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Article

Bibliometric Analysis of the ADDIE Method Using the Scopus Database

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ABSTRACT

The ADDIE method provides a structure that allows for a variety of interactions, such as collaborative discussion forums, practical simulations in a virtual environment, gamified quizzes, interactive videos, and case studies applied to professional and instructional realities, providing the necessary and systematized tools that can be used in various areas of knowledge. The objective of this study was to conduct a bibliometric analysis of the ADDIE Method (Analysis, Design, Development, Implementation, and Evaluation) in the context of Instructional Design. The research was conducted in May 2024, and the data were collected from the Scopus database using the term "ADDIE" to search for articles that contained this term in the title, abstract, or keywords. The search was limited to articles publishedem periódicos. Os . The results obtained show an average annual growth rate of publications on the ADDIE Method of 26.2% in the period from2000 a 2023. The years with the highest number of publications were those following the COVID-19 pandemic, mainly in Asian countries, with the Social Sciences area standing out the most, accounting for 60% of the articles published. The bibliometric analysis showed a growing academic production and the consolidation of the method as a

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reference for the development of effective educational practices, contributing to the understanding and evolution of teaching and learning processes.
Keywords: bibliometrics, instructional design, teaching-learning process.

RESUMO

O método ADDIE proporciona uma estrutura que permite gerar uma variedade de interações, como fóruns de discussão colaborativos, simulações práticas em ambiente virtual, quizzes gamificados, vídeos interativos e estudos de caso aplicados à realidade profissional, de instrução, fornecendo as ferramentas necessárias e sistematizadas que podem ser utilizadas em várias áreas do conhecimento. O objetivo deste estudo foi realizar uma análise bibliométrica a respeito do Método ADDIE (Análise, Design, Desenvolvimento, Implementação e Avaliação) no contexto do Design Instrucional. A pesquisa foi feita em maio de 2024, e os dados foram coletados na base Scopus usando o termo "ADDIE" para buscar artigos que contivessem esse termo no título, no resumo ou nas palavras-chave. A busca foi limitada a artigos publicados em periódicos. Os resultados obtidos mostram uma taxa média de crescimento anual das publicações sobre o tema Método ADDIE de 26,2% no período de 2000 a 2023. Os anos em que ocorreram os maiores números de publicações foram os posteriores à pandemia de covid-19, principalmente em países da Ásia, sendo a área de Ciências Sociais a que mais se destacou, com 60% dos artigos publicados. A análise bibliométrica evidenciou uma crescente produção acadêmica e a consolidação do método como referência para o desenvolvimento de práticas educacionais eficazes, contribuindo para a compreensão e evolução dos processos de ensino e aprendizagem.
Palavras-chave: bibliometria, design instrucional, processo de ensino-aprendizagem.

Introduction

The ADDIE Method is an instructional design (ID) methodology in which the acronym refers to: A – Analysis, D – Design, D – Development, I – Implementation, E – Evaluation. As an instructional modeling system, this method provides tools for building educational programs, designing courses, and even training in non-educational institutions, such as companies or similar organizations (Abuhassna et al., 2024). According to Cunha et al. (2024), in education in its broadest sense or in professional training, instructional design is a planning resource intended to ensure the development of learning activities in a systematic and coherent manner. Regarding this trend, which surrounds non-educational organizations and institutions with regard to the instruction and training of employees, Oliveira et al. (2011) states that:

> "In the age of knowledge, learning organizations are those that value knowledge management, combining modern management practices, people's talents, and technologies. Increasingly, public and private organizations are committing themselves, together with their employees, to the development of their skills, which is directly related to the knowledge assets managed by the organization itself. [...] This allows for the creation of excellent quality products and services, the manifestation of creativity, and the emergence of new talents, transforming risks into opportunities for personal and organizational growth" (Oliveira et al., 2011, p. 4).

The ADDIE method promotes and ensures effectiveness, creating a scenario where the content presented to students is assimilated with almost complete retention (Adeoye et al., 2024). The better the modeling of content and the more effective its presentation to students, the higher the retention rate of what has been transmitted (Reinbold, 2013).

As time goes by, we see more and more the need for and importance of an educational strategy that embraces changes in the global educational landscape, especially in the years following the COVID-19 pandemic. During 2020 and 2021, due to *lockdown* issues, everyone involved in any type of educational system had to adapt and deal with technological and remote means. This caused the modeling of the content being

taught to undergo a change. Previously, activities that were done in person now needed to be adapted and adjusted for the remote system—from instructional design to cybersecurity (Ivada et al., 2024)—in order to maintain the excellence of what was done in person, without leaving gaps in learning and providing security for teachers in what was being taught (Alda, 2023).

