Jurnal Cakrawala Pendas
Vol. 11 No. 1, January 2025
DOI: http://dx.doi.org/10.31949/jcp.v11i1.11511

p-ISSN: 2442-7470
e-ISSN: 2579-4442

MAPPING PERSONALIZED LEARNING IN ELEMENTARY EDUCATION: A BIBLIOMETRIC STUDY

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Abstract
This research aims to map the landscape of personalized learning in basic education through bibliometric analysis. The data used in this study was taken from the Scopus database, covering publications from 2004 to 2023. Using bibliometric analysis methods assisted by Vos Viewer, this research explores trends, publication patterns, and key topics that emerge in research related to personalized learning in elementary school level. The study results include 3 major theme clusters, namely Teachers, Schools and Learning Environment. Teachers, schools, and learning environments are three important pillars in a personalized learning approach, complementing each other to create meaningful learning experiences. The teacher acts as a key facilitator who designs learning methods according to the needs of each student. Schools provide policies, infrastructure and systemic support to support the implementation of personalized learning. The learning environment includes physical, social and technological components that encourage students to learn independently and collaboratively. Thoroughly understanding these three components is crucial for developing effective and relevant strategies in advancing personalized learning at the basic education level. Further exploration is needed on technological approaches in personalized learning, case-based research in specific schools, the role of feedback and teacher evaluation. These findings are important for understanding how learning innovations can be more effectively implemented in basic education contexts
Keywords: *Personalized learning; elementary school; teaching*

Abstrak
Penelitian ini bertujuan untuk memetakan lanskap pembelajaran personalisasi di pendidikan dasar melalui analisis bibliometrik. Data yang digunakan dalam studi ini diambil dari basis data Scopus, mencakup publikasi dari tahun 2004 hingga 2023. Dengan menggunakan metode analisis bibliometric berbantuan Vos Viewer, penelitian ini mengeksplorasi tren, pola publikasi, dan topik-topik kunci yang muncul dalam penelitian terkait pembelajaran personalisasi di tingkat sekolah dasar. Hasil studi meliputi 3 cluster tema besar yaitu Guru, Sekolah dan Lingkungan belajar. Guru, sekolah, dan lingkungan belajar merupakan tiga pilar penting dalam pendekatan personalisasi pembelajaran, saling melengkapi untuk menciptakan pengalaman belajar yang bermakna. Guru berperan sebagai fasilitator kunci yang merancang metode pembelajaran sesuai dengan kebutuhan setiap siswa. Sekolah menyediakan kebijakan, infrastruktur, dan dukungan sistemik untuk menunjang penerapan pembelajaran personalisasi. Lingkungan belajar mencakup komponen fisik, sosial, dan teknologi yang mendorong siswa belajar secara mandiri maupun kolaboratif. Memahami secara menyeluruh ketiga komponen ini krusial untuk mengembangkan strategi yang efektif dan relevan dalam memajukan pembelajaran personalisasi di jenjang pendidikan dasar. Eksplorasi lebih lanjut diperlukan pada pendekatan teknologi dalam pembelajaran personalisasi, penelitian berbasis kasus di sekolah-sekolah tertentu, peran umpan balik dan evaluasi guru. Temuan ini penting untuk memahami bagaimana inovasi pembelajaran dapat lebih efektif diterapkan di konteks Pendidikan dasar
Kata Kunci: Personalized learning; sekolah dasar; pembelajaran

Received	: 2024-10-10	Approved	: 2025-01-30
Reviesed	: 2025-01-28	Published	: 2025-01-31

Introduction

In Elementary education, personalized learning has become a popular strategy since it allows teachers to customize lessons to each student's specific needs and preferences (Nandigam et al., 2014). This method has become more popular as researchers and educators see how beneficial it is to accommodate students' varied learning preferences and objectives to improve motivation, engagement, and academic performance. Learner-centered approaches, differentiated education, adaptive technologies, and other tactics are all part of the broad notion of personalized learning (Ellis, B. J. & et all, 2023).

Personalized learning has been the subject of extensive research, with scholars and practitioners recognizing its potential to address the diverse needs and preferences of students. One of the key aspects of personalized learning is its ability to tailor the educational experience to the individual, taking into account factors such as learning styles, prior knowledge, personal interests, and cultural background. It has been demonstrated that using a tailored approach improves student motivation, engagement, academic achievement, and the growth of their critical thinking and problem-solving abilities (Reber, R., 2018). Personalized learning fosters a more inclusive and fair learning environment where students can realize their greatest potential by meeting their individual requirements.

