Wearable technology (smartwatch) as an innovative learning support media post-COVID-19 pandemic

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ABSTRACT

Post-COVID-19 pandemic, the world of education has undergone significant changes in the learning process, especially in the use of technology. The research examines the use of smartwatches to support innovative and exciting learning processes. The main objective of this research is to find out the teacher's understanding of the potential and how to use smartwatches in the learning process. The research also analyzes the significant relationship between the teacher's understanding of the subject and the use of smartwatches in the classroom by using quantitive methods. The research approach used is quantitative. Respondents from secondary and high school teachers who participated in the study were 51 teachers from private and state schools. Data analysis shows that smartwatches can be an innovative and enjoyable learning support medium. The use of smartwatches increases involvement, thus enriches the learning experience, and encourages an independent search for information. Smartwatches can also help students increase their confidence in expressing their ideas and creativity, especially when writing learning reports and other tasks. The study also shows that there is a challenge in integrating smartwatches into education, namely, teachers need to understand the potential and how to use smartwatches that can help to develop the student's knowledge through creating an innovative learning medium.

INTRODUCTION

Education is an effort that has a purpose to mature humans through teaching and training until it could affect the attitudes and behavior of a person or group (KBBI, 2024). The main purpose of education is to help students to develop themselves into smart and good individuals. The process This process can be done in various ways, one of which is providing students with interesting learning experiences to make them more motivated to improve their learning outcomes (Zabir, 2018). The use of different media has become an important and inevitable part of today's learning process, as it allows for a diverse learning experience and increases students' interest in learning. Meanwhile, the media referred to various forms and types, which can provide the potential to increase the effectiveness and efficiency of learning (Daryanto, 2015).

The word "media" from Latin means intermediary or introducer (Sadiman, et al, 2018). Learning media refers to everything that is used to convey the content of the lesson by stimulating thinking skills, processing emotions, increasing students' attention and abilities, and allowing

students to participate enthusiastically in learning (Ibrahim & Syaodih, 2003). By using learning media, the teaching and learning process is more interesting and efficient. It also could impact the students' quality (Widodo & Jasmadi, 2008). In the post-COVID-19 pandemic era, challenges in education are becoming increasingly complex, demanding innovation in teaching methods, especially the use of technology in learning in order to increase student learning interest (Andriani et al, 2024).

The role of teachers in learning has an important task to teach and educate students. Teachers need to consistently improve their competencies until they can help students face challenges in the digital era. This is by Law Number 14 of 2005 of the Republic of Indonesia Article 8 regarding the competencies that teachers must have, namely personal, pedagogical, social, and professional competencies. The indicator of pedagogical competence is the ability to utilize various technologies as learning media. Therefore, teachers need to develop their abilities, in terms of skills and, until they can develop innovative learning mediums that solve the challenges in this digital era (Sitompul, 2022). The COVID-19 pandemic that occurred made many students experience problems in the form of mental health, physical health, and student concentration in learning. Health problems are related to excessive anxiety which makes students feel stressed and depressed (Liang et al, 2020). One of the anxieties that occur is due to the lack of physical activity carried out by students (Okuyama et al, 2021). Not only that, many students experience problems in participating in the process due to a lack of focus and involvement in the learning process (Isha & Wibawarta, 2023). Therefore, in the post-Covid-19 pandemic era, the world of education is facing a significant paradigm shift. The pandemic has forced educational institutions around the world to adapt to more flexible teaching methods by using advanced technologies, such as the use of wearable technology, which has emerged as a potential educational tool (Fauziyyah, 2019).

The use of wearable technology and smartwatches in learning shows the potential to improve student learning outcomes by providing a more engaging experience for students (Syafi & Kurniawati, 2023). Thus, the use of wearable technology emerges as an innovative solution that allows educators and students to go beyond the boundaries of traditional learning. The use of technology as a medium in learning provides real-life experiences through simulations, interactive games, and the use of virtual reality technology, which are difficult to present in traditional learning. By using these tools, teachers and students have full freedom to learn anytime and anywhere and get access to relevant and up-to-date information. With this freedom, teachers and students are more eager to gain new knowledge and understanding that can be used in the learning process. In addition, wearable technology helps in tailoring learning methods to the individual needs of each student. By collecting real-time data on how students learn, educators can customize their approach to meet diverse learning needs. This is important to support students with different ways of learning and ensure that every student gets an optimal learning experience (Tanjung & Namora, 2022).