To this end, Instructional Design and its methodologies, such as the ADDIE model, with a proven track record of success (González, 2022), provide the necessary and systematic tools for building teaching that starts from the moment of leveling and instruction and achieves favorable results in a diagnostic learning assessment (Branch, 2009). By analyzing bibliometric indicators, it is possible to evaluate academic production (García-Villar & García-Santos, 2021; Joshi, 2014), identify the researchers involved in this production, map the institutions that publish most on the subject, measure the frequency and recurrence with which the subjects are mentioned, and understand the geographical distribution of knowledge (Durieux & Gevenois, 2010).

The use of bibliometrics is essential, as it is the science that uses mathematical and statistical models to analyze scientific production (Goel et al., 2024; Jaramillo et al., 2023; Makda, 2024). Thus, this analysis aims to investigate the evolution of publications in Brazil and worldwide, highlighting trends and the relevance of the model, especially after COVID-19 (Mahat, 2024).

Therefore, the study presented here sought to broaden understanding and promote the continuous evolution of educational processes by emphasizing the relevance of an evidence-based approach to improving teaching and learning practices.

Literature Review

Addie

The acronym ADDIE refers to the systemic process of pedagogical modeling, which stands for Analysis, Design, Development, Implementation, and Evaluation. González (2022, p. 82) points out that "The ADDIE model can be used for various purposes because it provides a structure that allows for a variety of instructional interactions." Each stage of Instructional Design (ID) covers a variety of activities and outcomes that, in a cohesive and integrated manner, support the subsequent phases. If one of these phases is eliminated or poorly executed, it can jeopardize not only the next phase but the entire instructional modeling process.

Oliveira et al. (2011, p. 6) mention that the Analysis phase "comprises the diagnosis of the situation or identification of performance problems that may require training intervention, i.e., this intervention will not always be training." The initial diagnosis determines how a problem will be solved, whether through an instructional methodology, remodeling, or some other means of resolving the issues.

After the Analysis phase, in the Design phase, the learning objectives are defined. In this phase, the content is modeled and learning paths are planned to achieve the highest possible performance of those who are promoting instruction. According to Branch (2009, p. 3), this phase seeks to "conduct an inventory of tasks, compose performance objectives, generate testing strategies, and calculate returns and/or results of the investment." During this stage, the Educational Designer—the professional who works in the Instructional Design ssessment process—anticipates the difficulties that students may encounter in the learning process and develops a path that can solve these problems.

Once the design is complete, the development phase begins. In this phase, all the elements designed and planned in the previous phase will be developed and elaborated. It is the phase in which the design leaves the drawing board and comes to life (Abuhassna et al., 2024). Here, texts, images, questions, tests, quizzes, games, videos, and various learning objects, even the most complex ones, will be elaborated so that the next phase,

Implementation, can take place (Donnelly et al., 2011). Due to its nature, this stage is more time-consuming, as it ranges from the development of production scripts to the analysis of possible difficulties and problems in the process (Gledhill & McAuliffe, 2025).

The Implementation phase is when students, whether from regular courses or training and capacity building, will have access to the content and learning objects, so that they can consume them, deepening their knowledge and, with that, generating indicators for the next phase, which is Evaluation (Lee, 2009). During Implementation, reviews and validations of the production are carried out, in addition to the necessary adjustments to make the produced material available. At this stage, the inclusion of a technical team for execution is indispensable, ensuring that the topic is conducted in a natural and fluid manner (Anthony et al*.,* 2020).

The Evaluation stage is based on the collection of data on the material produced and the efficiency of its applicability. For Horst et al. (2022), this stage:

> "can be carried out during each stage of ADDIE development, as well as at the end of the entire process. This phase highlights improvements and observations that can be implemented and may result in a new ADDIE cycle, based on the analysis of the results. [...] It is important that the 'Evaluation' be plural and continuous, that is, before going live, it must be conducted by the project coordinator and the instructor. During a pilot class, it should be conducted by experts in the topics covered. And afterwards, by the students, using specific forms that assess satisfaction" (Horst et al., 2022 p. 104).

Evaluation serves to validate the quality of the instructional production carried out, in addition to the processes developed before and after implementation (Mohammed, 2021). Classically, evaluation methods are applied in productive and administrative business areas, as well as in the context of qualification measures (Karcher et al., 2023). This comprehensive approach ensures that all aspects of instructional design are considered, from initial conception to implementation and results (Luo et al*.,* 2024). In this way, it is possible to reanalyze the project and remodel content production.

Elements of the ADDIE method can be used in both online and face-to-face projects, as it is a methodology that assists teachers and instructional designers in creating educational products.

