Scientific articles

Actitudes del profesor de matemáticas hacia el uso de la computadora en el aula

Mathematics teacher's attitudes towards computer use in the classroom

Atitudes dos professores de matemática em relação ao uso do computador em sala de aula

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Resumen

El desarrollo tecnológico ha impulsado un cambio significativo en la educación, de ahí que se requieran nuevas habilidades, actitudes y conocimientos por parte del docente. En el caso del profesor de matemáticas, su disposición hacia el uso de la computadora en el aula es un factor que puede impactar de manera positiva o negativa en el aprendizaje de los estudiantes. Por ende, el presente estudio buscó identificar la actitud de los maestros del Departamento de Matemáticas del Instituto Tecnológico de Sonora respecto al empleo de dicho recurso con fines académicos. Para ello, se desarrolló un estudio cuantitativo, con un diseño no experimental, transeccional y correlacional; se utilizaron pruebas de hipótesis y de correlación. Participaron 67 docentes, quienes respondieron una encuesta de 16 ítems con cinco opciones de respuesta. Los resultados muestran que los docentes tienen una actitud muy favorable, ya que el 85.2 % de ellos respondieron con las opciones "de acuerdo" y "totalmente de acuerdo". Además, se encontró que, a mayor edad, los profesores se sienten más seguros con el uso de la computadora, pero también piensan que los estudiantes se distraen más y que el uso de la tecnología fomenta la pereza en el alumno. Estos hallazgos son similares a los encontrados en otras investigaciones, que también señalan una actitud favorable de los docentes de matemáticas hacia el empleo de la tecnología en el aula, así como una mayor desconfianza hacia su uso a medida que aumenta la edad del docente.

Palabras clave: actitud del docente, análisis comparativo, correlación, encuesta, enseñanza superior.

Abstract

Technological development has led to a significant change in education and demands new skills, attitudes and knowledge from the teachers. The mathematics teacher's attitude toward computer use in the classroom is a factor that can positively or negatively impact student learning. That is why the present study aims to know the attitude that teachers of the Mathematics department of the Instituto Tecnologico de Sonora have towards the use of the computer for academic purposes. Sixty-seven teachers participated in the survey, which included 16 items with five response options. The study design contemplates a quantitative approach and the type of research is non-experimental, transactional and correlational, using hypothesis and correlation tests. The results show that the teachers have a very favorable level of attitude; 85.2% of the teachers answered the option of agreeing and totally agreeing. It was found that as the teachers grow older, they feel more confident with the use of the

computer and the more they think that students are distracted by its use in the classroom and that the use of the computer encourages laziness in the student. Similar results have been found in other research regarding the favorable attitude that mathematics teachers have towards the use of technology in the classroom; as well as the distrust they have towards the use of technology as age increases.

Key words: teacher attitudes, comparative analysis, correlation, surveys, higher education.

Resumo

O desenvolvimento tecnológico impulsionou uma mudança significativa na educação, pelo que são necessárias novas competências, atitudes e conhecimentos por parte do professor. No caso do professor de matemática, sua disposição para o uso do computador em sala de aula é um fator que pode impactar positiva ou negativamente a aprendizagem dos alunos. Portanto, o presente estudo buscou conhecer a atitude dos professores do Departamento de Matemática do Instituto Tecnológico de Sonora em relação à utilização do referido recurso para fins acadêmicos. Para tanto, desenhou-se um estudo quantitativo, de desenho não experimental, transecional e correlacional, e foram utilizados testes de hipóteses e de correlação. Especificamente, participaram 67 professores, que responderam a uma pesquisa de 16 itens com cinco opções de resposta. Os resultados mostram que os professores têm uma atitude bastante favorável, uma vez que 85,2% deles responderam com as opções "concordo" e "concordo totalmente". Além disso, constatou-se que, com a idade mais avançada, os professores sentem-se mais confiantes com o uso do computador, mas também acham que os alunos ficam mais distraídos e que o uso da tecnologia estimula a preguiça no aluno. Esses achados são semelhantes aos encontrados em outras pesquisas, que também indicam uma atitude favorável dos professores de matemática em relação ao uso da tecnologia em sala de aula, bem como uma maior desconfiança em relação ao seu uso à medida que aumenta a idade do professor.

Palavras-chave: atitude docente, análise comparativa, correlação, pesquisa, ensino superior.