Wearable technology, such as smartwatches, Fitbits, fitness trackers, augmented reality (AR), and virtual reality (VR) can also be used in the learning process. By utilizing wearable technology devices, such as smartwatches, students can measure heart rate, count the number of steps taken, calculate calories burned, know the level of stress experienced, etc. The use of smartwatches in everyday life can be used to track students' physical activity and integrate it with science or health lessons. It also could provide a practical understanding of concepts such as heart rate and physical health. Through the experience of measuring heart rate, counting the number of steps, and calories burned, students are invited to learn through real-life experiences that are interesting and fun until it helps students in providing new knowledge and understanding (Sadikin, 2019). This development is driven by the need to create learning methods that are not only effective but also interesting and able to adapt to the changing learning environment (Wulandari & Mudinillah 2022). Learning using smartwatches creates a sense of interest in students, thus stimulating student engagement and making learning more interactive (Liang et al, 2019).

Smartwatch is capable of being one of the popular human activity monitoring tools. With this ability, the relationship between smartwatches and learning is an interesting thing to study because of its ability to adapt quickly to fulfill students' needs. Several similar studies allude to

this, such as the use of smartwatches that can monitor student activity in real-time (Herrera et al, 2019). Smartwatches used in the learning process can ensure they achieve the targets set by the teacher while remaining safe (Attallah & Ilagure, 2018). In addition, the use of smartwatches in the learning process is proven to significantly improve student learning outcomes (Syafi, & Kurniawati, 2023). On the other hand, the use of smartwatches creates more interaction between teachers and students. It also makes learning innovative and able to increase student concentration in the classroom (Liang et al, 2019). Smartwatches used in the learning process can ultimately improve students' motivation and attitude towards learning (Koutromanos, & Kazakou, 2020).

The research provides new contributions to the existing literature by incorporating a quantitative approach to analyzing the use of smartwatches as supporting media in the innovative learning process in the post-COVID-19 pandemic era. Previous research has explored various aspects of the use of smartwatches in education, describing the characteristics of smartwatch use and identifying relationships between various variables that affect their effectiveness in learning. One of the new aspects presented in this study is the emphasis on teachers' understanding of the use of smartwatch features and how this affects the learning opportunities given to students to explore those features in the learning process. The research also offers new insights into the differences in acceptance of smartwatches at different levels of education. Based on the background and some previous research. Then this research will do some research on the formula of the problem: first, the teacher's understanding of the potential use of smartwatches in learning, second, the teachers' understanding of how to use the smartwatch, and third, whether there is a significant relationship about the understanding of a maple teacher with the use of a smartwatch in his classroom. This research can contribute to determining the right start-up for the transition back to face-to-face and hybrid classes. This research can enhance student learning experience and involvement until it can create learning experiences with real-time data. Therefore, a proper strategy is needed for teachers to integrate the use of smartwatches as technological innovations in teaching and learning processes at various levels.

METHOD

This research adopts a quantitative approach. The data is collected using research instruments. The analysis is performed quantitatively or statistically to test the hypothesis that has been established (Ardyan et al, 2023). applied a descriptive and correlational method, which aims to describe or describe the characteristics of a phenomenon or population studied as well as to identify relationships between various variables. The sample of this research consists of 50 teachers from the middle and high school levels. These teachers teach taught a wide range of subjects, including Mathematics, Religious Education, Indonesian Language, Natural Sciences (IPA), Social Science (IPS), Arts, Information and Communication Technologies (ICT), Physical Education, Sports and Health, English, and other subjects. The data collection process took place from 23 November to 6 December 2023. On the other hand, samples of respondents were randomly selected from public and private schools in different regions to ensure wider diversity and representation. The selection process of respondents is carried out by taking into account the diversity of backgrounds of the subjects enabled, to obtain a comprehensive perspective related to the application of wearable technology in the learning process.