Personalized learning should be used in elementary school because it is the foundation for a child's academic and social-emotional development. In elementary education, personalized learning can help teachers gain a thorough grasp of each student's needs and objectives. This information can then be used to build instructional strategies that are specifically targeted at each student and provide timely feedback and support (Pane, J. F., 2015). Furthermore, the integration of technology has been a key driver in the advancement of personalized learning, enabling the collection and analysis of student data to inform personalized instructional decisions, the development of adaptive learning systems that can tailor content and pace to individual needs, and the facilitation of collaborative and personalized learning experiences (Tetzlaff et al., 2021).

While the benefits of personalized learning are well-documented, the implementation of this approach in elementary education has faced various challenges. These challenges may include the need for specialized teacher training, the integration of personalized learning strategies within the constraints of standardized curricula and assessments, and equitable access to the necessary technological resources (Escuenta et al., 2017). Nevertheless, the growing recognition of the importance of personalized learning in elementary education, coupled with ongoing research and the development of innovative practices, suggests that this approach will continue to play a crucial role in shaping the future of education.

The benefits of personalized learning have been well-documented, with research demonstrating its potential to bridge achievement gaps and foster the development of crucial cognitive and social-emotional skills (Dumont & Ready, 2023). However, the implementation of personalized learning in elementary education settings has faced various challenges, including the need for specialized teacher training, the integration of personalized strategies within standardized curriculum and assessment frameworks, and ensuring equitable access to the necessary technological infrastructure, such as devices, software, and internet connectivity, to support the effective implementation of personalized learning initiatives.

According to (Pontual Falcão et al., 2018), personalized learning is regarded as an excellent strategy that can optimize learner satisfaction and learning effectiveness and increase student motivation, engagement, and awareness. Personalized learning, a sophisticated activity

strategy, is the outcome of self-organization or learning and specialized instruction that considers each student's requirements and objectives. According to (Gómez et al., 2014)., personalized learning has the potential to be a successful tactic for increasing learner satisfaction, learning effectiveness, and learning efficiency. It can also increase motivation, engagement, and understanding. Even though this kind of individualized learning is now achievable, one of the key problems facing contemporary educational systems is still implementing it. This paper offers an overview of the developments made in personalized learning with the use of modern technologies.

In the context of elementary education, personalized learning has gained particular attention, as it holds the potential to support the diverse learning needs of young students. Researchers have emphasized the importance of culturally responsive personalized learning, which recognizes and values the unique backgrounds and experiences of students. By incorporating personalized strategies that are aligned with students' cultural identities and learning preferences, educators can create a more inclusive and engaging learning environment that empowers students to thrive. For both teachers and students, a calm and cozy learning environment is essential to good teaching and learning. This is a result of the majority of pupils' time being spent in class. For student to effectively gain knowledge, teachers must be more creative and imaginative in their application of teaching and learning approaches or strategies (Che Ahmad et al., 2017).

Personalized learning has existed for several years in the form of tutoring and guidance. Before the end of the 19th century, when educational technology began to emerge, personalized learning programs created a rigid learning environment. Within Big data and educational analysis are becoming increasingly important in this day and age to improve instruction that is frequently personalized (Shemshack & Spector, 2020). According to (Niknam & Thulasiraman, 2020), the educational community has expressed interest in a personalized learning system that modifies the curriculum, pedagogy, and learning environment to suit the requirements and preferences of individual students. A personalized learning system can overcome the drawback of one-size-fits-all methods in technology-enabled learning systems by adapting to the needs of various learners. The idea is to have a learning system that can give personalized learning by dynamically adapting to the demands and features of each individual learner. Not only are human one-on-one teachers capable of doing this, but computer technologies can now do it as well.

A specific example or case study to contextualize the importance of personalized learning in elementary schools in Indonesia is Sekolah Cikal. They applies a personalization approach by giving students the freedom to design their own batik uniform models and express themselves through hairstyles. This approach aims to encourage students to develop their interests and talents, as well as carry out a more complete learning reflection process. Apart from that, Personalize Learning is also implemented in Forest Schools, England. This program offers an alternative approach that supports children learning in an outdoor environment. By allowing children to learn at their own pace without pressure to meet certain standards, this approach helps build emotional resilience and self-confidence.

