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Digital tools and autonomous learning in secondary school students

Herramientas digitales y aprendizaje autónomo en estudiantes de educación secundaria

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ABSTRACT

The use of digital tools (DT) and autonomous learning (AL) of secondary school students was determined, and differences by sex were explored. The sample consisted of 150 subjects (N: 244). The strategy was quantitative, descriptive, correlational and comparative. The survey was used, and the questionnaire (Lozano, 2017) was used to measure the use of DTs (α: >0.81). It is made up of 3 components (Technological-DTT, Informational-DTI and Communicative-CDT). The correlation inference was made with the Test-Spearman. The U-Mann-Whitney test (U_Test) was used for contrast by sex. High uses of the DT and its three components prevailed, which converged with an AL that reflected the achievement of the goals. No differences were identified by sex (U_Test>0.05). The bivariate correlations between the dimensions of the DT variable and the AL yielded a value of 0.60 (p.value <0.01). This confirms what was found in the contingency table, therefore higher levels of DT use are accompanied by higher levels of autonomous learning. The dimensions of the DTs also exhibit direct and significant relationships [(DTT↔AL r: 0.49; p.value < .01); (DTI↔AL r: 0.61; p.value < .001); (CDT↔AL r: 0.42; p.value < .001)]. It is statistically demonstrated that the levels of technological, informational and communicational DT are related to the highest levels of autonomous learning achievement of the students. In this sense, it would be prudent to promote through training the increase of DT levels so that this translates into better levels of LA.

Keywords: Autonomous learning, Learning in secondary education, Digital tools, Impact of technology on education.

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RESUMEN

Se determinó el uso de las herramientas digitales (DT) y el aprendizaje autónomo (AL) de discentes de secundaria, y exploraron las diferencias por sexo. La muestra fue de 150 sujetos (N: 244). La estrategia fue cuantitativa, descriptiva, correlacional y comparativa. Se empleó la encuesta, y el cuestionario (Lozano, 2017), fue utilizado para medir el uso de las DT (α: >0.81). Está conformado por 3 componentes (Tecnológico-DTT, Informacional-DTI y Comunicativo-CDT). La inferencia de correlación se hizo con el Test-Spearman. El U-Mann-Whitney test (U_Test) fue usado para el contraste por sexo. Prevalecieron usos altos de las DT y de sus tres componentes, los que convergían con u AL que reflejaba el logro de las metas. No se identificaron diferencias por sexo (U_Test>0.05). Las correlaciones bivariadas entre las dimensiones de la variable DT y la AL arrojó un valor de 0.60 (p.valor <0.01). Se confirma así lo apreciado en la tabla de contingencia, por tanto los niveles mayores de uso de DT se acompañan de mayores niveles de aprendizaje autónomo. Las dimensiones de las DT también exhiben relaciones directas y significativas [(DTT↔AL r: 0.49; p.valor < .01); (DTI↔AL r: 0.61; p.valor < .001); (CDT↔AL r: 0.42; p.valor < .001)]. Se demuestra estadísticamente que los niveles de DT tecnológica, informacional y comunicacionales se relacionan con los niveles más altos de logro de aprendizaje autónomo de los estudiantes. En este sentido, sería prudente propiciar mediante capacitaciones el incremento de los niveles de DT para que esto se traduzca en mejores niveles de AL.

Palabras claves: Aprendizaje autónomo, Aprendizaje en educación secundaria, Herramientas digitales, Impacto de la tecnología en la educación

INTRODUCTION

The recognition of the dynamics and diversity of learners' requirements and the personalization of processes has become a pedagogical necessity (Reyes et al., 2023, 2024). Similarly, the rapid advancement of technology has had a significant effect on the educational context, particularly in secondary schools (Albó et al., 2019; Balladares-Domo et al., 2023; Hew & Cheung, 2013). Digital tools (DT) have positioned themselves as an integral part of the learning process (Dávila Morán et al., 2022; Esteve-Mon et al., 2022), influencing the way students acquire knowledge, process information, and communicate ideas (Antonietti et al., 2022; Çebi et al., 2022; Núñez-Canal et al., 2022).

DT in education includes a wide range of technological applications, software and interactive platforms designed to increase the learning experience (Damşa et al., 2021; Hofer et al., 2021; Sandoval, 2020). These DTs can be classified into three dimensions: technological, informational, and communicative (Lozano, 2017). In parallel, the concept of autonomous learning (AL) has gained relevance as educators and researchers highlight the importance of fostering independent, self-regulated, and self-directed learning (Kirschner & De Bruyckere, 2017).

