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Measuring the quality of adaptive environments in instruction based on student perceptions

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ABSTRACT

Adaptive learning has been identified as a means of creating a student-centered environment that is more fulfilling in multiple aspects. Such an environment prioritizes the facilitation of students' interests in learning. The present study employs quantitative research methods to measure the quality of the adaptive learning environment at Wahid Hasyim Junior High School, as perceived by 144 students, using factor analysis techniques. The findings reveal several factors that are integral to the adaptive learning environment. Firstly, student interaction is deemed crucial, emphasizing interactive and personalized elements. Secondly, teachers' course delivery of learning is determined by design, models, strategies, and resources, with media use having a lesser impact. Thirdly, contextualized content and engaging instructional techniques are key factors in discovering and organizing learning materials. Finally, collaboration support is recognized as an essential factor. These conclusions can inform educational improvement initiatives at Wahid Hasyim Junior High School.

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ABSTRAK

Pembelajaran adaptif telah diidentifikasi sebagai cara untuk menciptakan lingkungan yang berpusat pada peserta didik yang lebih memuaskan dalam berbagai aspek. Lingkungan seperti ini memprioritaskan fasilitas minat peserta didik dalam belajar. Penelitian ini menggunakan metode penelitian kuantitatif untuk mengukur kualitas lingkungan belajar adaptif di SMP Wahid Hasyim, seperti yang dipersepsikan oleh 144 peserta didik, dengan menggunakan teknik analisis faktor. Temuan penelitian ini mengungkapkan beberapa faktor yang menjadi bagian integral dari lingkungan belajar adaptif. Pertama, interaksi peserta didik dianggap penting, dengan penekanan yang signifikan pada elemen interaktif dan personal. Kedua, penyampaian pembelajaran oleh guru ditentukan oleh desain, model, strategi, dan sumber daya, dengan penggunaan media yang memiliki dampak yang lebih kecil. Ketiga, konten yang kontekstual dan teknik pembelajaran yang menarik diidentifikasi sebagai faktor kunci dalam penemuan dan pengorganisasian materi pembelajaran. Terakhir, dukungan kolaborasi diakui sebagai faktor penting. Kesimpulan-kesimpulan ini memiliki potensi untuk menginformasikan inisiatif peningkatan pendidikan di SMP Wahid Hasyim.

Kata Kunci: *Lingkungan adaptif; pembelajaran; pendidikan; persepsi peserta didik.*

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INTRODUCTION

The concept of adaptive environments is becoming increasingly relevant in a rapidly urbanizing and interconnected world. This approach involves a variety of technological advancements, including smart homes that can automatically regulate temperature and lighting and smart cities that can respond to real-time traffic and air pollution. The potential benefits of this approach are numerous, including increased efficiency, sustainability, and comfort for all. As such, the development of adaptive environments represents a promising future for urban areas and will likely play an increasingly important role in shaping how we live and work. According to Thaariq & Surahman (2021), within the context of educational technology, it is crucial to enable the learning process through the teacher's facilitation, particularly in an adaptive teaching and learning environment with a connectivism paradigm (Slamet & Kuswandi, 2017).

In the context of learning, an adaptive environment refers to creating a supportive and flexible learning environment that caters to the individual needs of learners. It acknowledges that every learner is unique, with their own set of abilities, preferences, and learning styles (Kusworo et al., 2021). Educators can provide an inclusive and practical learning experience by adapting the learning environment. According to Soltani and Izquierdo (2019), effective learning in complex environments necessitates the ability to differentiate between insignificant alterations in the surroundings (expected uncertainty) and those that indicate significant occurrences (unexpected uncertainty). The authors describe the equilibrium between adaptability, which involves swift responses to environmental changes, and precision, which entails gradual updates to enhance accuracy after each feedback, as the balance between adaptability and precision. This balance is crucial for successful learning in complex environments.

