. 151-182, 2022. https://doi.org/10.21678/apuntes.92.1745

[18] O. Martínez, E. J. Steffens, D. C. Ojeda, and H. G. Hernández, "Pedagogical strategies applied to education with virtual media for the generation of global knowledge," *Formacion Universitaria*, vol. 11, no. 5, pp. 11-18, 2018. https://doi.org/10.4067/S0718-50062018000500011

[19] R. Hernández-Sampieri and C. Mendoza, "Investigation methodology the quantitative, qualitative and mixed routes, Mexico city." Mexico: Editorial Mc Graw Hill Education, 2018, p. 714.

[20] Valderrama, "Steps to develop scientific research projects." Lima: San Marcos Publishing House, 2015, p. 495.

[21] H. Ñaupas, M. Valdivia, J. Palacios, and H. Romero, "Investigation methodology," Quantitative – Qualitative and Writing the Thesis Bogotá Editions of the U, 2018.

[22] D. Alan and L. Cortez, *Processes and fundamentals of scientific research*. Ecuador: Ediciones UTMACH, 2018.

[23] A. Rodríguez Jiménez and A. O. Pérez Jacinto, "Scientific methods of inquiry and knowledge construction," *Revista Ean*, vol. 82, pp. 179-200, 2017.

[24] E. Gallardo, *Investigation methodology*. Huancayo: Editorial Universidad Continental, 2017.

[25] M. Navarro-Pablo, Y. López-Gándara, and E. García-Jiménez, "The use of digital resources and materials inside and outside the bilingual classroom," *Comunicar*, vol. 27, no. 59, pp. 83-92, 2019. https://doi.org/10.3916/C59-2019-08

[26] C. Ortega *et al.*, "A usability study on Yamashita's treasure: A game-based instructional material in teaching Philippine history," *Interactive Learning Environments*, pp. 1-7, 2022. https://doi.org/10.1080/10494820.2022.2125535

[27] M. D. Kasa *et al.*, "The morale of supervision: The impact of technical supervision skills of teaching and learning on teachers' self-efficacy," *International Journal of Criminology and Sociology*, vol. 9, no. 1, pp. 335-349, 2020. https://doi.org/10.6000/1929-4409.2020.09.32

[28] Y. A. Narvaez-Romo, G. C. Luna, H. F. Leonel, and J. O. Ruiz, "Evaluation of the mundo agroforestal educational software with rural youth from Nariño, Colombia," *Información Tecnológica*, vol. 28, no. 2, pp. 135–140, 2017. https://doi.org/10.4067/S0718-07642017000200015

[29] Y. P. Ordoñez, G. C. Luna-Cabrera, A. Narváez-Romo, and F. Torres-Martínez, "Assessment of food security didactic material for rural women from the municipality of Pasto, Nariño (Colombia)," *Informacion Tecnologica*, vol. 31, no. 3, pp. 103-113, 2020. https://doi.org/10.4067/S0718-07642020000300103

[30] P. Vidal, A. Kuzniak, S. Estrella, and E. Montoya, "Qualitative analysis of early statistical learning with the perspective of mathematical working spaces oriented by the research cycle," *Educacion Matematica*, vol. 6, no. 2, pp. 217-246, 2020. https://doi.org/10.24844/EM3202.09