By AL (Manrique, 2004; Monereo and Font & Castelló Badia, 1997) The faculties that allow the student to make decisions that allow him to regulate his own learning processes according to a certain goal and a specific context or conditions of learning are assumed.

The technological dimension (DTT) of DTs is circumscribed to the hardware, software and infostructure that favor digital learning experiences; and this includes devices such as computers, tablets and smartphones, as well as the corresponding software applications and learning management systems that facilitate educational activities. It also implies the inventory of basic knowledge and skills that facilitate the processes of identifying and solving problems, as well as the use of technology in a learning activity (Lozano, 2017).

The information dimension (DTI) of DTs incorporates the broad spectrum of digital resources and content available to learners, including e-books, online databases, pedagogical websites, and multimedia resources (Lozano, 2017), which give students the ability to access a wealth of information beyond traditional textbooks and encyclopedias (Vázquez-Cano, 2014). It also includes the skills and abilities for the development of the processes of exploration, selection, organization of data and information that is obtained from virtual spaces, and that are transformed into new knowledge (Lozano, 2017).

The communicative dimension (CDT) of DTs refers to the technologies and platforms that facilitate interaction, collaboration and the exchange of knowledge between students and between students and teachers. This includes social media, online discussion forums, video conferencing tools, and collaborative document editing platforms. It also considers the set of competencies and skills that drive the processes of exchange and transmission of information and ideas with certain audiences (Lozano, 2017). Positive impacts of DT have been determined in the AL. Sha et al. (2012) reported that the use of mobile devices and learning applications favorably impacted self-regulated learning in science teaching and they were more likely to participate in autonomous learning experiences (Sha et al., 2012).

A systematic review by Broadbent and Poon (2015) revealed that some online learning strategies, such as proper time management, metacognition processes, and self-regulation of effort, were directly correlated with academic performance in the context of online and hybrid learning. It follows that digital learning platforms can generate opportunities for students to develop and practice autonomous learning skills (Broadbent & Poon, 2015). Zhu (2021) and Chattattan, (2021), They reported that, although technology generates benefits for self-regulated learning, this will require providing support to students, in a way that promotes learning autonomy (Chatattan, 2021; Xu, 2021).

Aesaert et al. (2017) examined the relationship between students' technological self-efficacy and their actual competencies in this field. Their results revealed a difference between perceived and actually demonstrated digital skills, highlighting the urgency of targeted interventions for the development of digital skills and support for the autonomous use of digital skills for learning (Aesaert et al., 2017).

In the institution selected as the unit of analysis, this type of diagnosis has not been carried out, although the pedagogical model explicitly points out the need to integrate DT and autonomous learning mediated by technology. However, there are no metrics in this regard and self-assessment processes require them. Because of this, this work is aimed at determining the relationship between DT and AL in secondary school students. The work responds to an institutional need and aims to generate a space for discussion and practical action in favor of an improvement in the quality of education.

METHODOLOGY

It is a quantitative research, with two moments, first a descriptive one and then an inferential one of a correlational type, accompanied by a comparative inference by sex. From a population of 244 subjects, a census sample was carried out of 150 secondary school students who declared that they used technological devices in their activities at home. The Lozano (2017) questionnaire was used to measure the use of DTs (α: >0.81). It is made up of 3 components (Technological, Informational and Communicative) and groups 20 items, with options ranging from 1 to 5, and a subsequent classification by levels: "low (20 – 45); medium (46 –72) and high (73 –100)". The AL variable was based on the questionnaire by Manrique (2004) (α: >0.83), where 24 questions are grouped with ordinal assessment options (1 to 5), and a precision by levels: "beginning (24 – 55); process (56 – 87) and achieved (88 – 120)". Both tests are considered valid and reliable (Pérez Vertiz, 2022). The Jamovi 2.5.6 program was used, with which percentages and contingency tables were obtained. The correlation was based on Spearman's test (r: α: 0.05; H1: r: DT and AL ≤ 0.05). The contrast by sex was based on the U Mann Whitney test (U_Test: α: 0.05; H1: U_Test between men and women ≤ 0.05).

RESULTS

DTT and autonomous learning in students.

Table 1 summarizes the crossover between the DTT-levels and AL-levels of the students. It can be deduced from it that the level with the highest prevalence of DTT is the high one in correspondence with the AL achieved (n: 102; 80% high DTT - AL achieved); while the mean level of DT corresponding to the AL achieved (n: 48; 55% mean DTT - AL achieved) was noticeably lower. Low levels of DTT were absent, and levels of AL-in process were in the minority in contrast to AL-Achieved. No significant differences were observed between men and women (U_Test: p. >0.05). It can be pointed out from the results that a high level of DTT contributes to the increase of autonomous learning.