The data collection techniques that will be used in this study are Questionnaire (questionnaire). In this study, a closed questionnaire was used, namely the questions given to respondents already had answer choices. So this type of questionnaire respondents are not allowed to express their opinions. Instrument measurement using a Likert scale. The researcher also used the Likert scale as an instrument measurement. It is used to measure the attitudes, opinions, and perceptions of a person or group of people about social phenomena. The Likert scale has two forms of statements, namely positive and negative statements. Positive statements are scored 5, 4, 3, 2, 1, while negative statements are scored 1, 2, 3, 4, 5. The answer form of the Likert scale consists of strongly agree, agree, doubt / neutral, disagree, and strongly disagree. This study uses descriptive analysis and linear regression. Descriptive analysis is the collection and processing of data without making comparisons or connecting one variable with another (Hasan, 2022). It could describe a

study conducted to describe the use of smartwatches in learning. This analysis was carried out with linear regression to investigate the effect between one dependent variable and one independent variable from the data that had been obtained (Yusuf et al, 2024).

RESULTS AND DISCUSSION

Result

Based on the analysis results listed in Table 1, it can be concluded that there are several important aspects regarding the use of smartwatches in an educational context. First, most teachers have a fair understanding of how to use the various features available on smartwatches, with an average score of 2.94. It shows that teachers already have the basic operational knowledge of the device, which is an important first step in integrating the technology into the learning process. Furthermore, the features of smartwatches are considered to be able to be utilized as effective learning media, with an average score of 2.97. This indicates the potential of smartwatches to be used as a tool in the learning process, providing opportunities for more innovative and interactive teaching methods. Furthermore, teachers observed that students generally understand the use of smartwatches well, reflected in the high average score of 3.40. The ease of using the smartwatch contributed to the high level of student understanding. A good understanding of using the smartwatch was a critical aspect that showed the students' positions as the main users of this technology in a learning context.

The research also showed that the use of smartwatches in learning provides interactive and enjoyable experiences for students, with an average score of 3.03 and 3.00, respectively. It can be concluded that smartwatch not only supports educational aspects but also aspects of the learning experience that are more interesting and fun, thereby increasing students' involvement. However, some things needed further attention. The teachers acknowledged that they knew enough about how using smartwatches could help in explaining learning material, but still lacked the opportunity to allow students to explore the features of a smartwatch, with an average score of 2.51. It shows that there was a gap in using smartwatch features in the educational context optimally. Although the use of smartwatches has shown a positive impact on the interactive and fun aspects of learning, there is still room to improve how this technology can be more effective in helping students understand the learning material. Further developments in teacher training and the integration of smartwatch features into the curriculum could be the next step toward optimizing the use of smartwatches in education.

Table 1. The Use of Smartwatch as Supporting Media in the Learning Process

No.	Item	Mean
1	Teachers Knohow to Use the Features on Smartwatches	2.94
2	Teachers Know the Use of Smartwatch Features as the Learning Media	2.97
3	Teacher Knows how to Use Smartwatch Features to Explain the Material	2.54
4	Students Get the Opportunity to Explore the Features of the Smartwatch.	2.51
5	Students Know How to Use the Smartwatch	3.40
6	The Student is Proficient in Using the Features of the Smartwatch	2.94
7	Students Use Smartwatch Features in the Learning Process	2.51
8	Students have an Interest in Exploring the Features of Smartwatches.	2.97
9	Students Enjoy Using Smartwatches in the Learning Process	2.97
10	Using a Smartwatch Provides an Interactive Learning Experience	3.03
11	Using a Smartwatch Provides a Fun Learning Experience	3.00
12	The Use of Smartwatches Helps Students to Understand the Learning Material Provided	2.83