Introduction

Information and communication technologies (ICT) are used in all fields of knowledge and in many of them they have been the basis for their development. For example, in the educational field, teachers and researchers rely on these tools to improve the teaching and learning process, while training institutions are raising students' awareness about their use as part of their professional development.

Currently, the concept of ICT has evolved, as it now encompasses not only integration, but also the acquisition, construction and dissemination of knowledge. For this reason, the term has been expanded to information, communication, knowledge and digital learning technologies (ICKDLT), which are essential tools in teaching work, although they also require the development of digital skills and changes in educational practices. (Secretariat of Public Education [SEP], 2021).

In fact, the integration of technology in the teaching-learning process requires that educational institutions be willing and able to provide teachers with the necessary resources and infrastructure, as well as the technical and pedagogical support to carry out their work. efficient manner. Furthermore, they must respond to the new requirements of society regarding the educational use of ICKDLT and the development of digital skills, both in teachers and students (Vásquez and Henríquez, 2016).

Due to this, the incorporation of technology in education has caused changes in the ways of learning and, therefore, in the ways of teaching (Viñals-Cuenca, 2016). These new learning environments, both virtual and in-person, require that the teacher have favorable abilities, skills, knowledge and attitudes in pedagogical and technological aspects, which contribute to the development of good educational practices (Williams *et al.*, 2021). In this regard, UNESCO (January 4, 2018) establishes the following:

> The effective integration of ICT in the learning environment will depend on the ability of educators to structure learning in an innovative way, appropriately combine technology with pedagogy, develop social activity in the classroom, and encourage cooperation, learning collaborative and group work (p. 19).

In this sense, educational practices mediated by technology require a deep knowledge of the pedagogical and methodological changes that the teaching-learning process has experienced with the incorporation of ICT and how these have energized learning

environments, since they have transcended face-to-face presence. physics in terms of time and space.

However, for this to materialize, it is necessary for teachers to be aware of the mediating role of technology in educational processes, have a favorable attitude toward the incorporation of technological resources in their classrooms to improve students' learning experiences, and be capable of adequately implementing digital information. In addition, they must maintain synchronous and asynchronous communication with their students and develop content and materials using technological tools (Núñez *et al*., 2019).

Regarding this topic, Falco (2017) carried out a study whose purpose was to identify changes in teaching practices from the incorporation of technology. Among his findings, he pointed out that technological innovation is closely linked to educational practices, so teachers must cultivate new skills that involve the use of technology and apply them in their training processes.

On the other hand, in the incorporation of technology into educational practices, Figueroa *et al.* (2017), have identified some barriers, among which are teachers' attitudes and beliefs towards ICT. Their findings show that if teachers use technological resources, their attitude and beliefs towards these tools will be more positive. Similarly, Padilla (2018), cited by Ruiz-Aquino *et al*. (2022), identified the following obstacles: lack of technological support, need for teacher training in virtual environments, lack of institutional support, teacher resistance and an unfavorable attitude towards the implementation of technology.

Likewise, Zempoalteca *et al*. (2018), point out that the use of ICT in teaching practice is influenced by external factors such as the institution, teacher training, access and availability of technology, as well as its support and use. In addition, internal factors such as age, gender, academic degree, tenure in teaching, and individual interest in using technology also play a crucial role.

According to Haji (2015), the barriers that prevent teachers from having a positive attitude towards ICT can be divided into three categories: a) at the teacher level, which includes a lack of relevant competence and motivation; b) at the school level; that is, those related to the institutional context; and c) at the level of the educational system, which implies the guidelines or policies that govern it.

Therefore, Tezci (2010) suggests that teachers should develop positive attitudes towards computer use and be able to get the most out of it for educational purposes. Advocates of educational technology initiatives have been aware of this cyclical relationship

between attitude and computer use, and have often included activating positive teacher attitudes as part of their strategies (Williams, 2015). In other words, teachers should display strong and positive attitudes towards computer technology, as attitude is significantly associated with the use and intention to adopt technology in the classroom (Awofala *et al*., 2019).

For their part, Romero *et al*. (2020), consider that the teacher's attitude towards the integration of technology in the teaching-learning process is crucial, since the pedagogical use of it to achieve the proposed educational objectives depends on it. Furthermore, they explain that attitudes are usually stable and that it is possible to measure their intensity (positive or negative), and that they are regularly expressed through opinions, feelings, likes or dislikes. These experiences may be positive at the beginning, but they may change depending on the situations the teacher faces with its use.