Adaptive learning environments are designed to offer personalized information to learners through self-directed learning (Ulfa et al., 2020). These environments are tailored to the individual needs of learners, providing them with customized learning experiences based on their unique learning styles, preferences, and abilities, according to a preprint paper titled "*The Construction Model of Inculcating Principal Humanistic Values in Forming a Characteristic School Environment*" by Effendi et al. Adaptive learning environments have become increasingly popular in recent years as they offer a more efficient and effective way of delivering educational content (Huang et al., 2021; Kabudi et al., 2021; Saleem et al., 2022). By providing learners with personalized information, adaptive learning environments can help to improve learning outcomes and enhance the overall educational experience. As such, they are an essential tool for educators and learners (Normadhi et al., 2019). For example, adaptive learning can be used to improve the flipped classroom experience in online environments, to recommend learning materials based on students' collaboration and user modeling, to provide personalized content recommendations in personalized learning environments, to support dyslexic students' learning style preferences in virtual learning environments, and to construct dynamic learner profiles and automatic learner classification in adaptive e-learning environments (Alamri et al., 2021; Siripongdee et al., 2020; Surahman & Surjono, 2017). One specific example of adaptive learning technology in identifying learners is using adaptive educational games based on recommendation strategy and learning style identification based on a proceeding paper titled "*Adaptive Educational Games Based on Recommendation Strategy and Learning Style Identification*" by Imanian et al.

According to the proceeding paper titled "*Analysis of Learners Characteristics and Learning Process Preferences During Online Learning*" by Thaariq et al., adaptive learning may involve a teacher or instructor who observes and assesses the needs, preferences, and abilities of each student and adjusts the learning experience accordingly (Retrieved from https://www.atlantis-press.com/proceedings/icite-20/125948731). This approach may also involve peer-to-peer collaboration and feedback, where students learn from each other and provide constructive criticism (Jiang et al., 2022). These strategies may involve a teacher or instructor who observes and assesses each student's needs, preferences, and abilities and

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adjusts the learning experience accordingly. Peer-to-peer collaboration and feedback can also be used, where students learn from each other and provide constructive criticism. Additionally, these strategies may involve using problem-based learning, a student-centered approach that involves presenting students with real-world problems that require critical thinking and problem-solving skills. This approach allows students to learn at their own pace and provides opportunities for personalized learning (Benedicto & Andrade, 2022; Mustaro & Silveira, 2006).

The current state of the art in educational research underscores the growing importance of adaptive learning environments. Previous studies have emphasized the significance of personalization in education, highlighting how tailored learning experiences can enhance retention and engagement. Furthermore, integrating adaptive learning technologies, driven by artificial intelligence and algorithms has gained momentum for its potential to improve learning outcomes and efficiency. Collaborative learning and problem-based approaches have also emerged as effective strategies, with peer-to-peer interaction and real-world problem-solving at the forefront. However, a critical gap remains in the absence of standardized metrics for evaluating the quality of adaptive environments from students' perspective, posing a pivotal question in contemporary educational research.

The article "Measuring the Quality of Adaptive Environments in Instruction Based on Student Perceptions" makes a significant scholarly contribution by focusing on measuring adaptive learning environments' quality based on student perceptions. This contribution addresses a gap in the existing literature. It raises research questions regarding measuring adaptive environments' quality from students' perspectives, enhancing students' learning experiences through personalization, collaboration, and problem-based approaches in adaptive environments, and the factors that influence their effectiveness.

LITERATURE REVIEW

The term "adaptive environment" refers to an environment that can modify or adjust itself following the needs of its users. Furthermore, it may also indicate the capacity of an organism or system to acclimate to changes in its surroundings. The concept of "adaptive" is associated with the notion of general, which traditionally denotes the ability to adapt to the environment. However, it remains uncertain whether general intelligence provides an optimal means of defining intelligence as an adaptation to the environment (Sternberg, 2019). According to a paper titled *"What is an Adaptive Environmentally Induced Parental Effect*" by Lacey et al., a comprehensive understanding of the adaptive features of the environment is essential for comprehending the intricate development of traits and the interdependent relationship between genes and the environment in shaping diversity, shown in **Figure 1**.