Table 1

Contingency Table: DTT *-levels vs AL-levels.*

	AL-levels		
DTT *-levels*	**In process**	**Accomplished**	**Total**

DTT -*levels*		*AL-levels* In process	Accomplished	Total
Medium level	% of row	45 %	55 %	n: 48
High level	% of row	20 %	80 %	n: 102

U_Test: men ≠ women p. >0.05.

DTI and autonomous learning in students.

Table 2 shows the results of the contingency examination between the levels of DTI and AL indicate that the level with the highest prevalence of DTI is the high level corresponding to the AL achieved (n: 110; 92% high DTI - AL achieved); while the average level of DTI corresponding to the LA achieved (n: 40; 65% medium DTI - AL achieved) was much lower. Low levels of DTI were absent, and levels of AL-in process were significantly lower in contrast to AL-Achieved. Significant differences were also not observed between men and women (U_Test: p. >0.05). It follows that a high level of DTI contributes to autonomous learning.

Table 2

Contingency Table: DTI *vs AL.*

DTI-niveles		***V2- AL-levels*** In process	Accomplished	Total
Medium level	% of row	35 %	65 %	n: 40
High level	% of row	8 %	92 %	n: 110

U_Test: men ≠ women p. >0.05.

CDT and autonomous learning in students.

Table 3 shows the convergences between the levels of CDT-levels and AL-levels of the surveyed students. Again, it can be seen that the level with the highest prevalence of CDT is the *high* level corresponding to the AL achieved (n: 114; 86% high ECD - AL achieved); while the mean level of CDT corresponding to the AL achieved (n: 36; 66% medium ECD - AL achieved) was much lower.

Low levels of CDT were not recorded, and levels of AL-in process were also in the minority in contrast to AL-Achieved. Significant differences between men and women were not observed (U_Test: p. >0.05). Such findings suggest that a high level of use of digital communication tools contributes to the increase in autonomous learning and the achievement of goals.

Table 3

Contingency Table: CDT vs AL of graduate students.

CDT -levels	***V2- AL-levels*** In process	Accomplished	Total

CDT -levels		*V2- AL-levels*		
		In process	**Accomplished**	**Total**
Medium level	% of row	44 %	66 %	n: 36
High level	% of row	14 %	86 %	n: 114

U_Test: men ≠ women p. >0.05.

DT and autonomous learning in students.

Table 4 shows the summary of the bivariate relational analysis between the levels of DT-levels and AL-levels. It can be seen that the prevalent level of DT is high in correspondence with the AL achieved (n: 109; 90% DT high - LA achieved). The mean SD associated with the AL achieved was significantly lower (n: 41; 61% mean DT - AL achieved).

As could be seen at the dimension level, low levels of DT were not recorded. No significant differences were found between men and women (U_Test: p. >0.05). These findings are concurrent with what was observed with the three components, so that a high level of DT use translates into autonomous learning and the achievement of goals.

Table 4

Contingency Table: DT vs AL.

DT-LEVELS		**AL LEVELS**		
		In process	**Accomplished**	**Total**
Medium level	% of row	39 %	61 %	n: 41
High level	% of row	10%	90 %	n : 109

U_Test: men ≠ women p. >0.05.

The Correlation Test

Table 5 presents the results of the bivariate correlations between the dimensions of the DT variable and the AL. At the level of variables, the rho (r) yielded a value of 0.60, which reflects a positive relationship, with the p.value being <0.01; therefore, H_0 was rejected.

This confirms what was found in the contingency table, therefore higher levels of DT use are accompanied by higher levels of autonomous learning.

Table 5

Correlation Matrix

		DTT		**DTI**		**CDT**		**DT**
AL	r	0.49	**	0.61	***	0.42	***	0.60**
	p	<.01		<.001		<.001		<.01

	DTT	DTI	CDT	DT

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

The relationship between the dimensions of the DTs also exhibits direct and significant relationships [(DTT↔AL r: 0.49; p.value < .01); (DTI↔AL r: 0.61; p.value < .001); (CDT↔AL r: 0.42; p.value < .001)]. For all three cases , it was appropriate to reject H0.

