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RESEARCH ARTICLE

Herramientas Digitales en la Era del Aprendizaje: Un Análisis Comprehensivo basado en la Taxonomía de Bloom

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Resumen: La era moderna está basada en aspectos tecnológicos. Esto incluye el ámbito educativo, el cual, se debe acoplar a herramientas tecnológicas con fines educativos. En el actual estudio se examina de manera exhaustiva la aplicación de diversas herramientas digitales bajo el contexto educativo, utilizando de referencia la Taxonomía de Bloom. Esto se consigue mediante un análisis mixto, cualitativo y cuantitativo. Los métodos para obtener información precisa sobre el tema de estudio varían según el propósito. Primero, revisión de literatura, encuesta a 150 educadores y entrevistas en profundidad con 20 expertos en tecnología educativa, estos datos de analizan para evaluar el potencial de estas herramientas con el fin de apoyar diferentes niveles de habilidades cognitivas en entornos de aprendizaje distintos. Los resultados revelan 60 aplicaciones y herramientas en línea, una correlación significativa entre el uso estratégico de herramientas digitales y la mejora en el desarrollo de habilidades cognitivas de orden superior. De la misma manera, se identifican patrones de efectividad específicos para cada nivel de la taxonomía Bloom, así como, desafíos comunes en la implementación. Sin duda alguna, esta investigación sobre herramientas tecnológicas con fines educativos abre paso a la era moderna dentro de las instituciones educativas alrededor del mundo, pues, sus resultados afirman factores positivos como la fácil accesibilidad, capacidad de adaptación a distintos modelos de aprendizaje e integración curricular. Finalmente, la aplicación de las herramientas tecnológicas con fines educativos enriquecen el proceso de enseñanza-aprendizaje, además, fomenta habilidades cognitivas individuales, las cuales ayudan en el proceso de crear profesionales preparados para el mundo moderno con fines pedagógicos completos y adecuados.

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Palabras claves: herramientas digitales, Taxonomía de Bloom, tecnología educativa, aprendizaje en línea, innovación docente, análisis mixto.

Digital Tools in the Age of Learning: A Comprehensive Analysis Based on Bloom's Taxonomy

Abstract: The modern era is based on technological aspects. This includes the field of education, which must be coupled with technological tools for educational purposes. The current study comprehensively examines the application of various digital tools in the educational context, using Bloom's Taxonomy as a reference. This is achieved through a mixed qualitative and quantitative analysis. The methods for obtaining accurate information on the topic of study vary according to the purpose. First, literature review, survey of 150 educators and in-depth interviews with 20 educational technology experts, these data are analysed to assess the potential of these tools to support different levels of cognitive skills in different learning environments. The results reveal a significant correlation between the strategic use of digital tools and improved development of higher order cognitive skills in 60 applications and online tools. In the same way, specific effectiveness patterns are identified for each level of the Bloom taxonomy, as well as common challenges in implementation. Undoubtedly, this research on technological tools for educational purposes opens the way to the modern era within educational institutions around the world, as its results affirm positive factors such as easy accessibility, adaptability to different learning models and curricular integration. Finally, the application of technological tools for educational purposes enriches the teaching-learning process and fosters individual cognitive skills, which help in the process of creating professionals prepared for the modern world with complete and adequate pedagogical purposes.

Keywords: digital tools, Bloom's Taxonomy, educational technology, online learning, teaching innovation, blended learning.

1. Introduction

Today, much of the world's population uses technological and intelligent methods and tools for most everyday tasks. Within these skills is modern education, which is an immediate necessity for all teachers and students. These technological features have completely transformed conventional models of teaching and learning. Technological education methods were born out of a global event, the COVID-19 pandemic, catastrophic in some ways, but gratifying in others [1]. This historical turning point prompted teachers and educational institutions around the world to modify their thinking, ways and methods of teaching and learning. Such changes resulted in the creation and application of digital tools, which are intended to continue education from all points of view, without neglecting minorities, instead, overtaking them and making them part of the modern world, with the purpose of increasing the quality of teaching-learning [2].

Bloom's Taxonomy is one of the technological educational methods. Bloom's Taxonomy emerges as a fundamental piece to understand and structure various digital tools that support different levels of cognitive skills, from the most basic to the most complex [3]. Within Bloom's Taxonomy there are six key levels for teaching and learning, Remembering, Understanding, Applying, Analysing, Evaluating and Creating, each of which offers a hierarchy of cognitive processes, as well as the development of individual thinking skills and abilities [4].

The pedagogical world opens up great educational opportunities and challenges. For this reason, this study proposes to examine different digital tools under Bloom's method, in addition to explaining how they can be applied in effective ways, enhancing learning in different educational contexts. For these reasons, an exhaustive diagnosis of online applications and tools will be carried out. In order to evaluate their functionality, ease of application and educational support, with the purpose of developing different cognitive skills [5]. The present educational research will be guided by the careful selection of implementing digital tools within educational institutions, corresponding to the different

levels of Bloom's Taxonomy, which can enrich the teaching-learning process. In this regard, it is proposed that the technological approach will allow educators to design more dynamic, interactive and effective learning experiences, capable of fostering the development of higher order cognitive skills [6].