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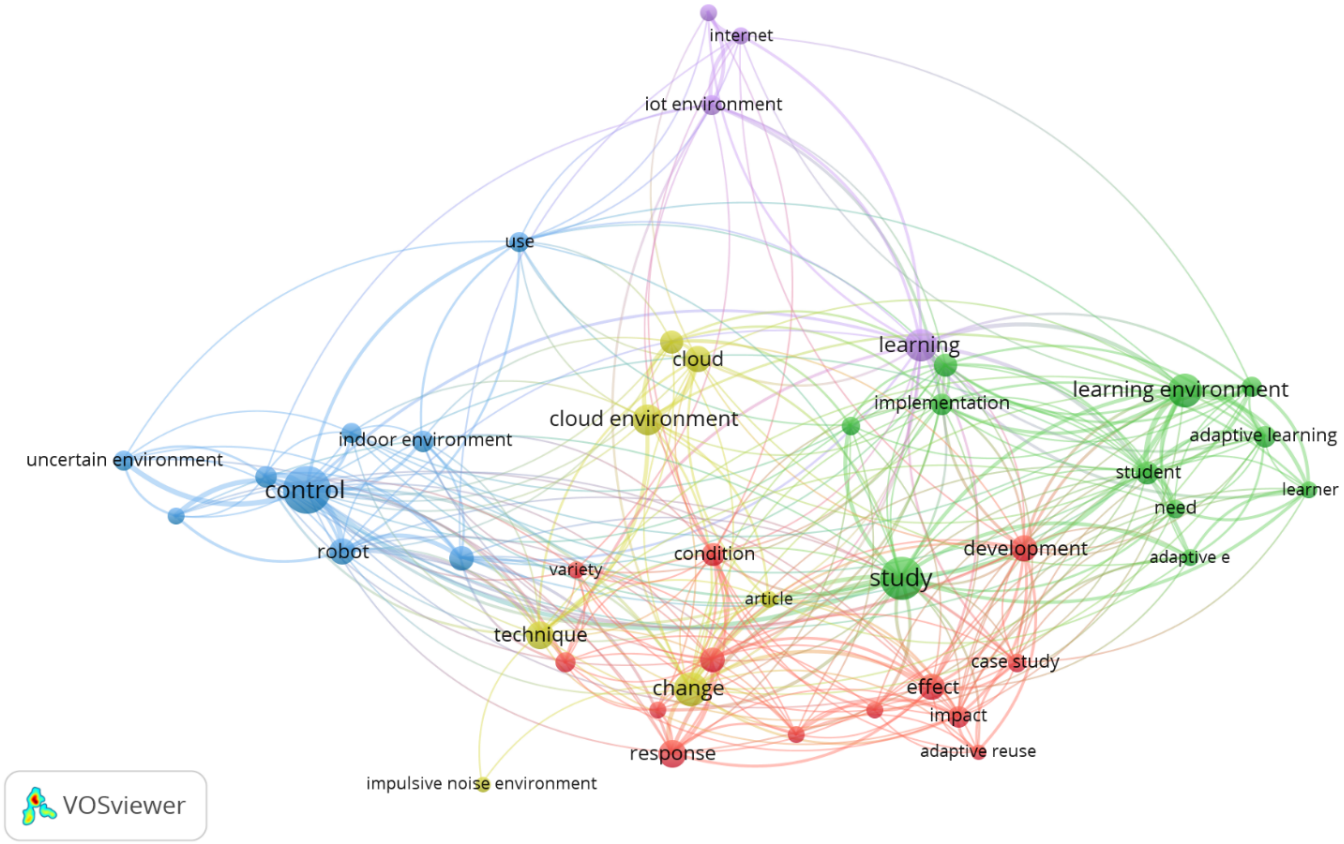

Figure 1. Distribution of Adaptive Environment research in the last five years
Source: VOS Viewer

Soltani and Izquierdo (2019) argue that successful learning requires mechanisms to discriminate inconsequential outcomes from those that reflect fundamental environmental changes. They refer to these two types of uncertainty as expected and unexpected uncertainty. Expected uncertainty refers to the range of typically experienced outcomes, while unexpected uncertainty reflects fundamental environmental changes. This is important because learners have different learning styles, cognitive traits, learning goals, and varying learning progress over a period, which affects their performance while providing the same bundle of courses to all learners. This adaptation can be done based on learner context parameters, such as their location, device, and time of day, as well as on the learning content (learning object) and the configuration of the learning environment (Premlatha & Geetha, 2015).