However, the existing literature also highlights the complexities and challenges associated with the implementation of personalized learning, such as the need for comprehensive teacher training, the effective integration of technology, and the alignment of personalized learning with broader educational goals and policies. The present study aims to contribute to this growing body of research by providing a comprehensive bibliometric analysis of personalized learning in the context of elementary education. So the aims on this study to

identify trends and patterns in personalized learning research in elementary schools. Specifically, this study seeks to identify trends and patterns in personalized learning research in elementary schools, including the most studied topics, the evolution of the concept, and the geographic regions where the most research has been conducted. Furthermore, this study aims to uncover key areas of focus such as the role of teachers, the integration of technology, and curriculum design tailored to individual student needs. Bibliometric analysis provides valuable insights into leading researchers, institutions, and countries actively contributing to this field, offering a deeper understanding of global contributions and revealing opportunities for collaboration among researchers or institutions. By mapping the current landscape of personalized learning research, this study aims to highlight gaps in the literature and inform future research directions to support the effective implementation of personalized learning in elementary education.

Research Methods

This research uses a bibliometric approach to map developments and research trends on personalized learning in elementary education during the period 2004 to 2023. The bibliometric approach is a quantitative method used to analyze academic literature through data collected from bibliographic databases such as Scopus. Bibliometric analysis is widely used in academic research because it allows for a systematic and objective exploration of large volumes of scholarly publications, enabling researchers to uncover trends, patterns, and gaps in the literature (Donthu et al., 2021; Zupic & Čater, 2015). This method is particularly useful for understanding the development of specific research fields and identifying influential works, authors, and institutions.

A literature search was conducted using keywords related to personalized learning and elementary education. Selecting appropriate keywords is a crucial aspect of bibliometric studies to ensure dataset relevance and comprehensiveness. The chosen keywords were based on initial literature review and consultation with subject matter experts to capture essential concepts of personalized learning and its implementation in elementary education. The keywords employed include Personalized Learning, Elementary Education, Primary Education, and Individualized Instruction. Boolean operators (AND, OR) and truncation techniques were utilized to broaden the search while maintaining specificity. The data was gathered from Scopus due to its extensive coverage of high-quality, peer-reviewed research publications. Analyzing the connection among researchers, institutions, and keywords was facilitated by the use of bibliometric software, specifically VOSviewer. VOSviewer enables the visualization and interpretation of bibliometric networks, including co-authorship, keyword co-occurrence, and citation patterns, offering profound insights into the structure and dynamics of the research field.

Result and Discussion

This research produced eightmapping data about personalized learning in research over the last 20 years. First, Number of publications each year. International publications regarding personalized learning in elementary school began in 2004 and experienced dynamic movement from year to year, as seen in graph 1. The highest peak number of publications occurred in 2023 with 19 documents. A significant increase also occurred from 2018 to 2020.

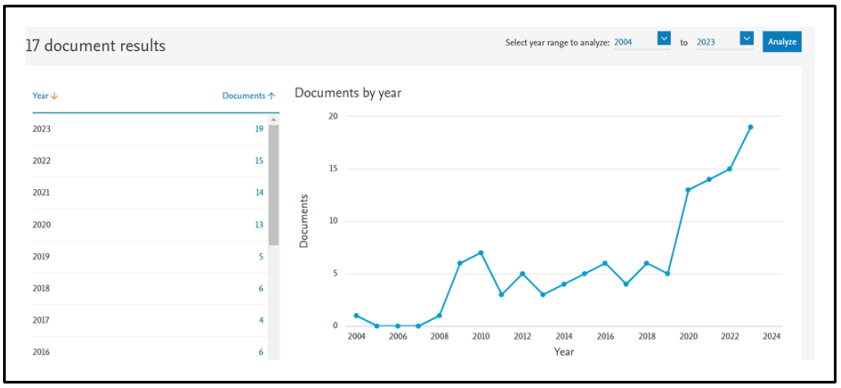

Figure 1. Number of publications each year on personalized learing in Elementary School

The year 2023 has the highest number of publications on the record due to possible reasons such as those, the following:

The Greater Emphasis on Personalization of Learning: The COVID-19 pandemic (2020–2022) motivated the educational system to turn digital, which became argumentative for the emergence of research in personalization learning as a result of technology being a part in the education process. Investment in research: Many a country, including Taiwan, is likely to allocate the funds to be larger and innovative education during and after the pandemic.