Figueroa *et al*. (2017), maintain that the attitude and beliefs towards the use of technological resources will be more positive the greater their use by teachers; while Sandoval *et al.* (2020), consider that the importance of studying this aspect of attitudes lies in the fact that, although technology allows access to valuable information, it does not guarantee the generation of knowledge. To do this, it is necessary to develop higher cognitive processes (such as identifying, classifying and prioritizing content), which is the task of teachers.

Now, in the case of attitude towards learning mathematics, this has been a topic that has attracted the attention of researchers and educators for a long time. Proof of this is the abundance of empirical studies on the relationship between teacher attitude and students' academic performance in Mathematics (Alghamdi, 2017; Mensah *et al*., 2013). Specifically, computers have impacted the teaching of mathematics in two different ways: because of their speed in processing large amounts of data and because they are a resource that has allowed learning to be strengthened (Salat-Figols, 2013). In fact, it can be stated that computer tools for teaching mathematics are increasingly efficient and are increasingly within the reach of teachers and students, which can be favored if teachers show a positive attitude towards their use in the classroom. classroom. Therefore, in this work it has been considered useful to analyze both their attitudes and current practices on this topic (Adric, 2021).

At the Technological Institute of Sonora (ITSON), a university located south of Sonora in Mexico, strategies have been implemented to incorporate ICT into teaching work. Teachers have even been provided with computer equipment, they have been trained in the

use of ICT and computers, projectors and Internet access have been installed in the classrooms. Specifically, the Department of Mathematics offers courses related to the use of *software* to improve the teaching-learning process of mathematics, although all these efforts are not enough if the teacher does not incorporate ICT in the academic activities that he programs in his courses. Therefore, in addition to being qualified in its use and having the necessary means, the teacher must have a good attitude towards the use of technology.

Based on all of the above, this study aims to identify the attitude of the teachers of the Mathematics Department towards the use of the computer for academic purposes in order to establish actions to improve said attitude and encourage the incorporation of technological tools in the classroom. of classes. These actions can range from the technological empowerment of teachers to the adaptation of facilities with cutting-edge technology.

To comply with the above, the following objectives are proposed.

1. Identify the level of attitude that the teachers of the ITSON Mathematics Department have towards the use of the computer for their academic activities.
2. Determine if the level of attitude of teachers in the ITSON Mathematics Department towards the use of computers in the classroom depends on gender, years of experience, years of study and type of employment contract.

Materials and method

This research was developed at the Technological Institute of Sonora (ITSON), a state public university located in Ciudad Obregon, Sonora, Mexico. The study had a quantitative approach and a non-experimental, transectional and correlational design, since the variable under study (the use of the computer by teachers for educational purposes) was not manipulated and was evaluated at a single moment in time. In addition, this variable was related to other attributes such as sex, age, years of teaching experience and type of employment contract.

Participants

The population was made up of all professors who teach courses in the ITSON Mathematics Department, but only 67 responded to the survey. Of these, 46% were women and 54% were men. Additionally, 11 (16%) are full-time faculty and 56 (84%) are part-time faculty. Figure 1 shows the percentage of participating teachers according to age, where it can be seen that 82% of the teachers are over 30 years old and 54% over 40 years old.

Figure 1. Percentage of participating teachers by age
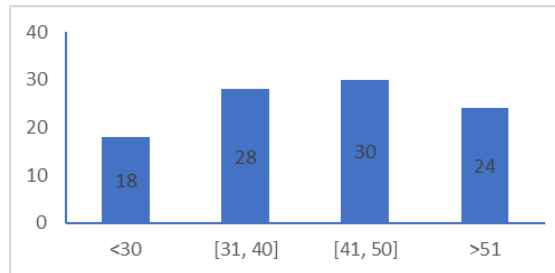
Source: own elaboration

The distribution of the participating teachers from the Department of Mathematics, according to their years of teaching experience, is shown in figure 2. It can be seen that 88% of them have three or more years of teaching experience in the area and almost 50% has more than 10 years of experience.