Bibliometrics

Bibliometrics is a quantitative methodology that analyzes the production and impact of scientific publications, with the purpose of promoting the advancement and growth of educational research, in addition to highlighting its importance (Souza et al., 2024). The purpose of bibliometrics is to develop indicators to summarize the most productive institutions and authors, recognize the most referenced academics in a specific area of study, and identify the most common research topics and methods (Bailón-Moreno et al., 2006). Bibliometrics uses statistical methods to analyze academic publications, revealing publication trends and relationships between published works (Ninkov et al., 2021).

To this end, when it comes to bibliometrics, certain steps must be followed in order to comply with research guidelines. Table 1 presents the following phases, according to Chueke and Amatucci (2022, p. 286).

Table 1: Steps in preparing bibliometric studies

STEPS	DESCRIPTION
Step	
Define the scope of the study	Identify the objectives of the study. Consider whether the scope is broad enough to conduct a bibliometric study, which focuses on large samples.
Step 2	
Develop the research protocol	Define keywords and establish criteria for including and excluding articles, as well as choosing the databases to be used.
Step 3	
Choose the bibliometric analysis technique to be used	(i) Performance analysis, (ii) science mapping, or (iii) network analysis, among others.
Step 4	
Collect data	Collect and organize the data using categories such as: article title, author(s), journal, year of publication, among others. At this stage, which is still exploratory, it is possible to broaden or narrow the scope of the study by returning to step 2.
Step 5	
Analyze data	Define which software you will use to analyze the data. Check whether there are any duplicate articles in the database.
Step 6	
Present the results	Prepare images, graphs, and tables to present the most relevant results. Present key findings and directions for future research.

Source: research data

When there is no connection between the steps to be followed and the objective to be achieved with these steps, it will be difficult to read the results or even read the wrong data. Data interpretation is a crucial step in research, involving description, comparison with hypotheses, and evaluation of the effect of independent variables (Kite & Whitley, 2018). Without a clear alignment between the methods used and the objectives set, the analysis becomes susceptible to confirmation bias and misguided conclusions (Yanai & Lercher, 2021).

Methodology

Data collection from the Scopus database, available on the Capes Periodicals Portal, was carried out on May 11, 2024, using the term "ADDIE." Articles containing this term in the title, abstract, or keywords were searched for, limiting the search to those articles publishedem periódicos. As . The search expressions with Boolean operators were:

TITLE-ABS-KEY (addie) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (SRCTYPE, "j"))

Information was obtained on the number of articles by country, year, institution, author, field, and journal.

Regarding the temporal analysis, exponential regression equations were obtained for the number of articles (Y) as a function of the year (X), restricting the analysis on to the period from 2000 to 2023. The

period analyzed did not include the year 2024, as data collection was carried out in May 2024 and the number of publications for that year could likely be underestimated, either because the year had not yet ended. Thus, based on these regression equations, the average annual growth rates of publications were calculated (Formula 1).

$$Tx\% = \left\{ \left[\left(\frac{\hat{y}'_{ano\_final}}{\hat{y}'_{ano\_inicial}} \right)^{(ano\_final - ano\_inicial)^{-1}} \right] - 1 \right\} x100\%$$

Formula 1 – Formula for calculating the growth rate based on the values estimated by the exponential regression equation.

Where:
Tx% = average annual growth rate

$\hat{y}'_{ano\_final}$ = number of publications in the final year estimated by the equation

$\hat{y}'_{ano\_inicial}$ = number of publications in the initial year estimated by the equation

ano_final = last year considered for obtaining the regression

$ano\_inicial$ = first year considered for regression

Results and Discussion

After applying the methodology using Boolean operators, 998 articles were obtained, which, after analysis, resulted in the creation of graphs for each bibliometric indicator.

Main Countries

This segment of the research brings together all the information collected on scientific production contained in the Scopus database, as well as all publications associated with the ADDIE method, presented in percentage terms. In addition, Figure 1 compares the leading countries in scientific production, highlighting Brazil's position in this context:

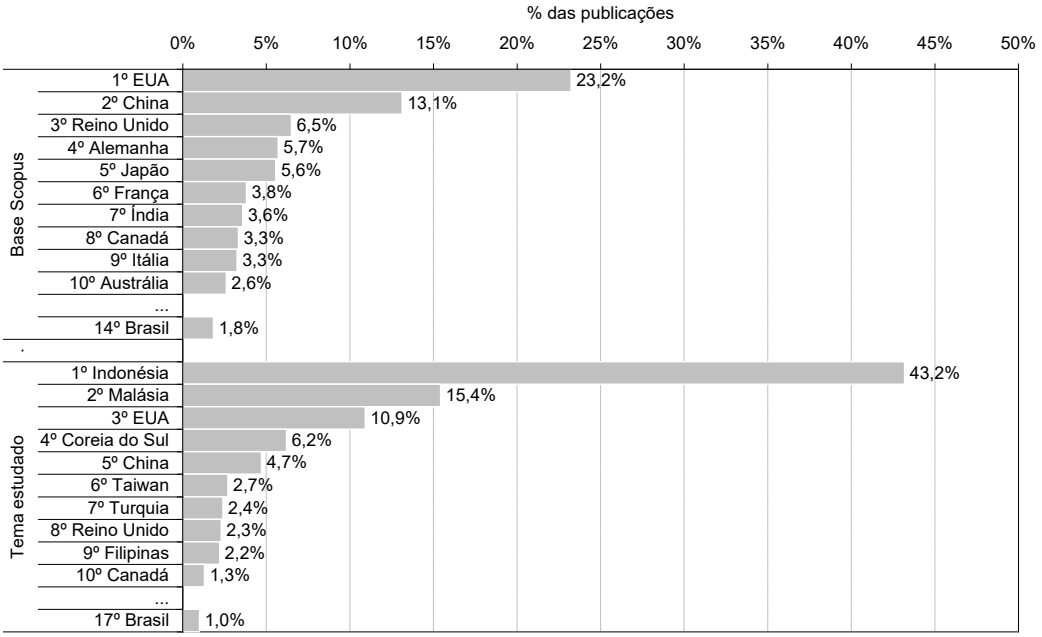

Figure 1: Scientific production of countries in the Scopus database considering all topics and the ADDIE method topic and Brazil's position. Source: research data

According to Figure 1, it can be observed that, with regard to global scientific production, the countries that produce the most are, in descending order, the United States, with 23.2% of all global scientific production, followed by China, with 13.1%, and the United Kingdom, with 6.5%.

When we analyze Brazil's position in global scientific production, specifically in articles present in the Scopus database, we see that Brazil ranks 14th, with 1.8% of the articles in the database. In terms of scientific production, this shows us that Brazil has a long way to go if it seeks to reach higher places in this ranking, because the greater the number of scientific productions, the greater the transmission of knowledge and discoveries, which can guarantee the development of a region, in addition to improving the quality of life.

When analyzing the data related to the topic studied, the ADDIE method, an interesting change can be seen in relation to the countries that produce the most scientific articles on the topic. The three countries that publish the most on the subject are Indonesia, with 43.2% of all publications, followed by Malaysia, with 15.4%, and the United States, with 10.9% of publications.

It is interesting to note that, although the countries that produce the most scientific output in general are developed and considered first world countries, when it comes to scientific output on the ADDIE method of Instructional Design, Asian and emerging countries occupy the top positions. Figure 1 also shows other countries, such as South Korea, with 6.2% of publications on the subject studied, Taiwan, with 2.7%, Turkey, with 2.4%, and the Philippines, with 2.2%. The reason for these figures may be related to the post-COVID-19 pandemic period (2020-2021). The data presented below in this study show the temporal evolution of publications on this subject in these countries.

When we compare Brazil's position in relation to scientific publications on the subject studied, we see that Brazil ranks 17th, with 1% of all scientific publications related to the ADDIE method. According to Andrade and Santos (2020, p. 66), "despite being a relatively new field of knowledge and not so common in pedagogy, it has gained relevance in terms of the development of courses, activities, virtual environments, and teaching resources." This shows us that, in Brazil, there are still not enough scientific publications

demonstrating the importance of the ADDIE method for Brazilian education and its use in Instructional Design.

Temporal Evolution

Figure 2 shows the temporal evolution of all publications worldwide present in the Scopus database, covering all subjects, as well as the global temporal evolution on the ADDIE method in the Scopus database and its respective exponential regression equations.