The introduction of new policies: The countries with the high education system might introduce the new policy or curriculum which will emphasize the personal learning and thereby will be promoting more research in this area. Second, The most researched subject in the publication personalized learning in elementary school. The most researched subject in international publications on personalized learning in elementary school is Social Sciences with a percentage of 36.7%. In addition, another subject that is quite widely researched is Computer Science with a percentage of 28.1%, followed by Engineering at 12.9%.

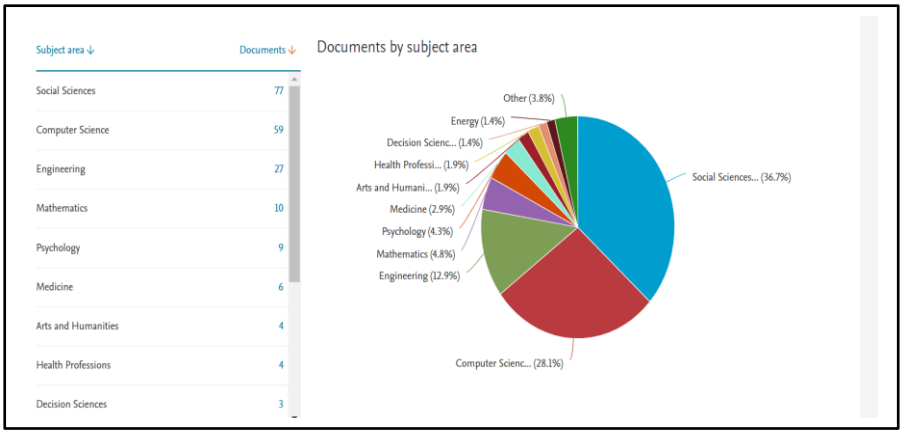

Figure 2. The most researched subject in the publication personalized learning in elementary school

Third, Published Document Type. In the research on the publication personalized learning in elementary school, the types of documents that are often published are articles (54.7%) and conference papers (28.2%), Conference review 8.5%.

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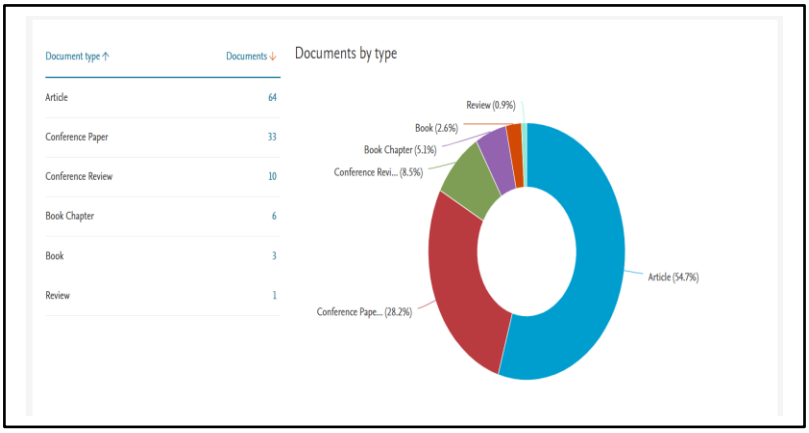

Figure 3. Published Document Type on the publication personalized learning in elementary school

Fourth, Countries that are productive in publishing research. The country that has published the most research on the publication personalized learning in elementary school is the United States with 29 documents, followed by Taiwan 28 documents, and China 9 documents.

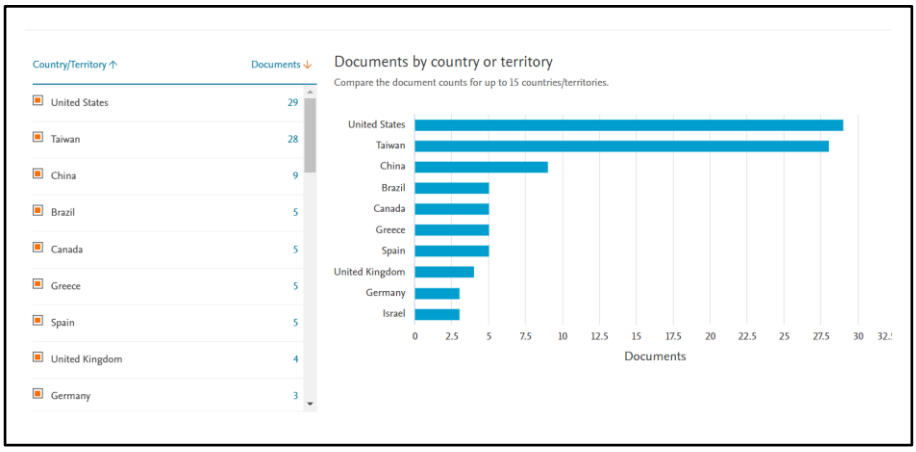

Figure 4. The country that has published the most research on the publication personalized learning in elementary school