Figure 2. Percentage of participating teachers by teaching experience
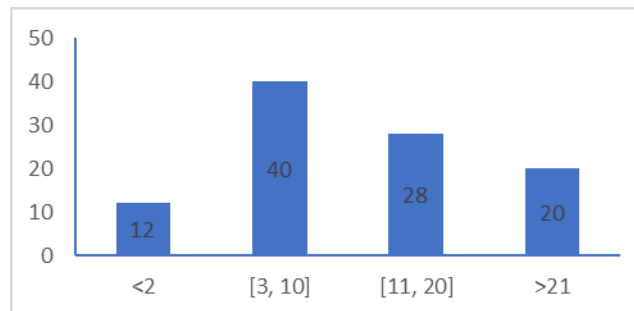
Source: own elaboration

Instruments

To measure the teachers' opinion about the use of the computer for educational purposes, a survey was developed that consists of two sections: 1) general data with four items and 2) attitudes towards the computer with 16 items on a Likert scale, with options of response ranging from 1 (strongly disagree) to 5 (strongly agree). For this, the studies by Tezci (2010) and Al- Zaidiyeen *et al.* (2010), were taken as a basis in relation to computer use and ICT in general, respectively. Table 1 shows the dimensions and indicators of the designed instrument.

Table 1. Description of the designed survey

Dimension	Definition operational	Indicators
Convenience of use	Relevance, need and ease of using the computer in educational activities in the area of mathematics. Advantages of using the computer.	1. I consider it convenient to use the computer as a tool in the teaching-learning process, since it allows content to be presented using text, images, audio and video. 2. I am motivated to use the computer as a tool in the teaching-learning process. 3. When I teach mathematics I feel more confident if I use a computer. 4. The computer helps teachers teach more effectively, since it allows different representations such as algebraic, graphic, tabular, etc. to be made more easily. 5. The computer helps me learn new things. 6. I can learn any new computer-based procedures that are required for my course. 7. To get the correct answer to exercises or class activities, I prefer to use a computer. 8. I believe that the computer helps students understand concepts in a more effective way. 9. I believe that with the use of the computer, students become more motivated. 10. I am able to prepare class activities efficiently whether or not I use the computer. 11. If the computer crashes, I am able to continue the activity on my own.
Inconvenience of use	Disadvantages or unwillingness to use the computer in educational activities in the area of mathematics.	1. Using computers in the teaching-learning process stresses me out. 2. I am distrustful of using a computer in the teaching-learning process. 3. The use of the computer distracts students. 4. The use of the computer makes the student lazy.

		5. More time is wasted in class using the computer.

Source: own elaboration

The instrument was subjected to content validity through expert review, with the participation of four advisory professors on the topic of use of technology for educational purposes. Their observations focused on the wording of the questions to facilitate their understanding, which were considered to improve the survey. In addition, its reliability was evaluated using Cronbach's alpha coefficient, which yielded a value of 0.803, indicating that the instrument is reliable.

Procedure

The survey was administered in printed format at the workplace of the participating teachers. The data were captured in Excel and subsequently migrated to SPSS version 19 *software* for analysis. Likewise, descriptive statistics, specifically frequency tables, were used to describe the characteristics of the sample and the responses to the survey items. In addition, non-parametric tests were applied, such as the rank test, to test differences between different groups and the Spearman non-parametric test to evaluate the presence of correlation between the variables under study.

Results

The results of the analysis of the data collected from the survey applied to the professors of the Department of Mathematics were the following: 100% of those surveyed stated that they had a computer at home, while 98.5% had Internet access at home, indicating a high level of connectivity between the teachers surveyed.

Regarding the use of the computer for educational purposes, 10% use it for one to two hours a week, 24% for three to five hours, 27% for 6 to 10 hours, and 39% use it more 11 hours a week.

Likewise, frequency tables were obtained for each of the 16 survey questions. Regarding the dimension *convenience of computer use* (the first 11 questions), it was observed that a percentage of 85.2% of respondents showed agreement or total agreement with the use of the computer in the classroom, which indicates a level very favorable acceptance of this technology by teachers.

However, regarding item 3 ("When I teach mathematics, I feel safer if I use a computer"), there was some ambiguity in the responses. 66.2% of respondents agreed with the statement, while 33.8% showed disagreement, indecision or total disagreement (see table 2). This question caused confusion, as some thought that they did not require a computer to feel confident teaching mathematics and others thought that with the computer the calculations can be done faster and with greater precision.