In this way, it is statistically demonstrated that the levels of technological, informational and communicational DT are related to the highest levels of autonomous learning achievement of the students. In this sense, it would be prudent to promote through training the increase of DT levels so that this translates into better levels of AL.

DISCUSSION

The results outlined indicate that the levels of use of the DTs and their components varied between the high and medium categories. This indicates that students make frequent use of them, both technological, informational and communicational. This is a representative aspect that would support the thesis of digital natives and the facilities they have for the use of technology. Additionally, this use resulted in high and medium AL levels. The contingency tables highlight this synchrony between high uses and the achievement of the goals established in terms of projected autonomous learning. The findings are concurrent with the reported positive impacts of DTs in AL. It coincides, for example, with what was pointed out by Sha et al. (2012), who a little more than a decade ago reported that the use of mobile devices and learning applications had favorable effects on self-regulated learning in the field of science, and students who were advantaged in this could better develop autonomous learning experiences (Sha et al., 2012).

The findings also coincide with the benefits of the use of DTT in learning, reported by Cajas Bravo et al. (2023), who demonstrated the relationship between both variables. However, they consider and recommended that the use of DTTs should not be excessive (Cajas Bravo et al., 2023). This is an aspect to consider because high levels are reported in this study.

It would be appropriate to undertake studies to determine the actual management of these DTTs, DTIs and DTCs. In view of this need, it would be necessary to consider what Aesaert et al. (2017) proposed, who found an absence of a relationship between the self-perception of efficacy and real technological skills. This would be a limitation of the work done that only remains in self-perceptions.

Despite this limitation, the results are a step forward, since they allow us to have a baseline to understand the use of technology and its relationship with self-regulated learning. There would also be the possibility of appreciating whether this also corresponds to the demands of online learning, and as Broadbent and Poon (2015) point out, unveiling learning strategies, time management mechanisms, in synchrony with metacognition and the regulation of effort.

To pretend that this is entirely driven by high school students could be a mistake. Zhu (2021) and Chattattan, (2021), reported the need to generate support strategies to stimulate learning autonomy, something relevant in adolescents (Chatattan, 2021; Xu, 2021).

These dissonances still point to the existence of potential challenges. Kirschner and De Bruyckere (2017) presented arguments against the conception of digital natives, arguing that the daily life and familiarity of students with a technological environment does not necessarily constitute an effective use of DT for learning. They emphasised the relevance of explicit work on digital literacy skills in order to ensure that they can take advantage of DT for LA (Kirschner & De Bruyckere, 2017).

On the other hand, this study also did not explore whether self-regulated learning translates into better grades. Lai and Hwang (2016) reported that students who used mobile phones for self-directed learning activities showed a significant increase in academic performance and the perception of self-efficacy. This suggests that the technological dimension of DT may be a supporting factor in autonomous learning behaviors (Lai & Hwang, 2016; Zheng et al., 2016).

With respect to DTIs, the results are consistent in relational terms with what has already been pointed out for DTDs. We agree with Vázquez-Cano (2014) that students who use and consult digital texts can improve their capacity for autonomous work and independent research, as well as critical thinking (Vázquez-Cano, 2014).

There is also an affinity with what was pointed out by Greene et al. (2018), who highlight that the use of DTI by secondary school students influenced their self-regulated learning strategies. They found that students who effectively used digital resources for information gathering and processing were more likely to employ advanced self-regulated learning strategies, indicating a positive relationship between the informational dimension of digital tools and autonomous learning behaviors (Greene et al., 2018).

In addition, we agree with Albó et al. (2019), regarding the favorable relationship between the use of CDTs and AL. They examined the impact of social media use, an aspect linked to CDTs, on secondary school students' autonomous learning behaviors.

Their findings indicated that students who actively participated in educational activities on social media demonstrated higher levels of self-regulation and metacognitive awareness, key components of autonomous learning (Albó et al., 2019).

CONCLUSIONS

The relationship between DT and AL in secondary school students is a rich area of study with significant implications for educational practice. Understanding the impact of the technological, informational, and communicative dimensions of DT on this type of learning will allow educators to take advantage of these resources more efficiently to promote autonomous learning behaviors.

As technology continues to evolve, ongoing practice and research will be crucial to ensure that DTs are optimally used to support the development of self-directed learners. In summary of the context of secondary education, fostering autonomous learning is particularly crucial, as it prepares students for the demands of the workforce and higher education, where self-direction and independent problem-solving are highly valued skills.

It is clear from this work to confirm the results in other sections and levels of the school institution. Also to diagnose the consistency between self-perception and management of DTs, as well as their relationship with academic performance.

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