Taiwan dominates publications related to personalized learning because Taiwan has a very competitive education system and supports innovation. The Taiwanese government often encourages research collaboration in the field of educational technology. So they have the resources to develop and integrate personalized learning technology in education. From cultural factors, Taiwan which values education and innovative learning is the main driver. Parents, schools, and educational institutions in Taiwan are often open to the adoption of new technologies.

Fifth, Author Affiliation Based on the data, the top three research institutions that publish their research most frequently are the National University of Taiwan, National Taiwan University of Science and Technology, and Soochow University Taipei. All three campuses come from Taiwan, showing the author's enthusiasm for writing about personalized learning in elementary schools. Authors from Taiwan may also be more likely to engage in international collaborations with countries that share similar interests in educational technology.

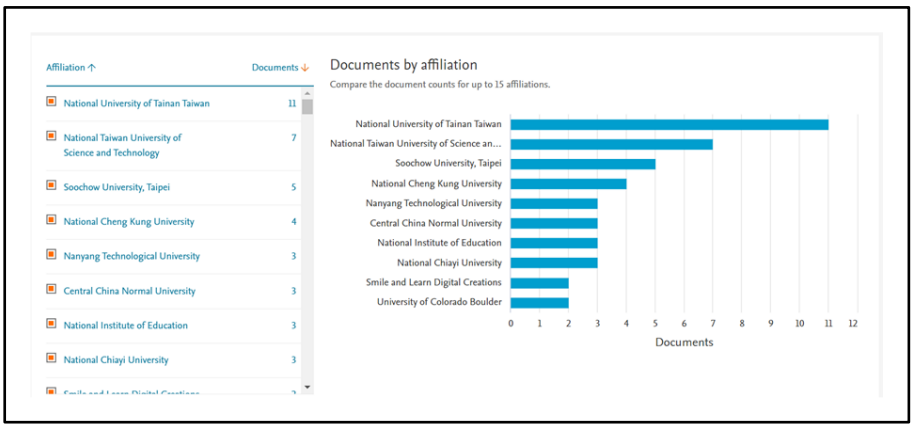

Figure 5. Author Affiliation on the publication personalized learning in elementary school

Sixth, Document per year, The number of documents each year based on international published sources on the publication personalized learning in elementary school. Based on the graph, it can be seen that the highest number of published documents on the topic is in 2023 with 6 documents on Computer and Education. From 2014 to 2022 with 4 documents on ACM International, and From 2014-2022 with 4 documents on Bristish Jpurnal of Educational Technology.

Figure 6. The number of documents each year based on international published sources on the publication personalized learning in elementary school

Seventh, The author with the highest number of topics on the publication personalized learning in elementary school. The authors with the highest number of publications belong to 3 authors namely Hwang G.J with 11 documents, Chu, HC with 9 documents , and Tsai. C.C with 4 documents.

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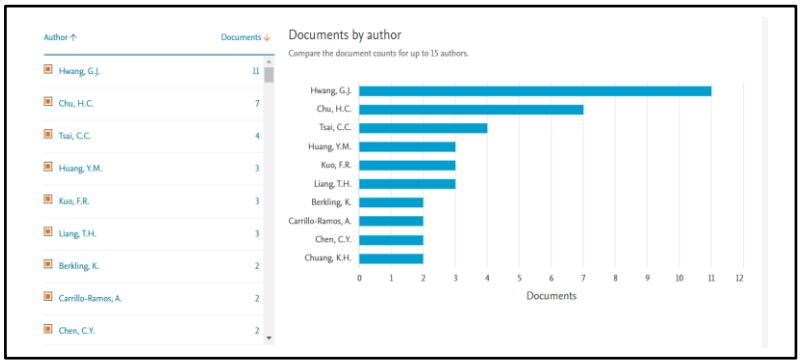

Figure 7. The highest number of topics on the publication of Personalized Learning in elementary school

Eighth, Map of Publication Theme. Based on study keywords linked to the publication personalized learning in elementary school, three sets of publication themes were identified via Circles Network Visualization using the VOS viewer program. The following are the themes that are covered.