Table 2. Frequency distribution corresponding to item 3

	Frequency	Percentage	Valid percentage	Accumulated percentage
1	6	9.0	9.2	9.2
2	6	9.0	9.2	18.5
3	10	14.9	15.4	33.8
4	30	44.8	46.2	80.0
5	13	19.4	20.0	100.0
Total	65	97.0	100.0	
Lost	2	3.0		
Total	67	100.0		

Source: own elaboration

In item 7 ("To obtain the correct answer to the exercises or class activities, I better use a computer"), the frequency distribution shown in table 3 was obtained. The results reveal that 53% were between completely disagree, disagree or undecided, while only 15.2% chose the strongly agree option. This indicates that almost half of teachers do not depend on the computer to obtain the correct answer in an exercise.

Table 3. Frequency distribution corresponding to item 7

	Frequency	Percentage	Valid percentage	Accumulated percentage
1	5	7.5	7.6	7.6
2	12	17.9	18.2	25.8
3	18	26.9	27.3	53.0
4	twenty-one	31.3	31.8	84.8
5	10	14.9	15.2	100.0
Total	66	98.5	100.0	
Lost	1	1.5		
Total	67	100.0		

Source: own elaboration

Regarding the last five items, most of the responses show a high percentage in option 1 (totally disagree), and when adding options 1 and 2, the percentage is at least 70%. However, in question 14 ("Computer use distracts students"), a frequency distribution is observed, shown in Table 4. In this case, 67.2% were between completely disagree and disagree; while 32.8% were between undecided, agree and totally agree. This suggests that some teachers have reservations about computer use, believing that it could distract students.

Table 4. Frequency distribution corresponding to question 14

	Frequency	Percentage	Valid percentage	Accumulated percentage
1	3	38.8	38.8	38.8
2	2	28.4	28.4	67.2
3	17	25.4	25.4	92.6
4	19	3.0	3.0	95.6
5	26	4.5	4.5	100.0
Total	67	100	100	

Source: own elaboration

On the other hand, correlation analyzes were carried out to determine if there is a dependency between age and years of teaching experience with respect to the use of the computer for educational purposes by teachers. Spearman's non-parametric test was used for each of the 16 questions. The results show that there is a positive correlation between age and questions 3, 14 and 15; all of them with a significance less than .01.

Question 3, which deals with feeling confident with the use of the computer, shows that the older the teachers are, the more confident they are with its use. Section 14 investigates whether the computer distracts the students. According to the results, at older ages teachers think that students do get distracted by using the computer in the classroom. Question 15 asks if the computer makes the student lazy. According to the results, the older the teachers are, the more they think that the students do show greater laziness.

However, for the 16 questions, the Spearman test was applied to check the existence of a correlation between years of teaching experience and computer use in the classroom, and in no case was it significant. Nor was a significant relationship found with respect to the number of hours that teachers use the computer for educational purposes.

In addition, hypothesis tests were carried out to test differences by gender, using the non-parametric rank test for each of the 16 questions. In no case did the results indicate any significant difference; That is, male and female teachers have the same opinion regarding the use of computers in the classroom.

Finally, the same hypothesis test was carried out to test whether due to the type of employment contract there was any difference in terms of the teachers' opinion on the use of the computer in the classroom, and it was obtained that no question was significant; Therefore, the opinion on the use of the computer does not depend on the type of employment contract that the teacher has (full-time or part-time dedication).

Discussion

Almost two decades after the use of computers in the classroom became popular at ITSON, teachers show a very favorable level of attitude, with 85.2% responding with the option of agree and totally agree. These results are consistent with the findings of Adric (2021) in a study with mathematics teachers, where attitudes towards technology were favorable and had a positive effect on its use in lessons.

Furthermore, the present study found that the older the teachers, the more confident they feel with the use of the computer; They think that students are distracted by its use in the classroom and they consider that it makes the student lazier. These findings coincide with those of Linne (2020), who reported that older teachers tend to distrust the use of technology.

However, no correlation was found between years of teaching experience and the convenience of using the computer in the classroom, nor with respect to the number of hours that teachers use it. These data do not coincide with those of Adric (2021), who concluded that teachers' attitudes differed significantly throughout the scale or in several factors depending on their age, the frequency of use of technology in their classes, and the variety of *hardware* and *software*.

Regarding differences by sex and type of employment contract, no significant differences were found in the opinion on the convenience of using the computer in the classroom between male and female teachers, nor between full-time and part-time teachers. However, Hoashla (2019) found that there is a negative attitude towards the use of educational technologies in teaching mathematics, as well as statistical differences in averages based on gender. These differences were in favor of the teachers and differences that are attributed to experience in the period of five to ten years.