A model of adaptive systems for mathematical training of students within the eLearning environment (Toktarova, 2022). The model includes a sequence of operations and actions focused on achieving the learning outcomes, such as diagnostics and detailing of personal student's characteristics, designing a student model based on personal student's characteristics and preferences, differentiation and selection of educational technologies, resources, and teaching methods depending on personal student's characteristics and preferences, formation and provision of an individual learning path to a student, and assessment and analysis of student performance. The results of a pedagogical experiment on using the adaptive system for the mathematical training of students within an e-learning environment in the educational process of a higher educational institution showed that the model effectively improves students' mathematical skills.

Another study by Sabry et al. (2021) investigated the effect of interaction between presentation patterns of the infographic (static/animated) and the learning styles (global/sequential) in an adaptive learning environment on the development of programming skills of secondary school students. The results showed a positive effect of such interaction between the patterns of the infographic and the learning styles in an

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adaptive learning environment to boost the programming skills of secondary school students and the efficiency of the adaptive electronic learning environment in providing content to each student.

An online flipped classroom with adaptive learning suggested positive changes in the following: classroom environmental perceptions, preference for flipped instruction, perceived responsibility imposed, motivation for independent learning, and perceived learning. Furthermore, there was a significant decrease in the proportion of students who experienced load, burden, or stressors in the online flipped classroom when adaptive learning was available versus not (Clark et al., 2022)—the impact of an adaptive e-learning environment based on learning styles on the development of students' engagement. Using adaptive eLearning technologies allows students to improve their learning knowledge and further enhance their engagement in "skills, performance, interaction, and emotional (El-Sabagh, 2021). It was also stated by Olmos-Gómez (2020) analyzed the impact of learning environments and psychological factors, and the data demonstrated that learning environments differ according to the degree studied. Those more used to physical exercise showed more positive psychological indices. Females reported more negative psychological indices than males.

The studies revealed that adaptive learning systems promise to improve students' skills, engagement, and overall educational experience. Toktarova (2022) and Sabry et al. (2021) demonstrate the effectiveness of adaptive systems in enhancing specific skills, while Clark et al. (2022) highlight their positive impact on classroom environment and motivation. El-Sabagh (2021) underscores their potential to increase student engagement, although their influence on learning outcomes may be limited. Olmos-Gómez (2020) also emphasizes the importance of considering diverse learning environments and psychological factors, particularly in unique contexts like the COVID-19 pandemic. Overall, these studies suggest that adaptive learning systems have the potential to impact various facets of education positively, but their implementation should be context-specific and consider individual differences.

The findings of these investigations demonstrate that adaptive learning systems can enhance competencies, involvement, and holistic educational encounters. Nevertheless, their execution necessitates the consideration of particular circumstances and individual disparities. Furthermore, the research underscores the significance of considering students' perspectives when assessing the caliber and efficacy of adaptive learning settings, which can furnish a more comprehensive and profound comprehension of the factors that determine the triumph of adaptive learning environments.

Thus, this research is necessary because it seeks to measure the quality of the adaptive environment in learning based on students' perceptions. The study stands out by focusing on collecting and analyzing student perceptions as a primary means of assessing the quality and efficacy of these adaptive instructional contexts. This student-centric perspective offers a distinct and valuable dimension to the evaluation process, as it delves into learners' subjective experiences and viewpoints, which often elude traditional objective metrics. By prioritizing student perceptions, this research seeks to provide a more comprehensive and nuanced understanding of the determinants of successful adaptive learning environments and their potential for further enhancement, ultimately contributing to advancing instructional design and educational quality assessment in the context of adaptive learning environments.