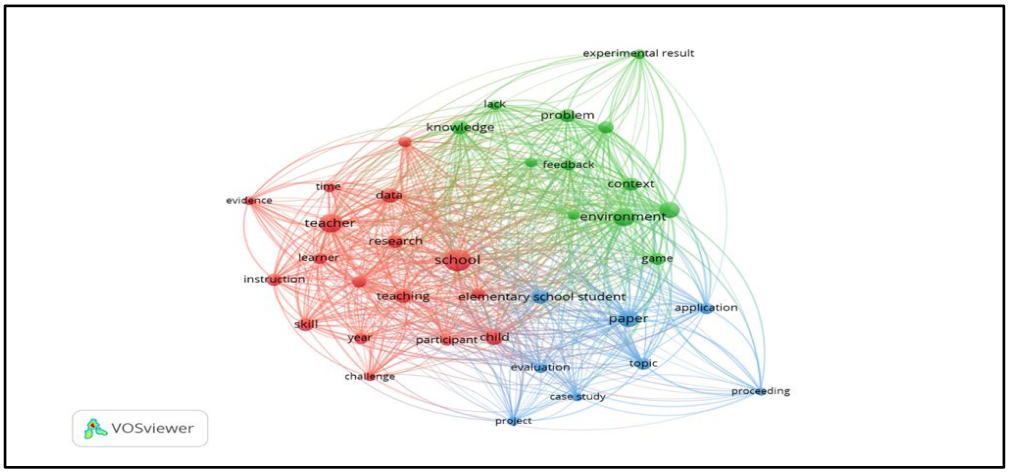

Figure 8. Network Visualization

Frequently occurring words displayed in lighter colors and larger sizes indicate the topics most frequently discussed in the research. Some dominant keywords are: Teacher, School, and Environment. This shows that the role of teachers in personalized learning is widely discussed in research. School, this refers to the institution that is the primary context for research on personalized learning. Environment, Personalized learning is often associated with a learning environment that supports or adapts to individual student needs.

Other relevant keywords: Feedback, issue, learner, ability, and context are a few more that are commonly used. This demonstrates that the study concentrates on critical components like learning feedback, skill development for students, and issues and difficulties with implementing individualized learning. The connections among these terms suggest that school environments, instructor roles, and student participation are major research topics in personalized learning. The relationship between concepts like teaching, learner, and instruction shows how important pedagogy and teacher-student interaction are to the successful application of individualized learning.

Additional investigation of tech-based individualized learning strategies. Keywords like application, game, and experimental outcomes (experimental results) show that technology has entered the conversation, albeit it's possible that it hasn't been thoroughly explored in relation to personalized learning. How technology applications or game-based learning might better enable personalized learning could be the subject of future research.

Implementation challenges are detailed in Key words like "challenges" and "problems" suggest that there are multiple obstacles or gaps in the individualized learning process. Future studies could look more closely at the particular difficulties that teachers or students have while using this strategy and how to get beyond them. The terms assessment and feedback draw attention to how crucial feedback is to the process of individualized learning. However, more investigation might be needed to determine which kinds of feedback work best for fostering the growth of specific students.

The case-based study using the keywords in specific schools Case studies and projects demonstrate how frequently case-based research may be employed as a methodology. Prospects for further investigation can involve expanding case studies in other cultural or geographical situations to observe differences in the use of individualized learning.

The phrase "teacher and student" is used frequently to interpret the interaction between teachers and students, suggesting that the link between teachers and students is emphasized in the context of individualized learning. Subsequent investigations may examine how these relationships' dynamics can enhance instruction that is customized to meet the needs of each individual student.

Overall, these results show that teachers, learning settings, and instructional problems are major subjects of interest in studies pertaining to individualized learning in basic education. However, opportunities for further research could be more focused on technological aspects, feedback innovation, and more specific challenges in implementation.