In the course of this educational article, we will explore well-known and enjoyable tools that have the purpose of improving the intellectual capacity of the people who use them on a daily basis. These tools are found within Bloom's Taxonomy of learning. In the same way, the characteristics, pedagogical applications and potential to foster educational skills for each student and teacher will be analysed. Some of these skills are memorisation, creation and critical evaluation [7]. In addition, best practices for integrating the tools into different educational media will be discussed, considering various factors, such as accessibility, adaptability to different learning styles and implementation challenges. Ultimately, this study will contribute to the development of knowledge on educational technology and instructional design. It will also provide evidence-based insights that will guide educators, curriculum designers and policy makers in making informed decisions about integrating digital tools into the educational process [8].

Despite the great advantages of educational tools in the modern era, several studies doubt their effectiveness when applied by ordinary users, as they can be complex to use or their results can be stubborn. Moreover, some practitioners warn of potential risks, such as critical overload, digital distraction and superficial learning [9]. For these reasons, these tools should be used appropriately, with a strong pedagogical foundation. However, while other researchers strongly support their effectiveness in modern education, they remain a matter of debate and controversy within the academic community. Therefore, the aim is to characterise and analyse data collected on digital tools under the Bloom's Taxonomy [10].

2. Materials and methods

2.1. Research design

In order to address the current issue of effectiveness of technological tools for educational purposes, we chose to employ a mixed methods approach, combining quantitative and qualitative analysis. This strategy allowed us to obtain a deep and nuanced understanding of the topic. As a result, the research design was structured in three main phases: first, diagnosis of digital tools, second, survey of educators and third, in-depth interviews with experts. All these factors open the way to diagnose the effectiveness of the application of technological tools in different educational institutions [11].

In order to diagnose the different digital tools, a literature review was carried out in academic databases. Information filters were applied in order to obtain documents with substantial information. In addition, we chose to take recommendations from experts in educational technology. Categorising the tools according to the six levels of Bloom's Taxonomy. To evaluate each educational technology tool, the following criteria were taken into account: alignment with specific levels of Bloom's Taxonomy, ease of use and intuitive interface, potential to foster collaborative interaction, adaptability to different contexts on educational disciplines, customisation options and easy accessibility [12]. The specific points guarantee adequate results for the research. Each educational tool was evaluated independently by three researchers using a standardised rubric. Discrepancies were resolved through discussion and consensus.

2.2. Encuesta a educadores

In order to obtain a real point of view from the teaching practice, we conducted a survey of 150 educators from different educational levels (primary, secondary, higher education). The instrument used was an online questionnaire that included structured and semi-structured questions. Some of them were: frequency of use of digital tools, perceptions of effectiveness, challenges in implementation within the educational institution and perceived impact on student learning. To ensure the validity of the results, we applied a pilot study with 20 educators, subjecting the questionnaire to review by educational technology experts [13].

2.3. Entrevistas en profundidad

Finally, in order to deepen the findings, we conducted semi-structured interviews with 20 educational technology experts. Participants were selected by random sampling, in order to ensure different experiences in educational contexts and area of expertise. The interviews, lasting 60-90 minutes, were conducted virtually and covered topics such as: Experiences in implementing digital tools, perspectives on alignment with Bloom's Taxonomy, best practices, lessons learned and vision on the future of educational technology. After data collection, the most frequent and salient outcomes were analysed quantitatively to compare perceived effectiveness between different tool models [14]. For the qualitative data, the thematic analysis method was applied to identify patterns of similarity between topics of academic importance, taking into account the survey and interview results.

3. Results and discussion

3.1. Características y análisis de datos recopilados sobre herramientas digitales bajo la Taxonomía Bloom.

Under the context of the literature review, 60 digital tools were established, which are among the most feasible to be applied in real cases, develop individual cognitive skills for teachers, students and users in general, each of them propose to ensure pedagogical capabilities within the academic branch, they are encompassed in most of the educational levels and in all possible subjects, in the same way, these educational digital tools are within the patterns of similarity with Bloom's levels (table 1). On the other hand, the final results of the survey of 150 educators revealed information on the perceived impact of digital tools on teaching practice. On the one hand, 45% of respondents reported a significant increase in the degree of student comprehension when using digital tools aligned with the six levels within Bloom's Taxonomy. Meanwhile, 35% observed a noticeable improvement in information retention, acquired knowledge and development of individual cognitive skills. However, 20% mentioned that no improvement was observed in students using these digital tools. These positive data provide a sustainable direction for the use of these tools within educational institutions (primary, secondary and higher education) and can also be applied at higher levels of education, such as masters, PhD, public and private companies, as they are necessary to develop various tasks that are complicated for common methods. Below is a list of 60 digital tools for educational purposes:

Table 1. Technological tools for educational purposes

Recordar (C):	*Comprender (U):*	*Evaluar (E):*
Quizlet	Mindmeister	Hypothes.is
Anki	Evernote	Flipgrid
Flashcards+	Inspiration Maps	Mentimeter
Kahoot!	Coggle	Poll Everywhere
Memrise	Skitch	Socrative