METHODS

This research uses a quantitative approach to elaborating topics that are presented measurably. This process tends to design systems that use mathematical models and quantitative analyses to guide the design process (Chang & Chang, 2001). Describing a trend implies that the research inquiry can be most effectively addressed through a study that aims to determine the general inclination of responses from individuals and to observe the extent to which this inclination differs among individuals. This approach is particularly useful when attempting to identify patterns or changes in behavior or attitudes over time.

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According to the book titled "*Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research*" by Creswell, by analyzing the overall trend, we can gain valuable insights into the underlying factors that contribute to the observed phenomenon and develop more nuanced and accurate explanations of the observed patterns.

We used a survey approach in the dissemination of the data. Surveys can be conducted in various ways, such as through online questionnaires, phone interviews, or in-person interviews. The purpose of a survey is to gather information about a particular topic or population, and the data collected can be used for various purposes (Ponto, 2015). In this context, an online survey was employed to gather data from a representative sample of 144 Wahid Hasyim Junior High School students. The questionnaire was distributed to the entire population of students at the school in a random manner (random sampling).

Upon acquisition of the data, we proceeded to analyze it through the utilization of factor analysis. Factor analysis is a statistical technique that enables the reduction of a large number of variables into a smaller number of clusters, known as factors. This method involves computing the correlations among all the variables and identifying groups of variables that exhibit high inter-correlations but weak correlations with other variables. The factors identified are then used as variables rather than the individual items within the factors. According to a book titled "*Educational Research: Competencies for Analysis and Applications*" by Gay et al., factor analysis facilitates the analysis of complex data sets by producing a manageable number of factor variables. This approach is widely used in various fields, including psychology, sociology, and marketing research. In this context, we used it in the field of education.

RESULTS AND DISCUSSION

The author's data collection yielded a sample of 144 students, comprising 64 in grade 9, 36 in grade 8, and 44 in grade 7. This sample size enabled the research to be conducted with greater depth and rigor. Data analysis revealed several intriguing findings that could enhance comprehension of the situation. The distribution of the student data is depicted in the accompanying illustration. Shown in **Figure 1**.

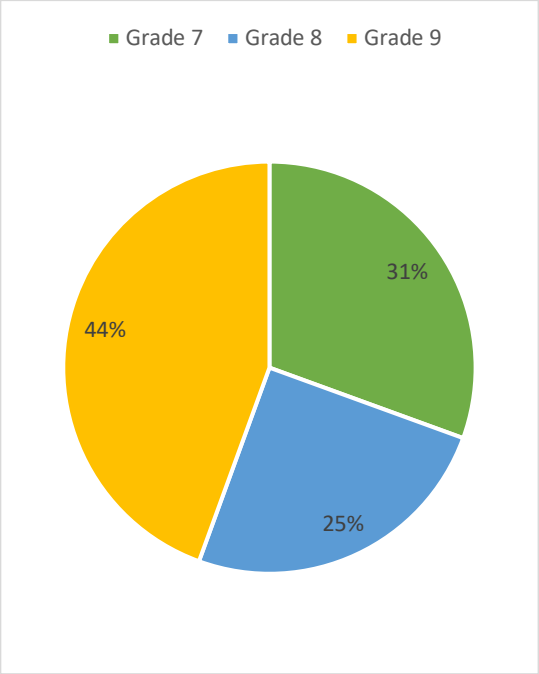

Figure 2. Data distribution by Grade
Source: Private Document

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This article examines the adaptive environment framework proposed by Paramythis and Loidl-Reisinger (2003), which comprises four key components: interaction, course delivery, content discovery and assembly, and collaboration support. The framework aims to create effective and adaptive e-learning environments capable of monitoring user activities, interpreting these based on domain-specific models, inferring user information by the server based on interaction monitoring information, and tailoring the interface to automatically tailor itself to each user. The framework also emphasizes the importance of standardization for e-learning to enable the transfer of adaptive learning material to new systems and facilitate adaptively supported, distributed learning activities (Laroussi, 2012; Vandewaetere et al., 2011).