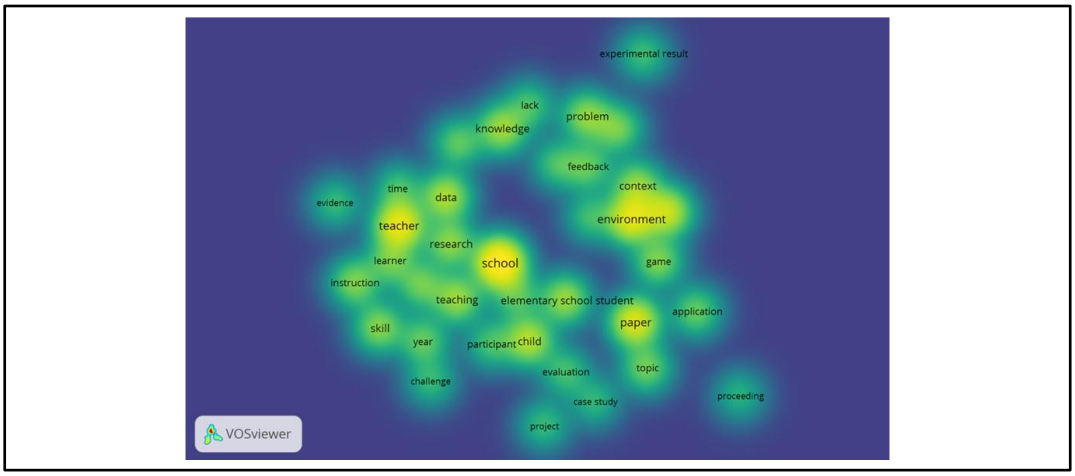

Figure 9. Visualization Map of Vos Viewer

Using the VOS viewer program, Figure 9 displays the density representation of the bibliometric analysis results. The study theme's density is displayed in vivid yellow in this graphic. The more vibrant the hue, the more study has been done on the theme; the fainter the color, the less research has been done on the theme. The darkly hued themes—The Teacher's Role in Personalized Learning, Games Integrated Into Personalized Learning—and the terms "evaluation" and "feedback" imply that more investigation is necessary to ascertain the effectiveness of personalized learning implementation. Further research endeavors could focus

on the effective quantification and evaluation of personalized learning as well as the use of feedback to improve students' learning outcomes.

This study maps advances and research trends on individualized learning in basic education from 2004 to 2023 using a bibliometric approach. Specifically, VOSviewer allows researchers to construct and visualize bibliometric networks, which can reveal various insight. about the structure and evolution of a research field(Al Husaeni & Nandiyanto, 2022). By utilizing VOSviewer, researchers can analyze the relationships between various publications, authors, and keywords, leading to a deeper understanding of the dynamics and developments within a particular area of study. To conduct the analysis, publication data was collected from various academic databases, such as Google Scholar, using relevant keywords related to personalized learning and primary education (Ellis, B. J. & et all, 2023).

The purpose of this study is to ascertain publishing trends of individualized learning in elementary schools in Scopus from 2004 to 2023. Three significant clusters were identified by the research's findings: the teacher, school, and environment concepts. Based on existing research data, research so far discusses the role of teachers in developing personalized learning with learning instructions, evidence, and paying attention to several factors such as time. According to (Ober et al., 2023), personalized learning has surfaced as a potentially effective strategy for meeting the various needs of students in the classroom. With this method, a thorough understanding of each student's particular learning needs is given first priority, and instructional strategies are customized to fit those needs. Teachers are key players in personalized learning, therefore it's important to look at how they see themselves and how they operate in this form of education.

Four essential functions—empowerers, scouts, scaffolders, and assessors—were identified by a recent study that examined instructors' roles in individualized learning settings (Bishop et al., 2020). Teachers are empowerrs; they give kids ownership, choice, and voice so they can participate actively in their education. Using their in-depth knowledge of each student to pinpoint their particular learning requirements, interests, and strengths, teachers also take on the role of scouts. Another important aspect is scaffolding, which is giving pupils the right amount of assistance to help them reach their learning objectives. Teachers also act as assessors, tracking students' progress and modifying instruction through a range of formative and summative evaluations.

The second theme is school, the findings in this study found that personalized learning is widely researched in elementary schools with the research focus being students. The varied variety of qualities exhibited by primary school kids can have a major impact on their learning experiences and outcomes. It is essential to acknowledge and address these individual variances in order to create tailored learning strategies that meet the specific requirements of every student (Pane, J. F., 2015). The varied variety of qualities exhibited by elementary school students can have a major impact on their learning experiences and outcomes. It is essential to acknowledge and address these individual variances in order to create tailored learning strategies that meet the specific requirements of every student.