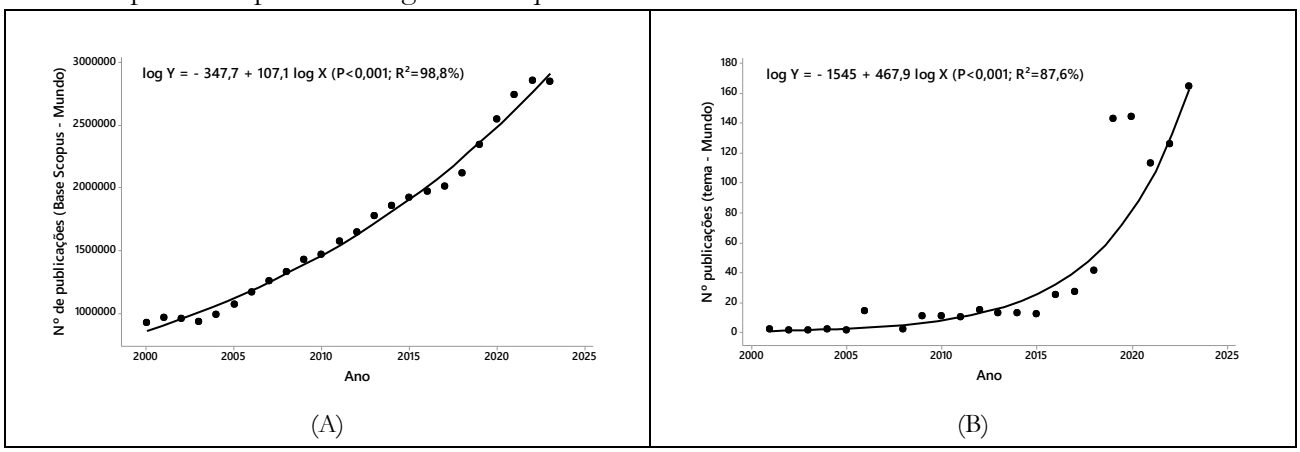

Figure 2: Temporal evolution of the number of publications in the Scopus database considering (A) all topics and (B) the ADDIE method topic. Source: research data

It can be seen that the exponential regression equations were significant (P<0.01), indicating that the temporal evolution of the number of publications per year in the period from 202000 a 2023 is statistically valid. It should also be noted that the coefficient of determination $R^2$was greater than 87%, indicating that the growth in the number of publications per year in the Scopus database is consistent with the exponential regression equations.

When it comes to the number of publications in the Scopus database, we see that there has been an evolution in recent years, from less than 1 million publications before 2000 to nearly 3 million scientific articles published by the end of 2023. When we analyze the evolution, now related to the topic studied, we can see that, worldwide, there were fewer than 20 publications between 2000 and 2005, but currently, there are close to 170 publications at the end of 2023.

Figure 3 shows the percentage impact of this temporal evolution. It illustrates not only the absolute growth in the number of publications over the years, but also how this trend manifests itself in relative terms.

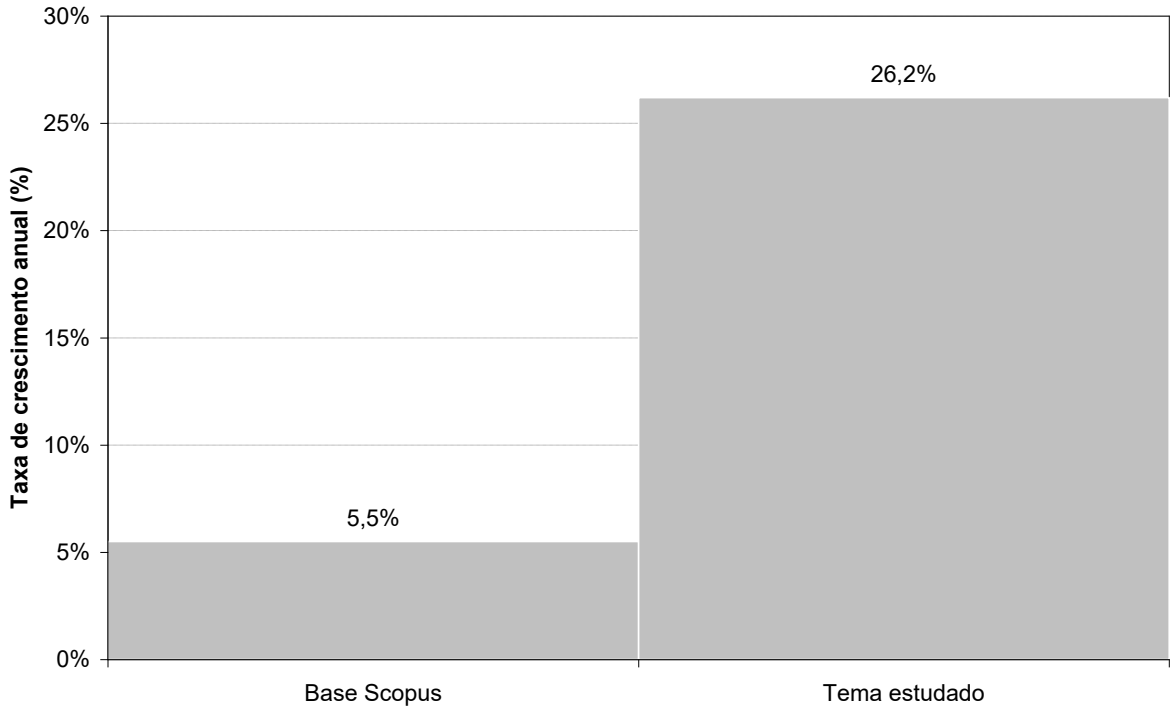

Figure 3: Annual growth rate in the number of publications on all subjects worldwide and annual growth rate in the number of publications on the ADDIE method from 2000 to 2023. Source: research data

This percentage increase highlights the growing importance and relevance of the topic studied within the global scientific community. Figure 3 shows that the annual growth rate of all publications in the Scopus database was 5.5%, compared to the annual growth rate of publications on the ADDIE method, which was 26.2%, allowing for a deeper understanding of how research in this area has advanced in relation to other areas of knowledge.