The interaction between students and the learning environment is paramount in an adaptive learning environment. This encompasses how students engage with learning materials, instructors, and peers. Paramythis & Loidl-Reisinger (2003) posit that adaptations occurring at the system interface are designed to facilitate or support user interaction with the system without altering the learning "content" itself. The authors identify two components of interaction, namely communication, and content. Communication is viewed from two perspectives, namely interactivity and personal proximity. According to the proceeding paper titled "*Multimedia Presentation Development Training for Vocational School Teachers*" by Degeng, on the other hand, content is perceived through the elements of multimedia. Multimedia comprises various components, including images, text, audio, video, and animation (Wiggins & Shiffer, 1990).

To describe the perceptions of students at Wahid Hasyim Junior High School regarding interactions in the adaptive environment, presented in **Table 1** and **Table 2** below:

Table 1. Interaction Level based on Eigenvalues

Factor	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	3.713	53.048	53.048
2	1.212	17.312	70.360
3	0.698	9.969	80.329
4	0.499	7.133	87.462
5	0.348	4.977	92.439
6	0.290	4.147	96.586
7	0.239	3.414	100.000

Source: Research Document 2023

Table 2. Interaction Factor Analysis

Variables	Factor	
	1	2
Interactive	**0.866**	0.123
Personal Proximity	**0.819**	0.244
Text	**0.790**	0.174
Image	**0.623**	0.486
Audio	0.304	**0.739**
Video	0.251	**0.833**
Animation	0.072	**0.865**

Source: Research Document 2023

The present study employed factor analysis to examine students' perceptions at Wahid Hasyim Junior High School regarding interactions in the adaptive environment described in **Table 1** and **Table 2**. The results revealed two factors that accounted for the variation in the data. The first factor had eigenvalues of 3.713 and explained 53.048% of the variance, while the second factor had eigenvalues of 1.212 and explained 17.312% of the variance. Together, these two factors accounted for 70.360% of the total variation in the data. Table 2 displays the relationship between the variables in the adaptive environment

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and the two factors. The first factor comprised interactive, personalized proximity use of text and images, while the second factor used audio, video, and animation.

Adaptive environments are a significant area of focus in course delivery. Such environments can modify the delivery of course material based on a student's understanding and ability level. For instance, if a student has already grasped certain concepts, the adaptive environment can expedite or simplify the material delivery to that student (Rachmayanti, 2022). The delivery of course material is structured and comprises various components, including designs, models, strategies, methods, media, and learning resources.

To see the factor analyses that provide significant insights into the course delivery of learning by teachers based on students' perceptions, presented in **Table 3** and **Table 4**:

Table 3. Course Delivery Level based on Eigenvalues

Factor	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	3.574	71.481	71.481
2	0.548	10.965	82.445
3	0.377	7.532	89.977
4	0.272	5.441	95.418
5	0.229	4.582	100.000

Source: Research Document 2023

Table 4. Course Delivery Factor Analysis

Variables	Factor
	1
Design	0.853
Model	0.865
Strategy	0.894
Methods	0.815
Learning Resource	0.796

Source: Research Document 2023

The present study examines the factor analyses presented in **Table 3** and **Table 4**, which provide significant insights into the course delivery of learning by teachers based on students' perceptions. The results of Table 3 indicate that a single factor accounts for the majority of the variance in the data, with a total value of 3,574 and a percentage of the variance of 71.481. This factor encompasses various aspects, including learning design, models, strategies, and resources, collectively shaping students' perceptions of how teachers deliver learning. However, this factor does not include the media variable because its commonalities value is below the 0.50 threshold. This suggests that media use in learning may not significantly influence students' perceptions of teachers' learning delivery, highlighting an area for further evaluation and improvement in teaching methods.