Conclusion

The multiple studies carried out over time have highlighted the importance of the use of technology in education, a tool that, regardless of positions for or against, continues to gain ground in daily life, since it is used for various purposes. purposes in all areas of society.

In this particular study, focused on the attitudes of mathematics teachers towards the use of computers in the classroom, a mostly favorable trend has been observed towards the incorporation of this technology. In fact, teachers consider it as a means to enhance the teaching-learning process and to energize classes, since it encourages student participation.

Likewise, a positive correlation has been found between the age of teachers and some positions regarding computer use. That is, as teachers' age increases, they feel more confident when using it, although they also perceive that it can be a source of distraction and encourage laziness in students, who can become dependent on it.

These results indicate that there is still a long way to go, for both teachers and students, in terms of developing digital skills that allow them to take full advantage of the advantages of technology, in particular, the computer. Therefore, it is essential that appropriate teaching strategies are developed and implemented to strengthen the teaching-learning process.

These findings, in summary, are relevant for the institution under study, since they allowed us to know the reality of an academic department where few studies linked to the work of its teachers have been carried out. Furthermore, based on this data, it will be possible to identify those aspects that must be improved in terms of the technological infrastructure available in the classrooms, as well as for the teacher qualification processes and student training, since it will be a true challenge to get the student to use the computer for educational purposes and not just for fun.

Future lines of research

Based on the results of this study, it is recommended that additional research be conducted to evaluate the impact of technology use in the classroom. Specifically, these investigations should focus on how teachers integrate technology into their teaching; that is, covering aspects related to instructional design and using a variety of technological tools. Furthermore, it is suggested that this use of technology be planned for pedagogical purposes to allow these tools to act as mediators of the learning process. Finally, it would be beneficial to explore how this technological integration affects students' academic performance and contributes to the development and strengthening of their digital competencies.

Acknowledgment

References

Al-Zaidiyeen, N. J., Mei, L. L. and Fook, F. S. (2010). Teachers' Attitudes and Levels of Technology Use in Classrooms: The Case of Jordan Schools. *International Education Studies*, *3*(2), 211-218. https://eric.ed.gov/?id=EJ1066020

Adric, M. A. (2021). Opinions and Attitudes of Secondary School Mathematics Teachers Towards Technology. *Participatory Educational Research, 8*(3), 136-155. https://doi.org/10.17275/per.21.58.8.3

Alghamdi, M. S. (2017). The Reality and Difficulties of Employing ICT in Teaching from the Perspective of Math Teachers of Middle Stage in Riyadh. *International Education Studies*, *10*(12), 109. https://doi.org/10.5539/ies.v10n12p109

Awofala, A. O., Olabiyi, O. S., Awofala, A. A., Arigbabu, A. A., Fatade, A. O. and Udeani, U. N. (2019). Attitudes toward Computer, Computer Anxiety and Gender as determinants of Pre-service Science, Technology and Mathematics Teachers' Computer Self-efficacy. *Digital Education Review*, *0*(36), 51-67. https://doi.org/10.1344/der.2019.36.51-67

Falco, M. (2017). Reconsiderando las prácticas educativas: TIC en el proceso de enseñanza-aprendizaje. *Tendencias pedagógicas,* (29), 59-76. https://doi.org/10.15366/tp2017.29.002

Figueroa, V., Burgos, F. y Guerrero, M. (2017). Actitud de los docentes hacia el uso de la computadora en las escuelas de República Dominicana. *Pixel-Bit, Revista de Medios y Educación*, (51), 197-210. https://doi.org/10.12795/pixelbit.2017.i51.13

Haji, S. (2015). Science Teachers' Attitudes Towards The Use Of Information And Communication Technology In Secondary Schools In Cameroon. *International Journal of Social Science and Humanities Research*, *3*(2), 573-585. https://www.researchpublish.com/issue/IJSSHR/Issue-2-April-2015-June-2015

Hoashla, Y. (2019). Mathematics Teachers' Attitudes Toward Employing Educational Technologies in Teaching Mathematics at the Negev Schools in Israel. *Journal of Education and Practice*, *10*(2), 82-92. DOI: 10.7176/JEP/10-2-11