Comparing Figures 2 and 3, it can be seen that the greatest variation in the increase in publications on the ADDIE method occurred in the years after 2000. One reason for this phenomenon is the COVID-19 pandemic, which, due to social distancing restrictions, caused all forms of teaching to become remote. Since the ADDIE method is mainly used for distance learning methodologies, there has been greater interest and debate about this method, which has been studied and discussed more by the global scientific community. This movement was essential for educational modeling in an unconventional scenario, where educational institutions that had previously been face-to-face had to adjust and adapt their teaching-learning mechanisms to standards that would ensure meaningful learning for students.

Main Institutions

The number of publications related to the ADDIE method is shown in Figure 4. It shows the universities that publish most on the subject and the countries to which they belong.

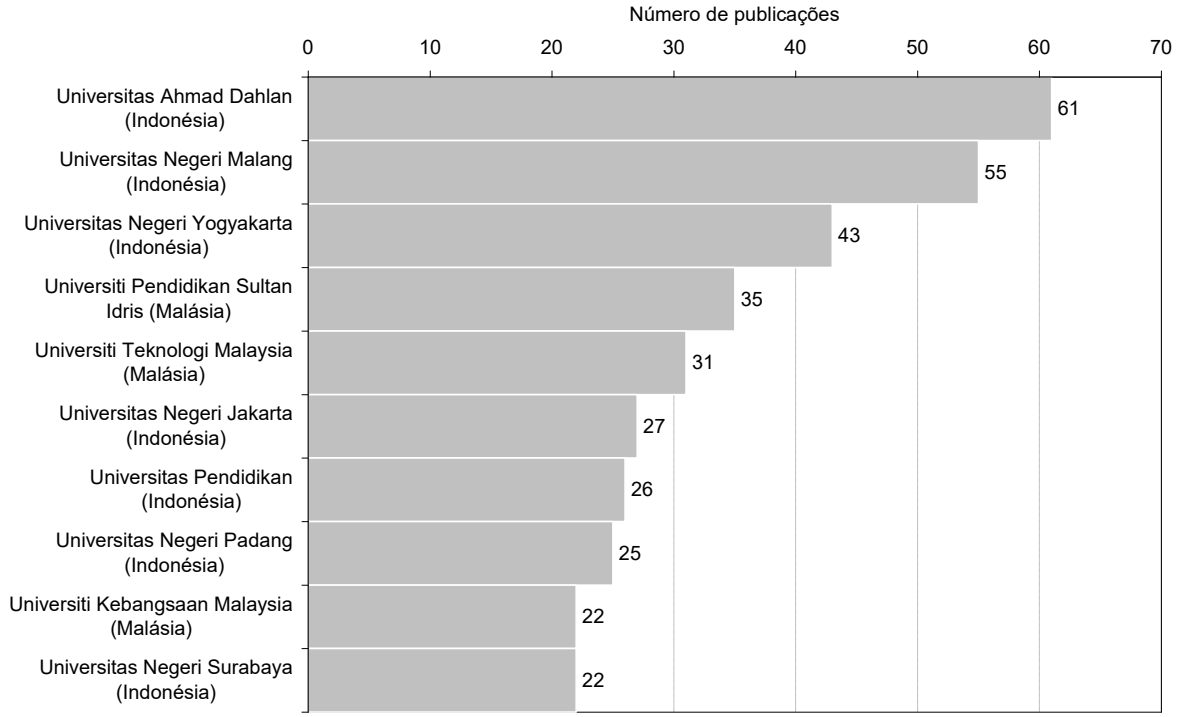

Figure 4: Institutions with the highest number of publications on the ADDIE method in the Scopus database and their respective countries. Source: research data

When analyzing Figure 4, it is noted that among all publications on the ADDIE method in the Scopus database, the ten institutions that contribute the most are from Indonesia or Malaysia. However, when considering the three institutions that publish most on the subject, all are from Indonesia: *Universitas Ahmad Dahlan* leads with 61 publications, followed by *Universitas Negeri Malang* with 55 publications, and *Universitas Negeri Yogyakarta* with 43 publications. This information is quite interesting, raising the question: why do these Asian countries lead in publications on the ADDIE method?

The following item presents a justification for this question, relating the ADDIE method to the content published by the main authors on the subject.

Main Authors

Figure 5 shows that, in line with what was presented earlier, the ten leading authors who have published on the ADDIE method are Indonesian or Malaysian.