Elementary school students are diverse individuals with a wide range of interests, talents, and backgrounds (Stumm, 2021). For instructors, this diversity in student traits offers both possibilities and challenges. In the past, schools have frequently made an effort to handle this variability by classifying and dividing up pupils based on their academic standing in order to customize instruction to each student's level. Nevertheless, studies have shown that these tracking strategies might have unforeseen effects, as they might unintentionally restrict the

educational options open to students in lower-performing groups, thereby aggravating already-existing disparities and impeding the general academic development of all students (Dumont & Ready, 2023).

Students need psychological and pedagogical support to succeed in personalized learning; it has been found that the emotional and psychological support of teachers is an important factor in the academic success of students (Tapalova, 2018). A student-centered approach that facilitates their varied needs and skill development is referred to as personalized learning (Lee, 2018). The system creates instructional materials and individualized learning strategies for students with particular traits and interests (Makhambetova et al., 2021).

The third theme is environtment, which is a crucial role in the academic and personal development of elementary school students. A positive and supportive learning environment can enhance students' motivation, engagement, and academic achievement (Amali, 2023). Educators should strive to create an environment that caters to the unique needs and preferences of young learners. Personalized learning is one strategy for establishing a favorable learning environment for elementary school pupils. This method highlights how crucial it is to customize the educational process to each student's particular requirements and preferences, taking into account aspects like their age, gender, financial situation, and cultural background.

The incorporation of environmental-based learning is another essential component of the learning environment. This method gives students the chance to engage in meaningful and meaningful interactions with their surroundings by acknowledging the classroom and the larger school environment as essential learning resources. The learning environment needs to be continuously modified and changed to the circumstances, learner goals, interests, talents, and basic knowledge. It also needs to be modified to reflect the learner's growing body of information and skills. According to (Bahçeci & Gürol, 2016), personalized learning is a technology that supports student-centered learning. A contemporary approach to using digital technologies for individualized learning was described by Swiss scientists. The widespread use of digital technologies in the learning environment characterized by open learning methods is an important aspect of personalized learning as it positively affects both the assessment of digital skills and ICT-related beliefs by learners (Schmid & Petko, 2019).

At the basic education level, personalized learning is often in new languages or through certain technological approaches. More complex studies on teacher-student interactions, including aspects of feedback, tend to be conducted more at secondary or higher education levels. The lack of specific literature on discussing teacher feedback in elementary schools is the result. Research on personalized learning is devoted to technological aspects only, namely, digital platforms, artificial intelligence (AI) algorithms, and learning analytics. Technology is considered an important element to provide a personalized learning experience. Because of this, there are many theories where the role of the teacher who provides feedback is often ignored, for example by technology.

The suggestions for future research, such as on technological approaches in personalized learning, Case-based research in selected schools, The role of teacher feedback and evaluation. Future research will continue to develop, there is a need for further research on the integration of technology used in personalized learning. The rapid development of information communication technology has made it possible to personalize learning through the implementation of intelligent learning systems, integration of learner preferences, and analysis of individual learning data (Xie et al., 2019).

Conclusion

Based on bibliometric analysis of Scopus data from 2004 to 2023 regarding personalized learning in elementary schools, it was found that the number of publications on this topic increased significantly, especially from 2018 to 2020. Then in 2023, there were the most publications on this topic on Scopus. Research on this topic involves various fields of science, such as social sciences, computers, and engineering. The country that publishes the most research on Personalization in Elementary Schools is Taiwan.

There are three main themes in this research, namely teachers, schools and the environment. Vaguely colored themes require more in-depth study as a reference for further research. This study shows that there is a need for further studies to explore personalized learning with the help of technology, research on feedback from teachers to students, and also challenges in personalized learning in elementary schools.

Here are a few sentences of suggestions for further research based on this study: 1) Future studies should address efforts to integrate advanced technological tools, for example, platforms via AI at a higher level to improve the implementation of personalized instructional learning in elementary schools. 2) Case-based teaching experiences, drawn from schools or regions, provide futures with a deeper knowledge of the practical challenges and opportunities in personalized interactive learning. 3) Further research may need to be conducted to explore teacher feedback and evaluation behaviors in terms of creating effective personalized learning experiences for students. 4) Examining the interrelationships as physical, social and technological factors in learning models may open up options for creating new ways to educate through practice without guidance and flippaborty groups among students. 5) Long-term studies can be undertaken as explanatory models of the long-term implications of personalized learning approaches on student outcomes and teacher effectiveness in primary education.

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