Adaptive environments have the potential to assist students in discovering content that is tailored to their individual needs (Thaariq & Wedi, 2020). This may encompass suggestions for supplementary content, assignments, or resources pertinent to the student's subject matter (Murtadho et al., 2022). Furthermore, the learning material can be dynamically generated or personalized following the student's progress. Content discovery generally refers to the process of finding and identifying relevant content, while content assembly involves organizing and presenting that content in a meaningful way. These terms are often used in the context of digital content creation and curation (Despotović-Zrakić et al., 2012). This instance comprises three distinct elements: educational content, teaching materials, and instructional techniques (Paramythis & Loidl-Reisinger, 2003). Learning material that is interesting and contextualized can enhance students' engagement and understanding of the subject matter. Contextualized learning material refers to

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content that is relevant to students' lives and experiences, making it easier for them to connect with and apply the concepts they are learning (Saptiyah et al., 2023; Napiah, 2022; Rizaldi et al., 2021). Interesting learning material can capture students' attention and motivate them to learn (Saptiyah et al., 2023; Basit et al., 2022; Novrida & Refelita, 2021). Furthermore, the teaching materials that have been developed must be fully utilized and integrated with digital technology. This will ensure that the educational resources are effectively disseminated and accessible to a broader audience. Integrating digitalization will enhance the delivery of the teaching materials, making them more interactive and engaging for learners. Educators must embrace technology in the classroom to keep up with the ever-evolving landscape of education. Therefore, utilizing and integrating developed teaching materials with digitalization is crucial for advancing education (Annuš et al., 2023; Zavodchikova & Bykova, 2021). Instructional techniques also should provide a sense of satisfaction and interactivity from students. Instructional techniques should provide a sense of satisfaction and interactivity from students because they have been found to enhance learning outcomes and motivation. Research studies have shown that learner-centered instruction, multimodal presentation systems, serious gaming and gamification instructions, collaborative learning techniques, and blended teaching strategies and materials are effective in increasing learning effectiveness, satisfaction, and motivation (Yang et al., 2022; Haruna et al., 2021; Kuo et al., 2013).

To see the context of content discovery and assembly about materials, teaching materials, and instructional techniques, presented in **Table 5** and **Table 6**:

Table 5. Content Discovery and Assembly Level based on Eigenvalues

Factor	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	2.792	69.808	69.808
2	0.521	13.023	82.831
3	0.432	10.803	93.634
4	0.255	6.366	100.000

Source: Research Document 2023

Table 6. Content Discovery and Assembly Factor Analysis

Variables	Factor
	1
Contextualized material	0.820
Interesting Material	0.826
Satisfaction with Instructional Techniques	0.882
Interactivity Techniques used	0.812

Source: Research Document 2023

The results of the factor analysis presented in Tables 5 and 6 demonstrate that only one significant factor was identified in the context of content discovery and assembly pertaining to materials, teaching materials, and instructional techniques. This factor had a total value of 2.792 and accounted for approximately 69.808% of the total variance in the data. This suggests that elements such as contextualized and engaging materials, satisfaction with instructional techniques, and interactivity of techniques were interrelated in students' perceptions. However, it is noteworthy that teaching materials and the digitization process were not included in this factor due to their commonalities values falling below the 0.50 threshold. This implies that teaching materials may not significantly impact how students evaluate instructional materials or techniques, warranting further investigation to enhance the quality of learning.

Collaboration among students can be a valuable means of enhancing the learning experience in specific contexts (Suhaimi & Permatasari, 2021). Adaptive environments can further facilitate such collaboration by offering a range of tools and features that promote student interaction and cooperation. These tools