Duolingo	Popplet	Formative
Cram	SimpleMind	Peergrade
StudyBlue	Mindomo	Voicethread
Brainscape	Explain	Seesaw
Tinycards	Everything	Spiral
	Padlet	
Aplicar (Ap):	*Analizar (An):*	*Crear (C):*
Google Earth	Lucidchart	Canva
Scratch	Tableau	Adobe Spark
PhET	MindMeister	iMovie
Simulations	Popplet	WeVideo
Geogebra	Cmaps	Animoto
Tinkercad	Mindomo	Storybird
CodeCombat	Canva	Book Creator
Duolingo	Visme	Piktochart
Kahoot!	Prezi	Thinglink
Nearpod	Google Drawings	Powtoon
Quizizz		

In the same way, the following section presents the most notable and important characteristics of the technological tools for educational purposes for the education and improvement of cognitive skills within the educational institution, each of them gradually improving the general and individual pedagogical level of the people who use them spontaneously, as well as standardising the results of the surveys and interviews carried out with the study population. Each level of Bloom's Taxonomy is described below:

Remember: At this level, the most effective tools were found to be Quizlet (37%), Kahoot (29%) , Brainscape (23%) and others (11%). The characteristics of this group of tools are distinguished by spaced repetition, elements of educational gamification and content customisation options. In particular, educators valued the ability of these tools to reinforce memorisation of basic concepts in an interactive and adaptive way.

Understanding: For this cognitive level, tools such as Padlet (40%), Mindmeister (30%) and Coggle (20%) and others (10%) stood out. The strongest features are the visual organisation of information and the ability to create connections between concepts. Teachers highlighted these tools because they facilitate the structuring and synthesis of complex information, promoting a deeper understanding of previously studied topics.

Apply: In the category of practical application of knowledge, the most prominent tools were Quizizz (35%), Google Earth (25%) and Nearpod (25%) others (15%). These tools provide knowledge and meaningful educational experiences, because realistic or programmable plans can be seen. For this reason, both teachers and students emphasise the importance of applying this information in real cases, increasing experiential learning.

Analyse: This set of educational technology tools enhance analytical skills, the most effective of which are Wufoo (45%), Cmaps (25%) and Google drawings (20%) others (10%). These applications

stand out for their ability to visualise data, real-time collaboration and facilities for comparative analysis. Students and teachers appreciated how these tools allow complex information to be broken down and relationships between different elements studied to be examined.

Evaluate: For this learning category tools such as Mentimeter (40%), Socrative (25%) and Formative (25%) others (10%) stood out. The most significant features are collaborative annotation, the possibility of asynchronous discussion and peer assessment options. Educators affirm how these tools foster students' critical thinking and argumentation skills inside and outside the classroom.

Create: Finally, one of the most important levels of Bloom's taxonomy, applications such as Canva (50%), Book Creator (20%) and WeVideo (20%) and others (10%) stand out. These technological tools are distinguished by their intuitive design, variety of creation formats, which offer options for collaboration in projects. Teachers and students highlighted these tools as innovative during the teaching-learning process, as they empower users through the expressiveness of their creativity, taking into account their knowledge in an innovative way.

These results affirm the immediate need to apply digital tools for educational purposes in academic institutions. This argument is supported by other studies that affirm the use of digital media for teaching and learning [15]. Several studies carried out in the United States and the United Kingdom support the application of digital media in various academic fields, focusing on the Arts, Natural Sciences, Mathematics and Statistics [16]. Within these studies they state the use of technology for learning through online discussion forums, general websites, learning management systems, literature review, digital games, wikis, web conferencing software, blogs, general campus software and videos [17]. They have found that these digital educational tools have a positive impact on teachers and students who use them to solve their tasks, provide interest, increased confidence, improved individual attitudes, enjoyment of learning and, above all, improved relationships between teachers and students [18]. In the same way, several studies and educational researchers support the reliability of Bloom's taxonomy, as it offers a set of cognitive skills when applied in real life [19]. In addition, it develops cognitive, affective and psychomotor domain abilities encompassed in the educational learning objectives. These attributes provide intellectual skills and improve behaviour in the learning process [20].

4. Conclusion

Technological tools for educational purposes are a great asset in modern education. They pave the way for the emergence of a new generation of professionals trained to meet the challenges of the current era. Each educational tool has its own characteristic that differentiates it from the rest, which is favourable, as a specific tool can be applied depending on the level of complexity that arises at the time. Educational institutions must adapt to change in terms of methods and ways of teaching and learning, therefore, these 60 tools that are presented are suitable to be implemented in all levels of education and all courses that are taught in academic institutions. This statement is convincing because it has a support of more than 50% according to the study population of 170 participants in total, each of them affirming the educational enhancement that each educational tool entails. However, the way they are used must be taken into account, since they are all developed on a systematic computer, which must have access to the internet, which currently has advantages and disadvantages, since there are malicious platforms, such as social networks and pages with irrefutable content. For these reasons, all points of view must be considered when applying technological tools for educational purposes within educational institutions and at home, teachers and students must be trained before they are applied in the teaching-learning process.

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