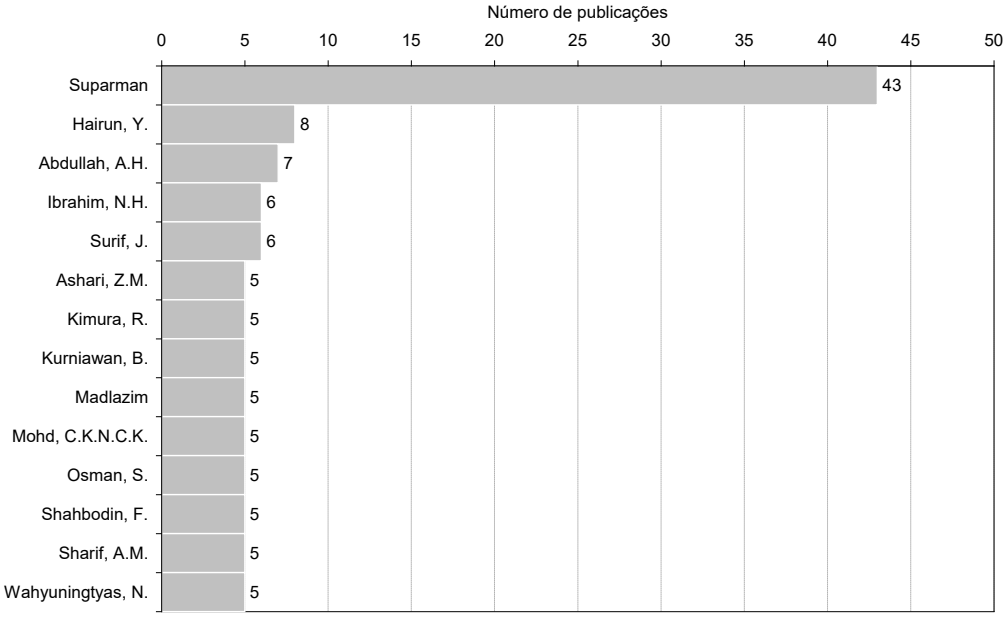

Figure 5: Authors with the highest number of publications on the ADDIE method in the Scopus database. Source: research data

After analyzing the articles by the main authors, we noticed that researchers from the two nations mentioned above have produced numerous publications and studies on the ADDIE method, aiming to research teaching methodologies and strategies that facilitate the learning process, as well as ways of integrating the school and the school community, with a view to maximizing student performance.

Among the universities that publish the most and the authors presented, we observed that the publications show a trend towards improving the teaching-learning process, seeking ways to make it more relevant and disruptive. Among the topics covered, we highlight the study by Hardianto et al. (2023), in collaboration with *Universitas Negeri Yogyakarta,* Indonesia, and other institutions, who published on the topic "Participatory blended learning model: partnership between school and parents."

Also noteworthy is the work of Hairun et al. (2020), entitled "Analysis and design of PBL-based mathematics student worksheets to improve critical thinking skills"; and the work of Prabowo et al. (2023), with the theme "The effect of reading literacy on the mathematical understanding of elementary school students in Indonesia and Malaysia." Problem-Based Learning (PBL) is a teaching approach, an educational strategy, in which students learn to actively engage in projects to solve real problems (Santos; Santiago; Cruz, 2024).

Finally, we can mention the work of Suhendri and Suparman (2019) entitled "Design of a spreadsheet for linear equations based on discovery learning to improve creative thinking," which uses both the mechanisms of Instructional Design based on the ADDIE method and learning methodologies.

Main Areas

Figure 6 shows the main areas to which the ADDIE method is related.

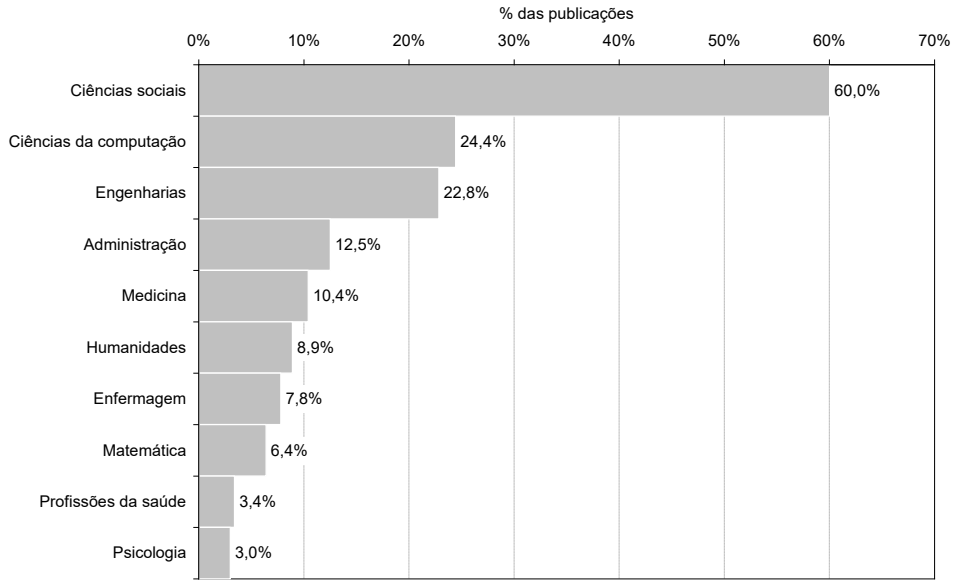

Figure 6: Areas with the highest number of publications on the ADDIE method in the Scopus database. Source: research data