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may include discussion forums, collaborative projects, or other resources enabling students to work together to achieve their learning objectives. By leveraging these adaptive technologies, educators can create a more dynamic and engaging learning environment that fosters student collaboration and teamwork, ultimately leading to improved learning outcomes. The present collaboration encompasses three distinct forms of collaboration: team, community, and network. These forms of collaboration are characterized by their unique features and modes of operation. Based on the reference *Proceedings of the ACM on Human-Computer Interaction 6* (see: https://dl.acm.org/doi/10.1145/3512895) titled "*A "Distance Matters" paradox: Facilitating intra-team collaboration can harm inter-team collaboration*" by Xinlanemily, team collaboration can be facilitated by various tools and techniques, such as collaboration software, project management tools, and team-building activities. Additionally, adopting team-based competencies for interprofessional collaboration can help support the collective efforts of team members to deliver optimal care within complex settings (McLaney et al., 2022). Community collaboration involves individuals and organizations working to address issues or achieve shared goals within a specific community. It can occur in various contexts, such as community development projects, healthcare initiatives, or environmental conservation efforts (Susilo, 2022; Calancie et al., 2021; Zhang et al., 2020; Jang et al., 2009). Network collaboration involves working with individuals or organizations across different networks or systems. It can occur in various contexts, such as research collaborations, supply chain management, or disaster response efforts (Lerner & Hâncean, 2023; Zhang et al., 2020; Song et al., 2019).

To see the context of collaboration support based on student perceptions, described in **Table 7** and **Table 8**:

Table 7. Collaboration Support Level based on Eigenvalues

Factor	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	1.949	64.974	64.974
2	.731	24.381	89.355
3	.319	10.645	100.000

Source: Research Document 2023

Table 8. Collaboration Support Factor Analysis (Source: Private Document)

Variables	Factor
	1
Team Collaboration	0.790
Community Collaboration	0.901
Network Collaboration	0.717

Source: Research Document 2023

The results of factor analysis presented in **Table 7** and **Table 8** indicate that only one significant factor was identified in the context of collaboration support based on student perceptions. This factor had a total value of 1.949 and accounted for approximately 64.974% of the total variance in the data. The variables included in this factor, namely team collaboration, community collaboration, and network collaboration, suggest that students perceived significant support for collaboration in various contexts. These findings provide a basis for further exploration of ways to enhance the aspects of collaboration identified in this factor analysis to enrich students' learning experience.

CONCLUSION

This study employed factor analyses to explore students' perceptions of various educational aspects at Wahid Hasyim Junior High School. The findings revealed valuable insights into four key domains. Firstly, in the interaction section, two factors emerged, highlighting the importance of interactive and personalized

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elements alongside multimedia components like text, images, audio, video, and animation. Secondly, when course delivery of learning by teachers, a single dominant factor encompassed learning design, models, strategies, and resources, although media use did not significantly impact student perceptions. Thirdly, regarding content discovery and assembly, one significant factor emphasized the importance of contextualized and engaging materials and satisfaction with instructional techniques, with teaching materials and digitization playing a less influential role. Lastly, in collaboration support, a single factor identified significant support for collaboration in various contexts. These findings offer valuable insights for educators and administrators aiming to enhance the educational experience at the school.

In conclusion, this study sheds light on the multifaceted aspects of education at Wahid Hasyim Junior High School, emphasizing the importance of tailored and interactive learning environments, effective teaching strategies, and collaborative opportunities. While these insights provide a strong foundation for educational improvements, they also underscore the need for further investigation into specific areas, such as media use and teaching materials, to continually enhance students' education quality.

The present study evaluates the quality of the adaptive environment in teaching at Wahid Hasyim Junior High School. The findings indicate that the quality of the adaptive environment can be considered reasonable. Factor analysis reveals that interactive elements, personalization, and various media, including text, images, audio, video, and animation, are crucial in creating an adaptive learning environment that aligns with students' perceptions. However, there is room for improvement in media utilization in learning delivery to better meet students' expectations. Furthermore, while aspects of learning delivery by teachers and content discovery and organization are of good quality, further attention is required regarding media use in adaptive learning. Consequently, the results of this study provide a positive outlook on Wahid Hasyim Junior High School's efforts to develop an adaptive environment based on students' perceptions.

AUTHOR'S NOTE

The authors declare that there is no conflict of interest related to the writing or publication of this article. This article is purely the fruit of the author's thoughts by adapting several reinforcing references so that the data and content in this article are free from plagiarism.

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