Linne, J. (2020). Las TIC en la intersección áulica: Desafíos y tensiones de la alfabetización digital en la escuela media. *Revista Electrónica de Investigación Educativa*, *22*, 1-13. https://doi.org/10.24320/redie.2020.22.e24.3072

Mensah, J. K., Okyere, M. and Kuranchie, A. (2013). Student attitude towards Mathematics and performance: Does the teacher attitude matter? *Journal of Education and Practice*, *4*(3), 132-139 https://iiste.org/Journals/index.php/JEP/article/view/4502

Núñez, C., Gaviria-Serrano, J. M., Tobón, S., Guzmán-Calderón, C. E. y Herrera, S. R. (2019). La práctica docente mediada por TIC: una construcción de significados. *Revista Espacios*, *40*(5), 4-18 https://www.revistaespacios.com/a19v40n05/19400504.html

Romero, S. J, Guillén, F. D., Ordóñez, X. G. y Mayorga, M. J. (2020). Desarrrollo y estructura de un instrumento de actitud hacia el uso de la tecnología para la enseñanza y la investigación en docentes universitarios. *Tecnología, Ciencia y Educación*, (16), 85-111. Doi: https://doi.org/10.51302/tce.2020.443

Ruiz-Aquino, M., Borneo, E., Alania-Contreras, R. D., García, E. S. y Zevallos, U. (2022). Actitudes hacia las TIC y uso de los entornos virtuales en docentes universitarios en tiempos de pandemia de la COVID-19. *Publicaciones, 52*(3), 107–120. https://doi.org/10.30827/publicaciones.v52i3.22270

Salat-Figols, R. S. S. (2013). La enseñanza de las matemáticas y la tecnología. *Innovación Educativa*, *13*(62), 61-74. https://www.scielo.org.mx/pdf/ie/v13n62/v13n62a5.pdf

Sandoval, F. J., Yévenes, J. N. y Badilla, M. G. (2020). ACT-ED: instrumento unifactorial para medir la actitud hacia el uso educativo de TIC en docentes chilenos de educación secundaria. *Revista de Estudios y Experiencias en Educación*, *19*(41), 225-237. Doi: 10.21703/rexe.20201941sandoval12

Secretaría de Educación Pública [SEP] (2021). *Agenda Digital Educativa*. https://infosen.senado.gob.mx/sgsp/gaceta/64/2/2020-02-051/assets/documentos/Agenda_Digital_Educacion.pdf

Tezci, E. (2010). Attitudes and knowledge level of teachers in ICT use: The case of Turkish teachers. *Journal of Human Sciences*, *7*(2), 19-44. https://www.j-humansciences.com/ojs/index.php/IJHS/article/view/797

Unesco (4 de enero de 2018). *Marco de Competencias de los Docentes en materia de TIC*. Unesco. https://es.unesco.org/themes/tic-educacion/marco-competencias-docentes

Vásquez, C. E. y Henríquez, P. (2016). Las competencias de los docentes para el uso y manejo de las TIC en la implementación del Proyecto Educativo Canaima. Caso: Escuela Municipal San José. *Acción Pedagógica*, *25*(1), 22-32. https://dialnet.unirioja.es/servlet/articulo?codigo=6224925

Viñals, A. y Cuenca, J. (2016). El rol del docente en la era digital. *Revista Interuniversitaria de Formación del Profesorado*, *30*(2), 103-114. Doi**:** https://doi.org/10.47553/rifop.v30i2

Williams, D. C. J. (2015). An Investigation of K-12 Teachers' Attitudes toward Computer Technology use in Schools. *Journal of Business*, *2*(1), 71-87. http://www.jbepnet.com/journals/Vol_2_No_1_March_2015/9.pdf

Williams, L., S. de Peralta, M. y Marín, J. (2021). El papel del docente frente a las nuevas formas de aprendizaje: ubicuo, flexible y abierto. *Centros: Revista Científica Universitaria*, *10*(1), 82-94 Doi: https://doi.org/10.48204/j.centros.v10n1a6

Zempoalteca, B., González, J., Barragán, J. y Guzmán, T. (2018). Factores que influyen en la incorporación de las Tecnologías de la Información y la Comunicación en universidades públicas: una aproximación desde la autopercepción docente. *Revista de la Educación Superior, 47* (186), 51-74. Doi: https://doi.org/10.36857/resu.2018.186.348

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