The main areas in which the scientific community publishes on the ADDIE method are predominantly concentrated in the Social Sciences, representing 60% of all publications in the Scopus database. More than half of these publications are directly related to topics such as Education, Pedagogy, and related areas.

In second place is the area of Computer Science, with 24.4% of publications, followed by Engineering, with 22.8%. This is because the ADDIE method was developed as an instructional modeling methodology for Distance Learning, using technologies for lesson design.

Main Journals

Figure 7 shows the main journals in the Scopus database that have published specifically on the ADDIE method or articles that apply this theme to specific research and analysis.

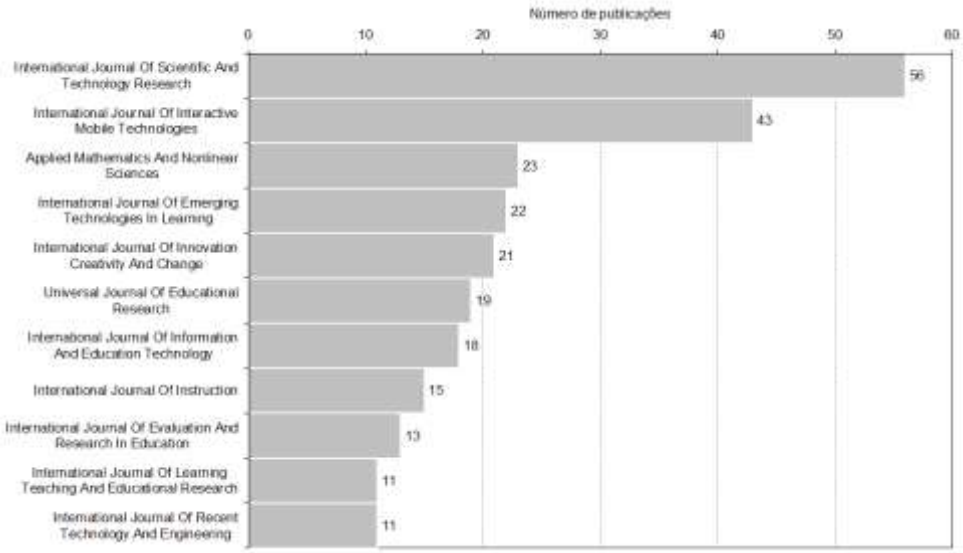

Figure 7: Journals with the highest number of publications on the ADDIE method in the Scopus database. Source: research data

The journals that publish most on the ADDIE method and its applications are, as mentioned earlier, in the fields of Social Sciences, Engineering, and Computer Science. In addition, we note that these journals not

only address specific topics in their respective fields, but also apply the concepts of the ADDIE method in their publications.

It can be seen that the journal that has published the most on the subject worldwide is the *International Journal of Scientific and Technology Research*, with 56 publications. Next comes the *International Journal of Interactive Mobile Technologies,* with 43 publications, and the journal *Applied Mathematics and Nonlinear Sciences,* with 23 publications related to the topic of this work. These numbers demonstrate how much the topic studied is not only essential for instructional work, but also represents an application of a robust and adaptable methodological structure in modern academic research.

Final Considerations

Based on the data analyzed in this study, it is possible to identify a distribution of scientific production, highlighting the United States, China, and the United Kingdom as leaders in overall production, while emerging Asian countries such as Indonesia and Malaysia stand out in research on the ADDIE method. These results are perceived from a systematic analysis of journal publications in the Scopus database. This fact indicates an interesting change in scientific production patterns, where emerging nations are taking on prominent roles in specific areas such as Instructional Design in dealing with issues such as the ADDIE method.

Brazil, although showing progress, has the potential to expand its contribution and scientific impact in this global scenario. The results reveal trends and patterns in scientific research on the ADDIE method, with a higher incidence in the years following the COVID-19 pandemic and in Asian nations, emphasizing its importance and applicability in various educational contexts. The analysis demonstrated an increase in academic production and the consolidation of the method as a standard for the development of effective educational practices, promoting the understanding and advancement of educational processes.

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