The analysis of the data contained in Table 2 provides valuable insights into the impact of smartwatch use in the learning process, especially in student skill development. From the data collected, it is known that teachers generally agree that the use of smartwatches contributes positively to students' skill development, with an average score of 2.80. This indicates a perception

that smartwatches are not only technological aids but also effective educational tools for improving students' skills. In addition, the use of smartwatches in the learning process seems to be successful in fostering a sense of curiosity in students, with an average score of 2.91. This sense of curiosity is an important factor in learning, as it can encourage students to more actively explore and learn the learning material. The curiosity generated by the use of smartwatches can be seen as an impetus for more independent and discovery-oriented learning. Furthermore, the data shows that this sense of curiosity has a positive impact on students' self-confidence with an average score of 2.94. When students feel curious and encouraged to explore, they tend to become more confident in expressing their ideas and thoughts.

The use of smartwatches helped in facilitating this process, as reflected by the mean score of 2.83, indicating that students became more courageous in conveying the ideas they acquired during smartwatch learning. Finally, the use of smartwatches seemed to have an impact on improving students' ability to create more creative learning reports with an average score of 2.97. This suggests that the integration of wearable technology such as smartwatches in learning not only supports knowledge enhancement but also stimulates students' creativity. Through the use of smartwatches, students get the opportunity to apply their knowledge in the form of more innovative and creative learning reports or projects. The data in Table 2 shows that smartwatches had significant potential in supporting the development of students' abilities and creativity in the learning process. Smartwatches not only enrich the learning experience through technology but also play a role in encouraging students' curiosity, confidence, and creative thinking skills. It confirmed the importance of integrating wearable technology in education to create a more dynamic and interactive learning environment to support students' all-round development.

Table 2. The Use of Smartwatch as Supporting Media in the Learning Process

No.	Item	Mean
1	The Use of Smartwatches in the Learning Process Helps Students to Develop Student their Abilities such as Creativity, Fighting Power, Discipline, etc.	2.80
2	Students have a High Curiosity when Using Smartwatch in the Learning Process	2.91
3	Students are excited when Using Smartwatches to Search for New Information	2.89
4	Students have Confidence in Expressing Information Obtained when Using a Smartwatch	2.94
5	Students can Express New Ideas After Using Smartwatches in the Learning Process	2.83
6	Students can Develop their Creativity when Exploring New Material through Smartwatches	289
7	The Use of Smartwatches Helps Students to be Creative in Making Learning Reports	2.97

Based on the calculated value, Pearson correlation showed Sig. (2 tailed) of 0.09: it was found that there is an influence of subject teachers' understanding in using smartwatches in the learning process, although not all subject teachers can accept it. In addition, Mapel teachers also provide opportunities for students to explore the features of smartwatches in the learning process. It can be concluded that there is a relationship between teacher knowledge in using smartwatches. It also can be concluded that it could provide opportunities for students to explore various features in the learning process. It also correlated with the opportunities provided by teachers in utilizing the use of smartwatches to make students able to express new ideas. It can be seen in Sig. (2 tailed) of 0.03. In addition, it was found that level influences the use of smartwatches in the learning process. At the high school level, students are more interested in using smartwatch features in the learning process. On the other hand, the use of smartwatches could help students to develop character education, such as fighting power, and discipline, thus making students creative in making learning reports. It can be seen from the Sig (2-tailed) result below 0.04.

Discussion

In today's digital era, the use of technology to assist the learning process is a necessary thing to do. Technology in learning is an innovation made to be innovative and creative (effendi & Wahidy, 2019). The use of technology in the learning process can be used as a medium by teachers to make it easier to convey learning materials. By using technology in learning, students are invited to explore more knowledge and carry out a learning process that is different from what is done.

Based on Table 1, it can be seen that the use of smartwatches was one of the supporting media that can be used in the learning process. Not only that, by using technological devices learning becomes interactive and fun for teachers and students. This can happen if the teacher first uses and utilizes technology in the learning process. In addition, teachers need to invite students to be actively involved in the learning process supported by technology. Through the use of technology, such as smartwatches, students get the opportunity to understand the subject matter through real practical experience. This helps students develop a deeper understanding of learning concepts and apply this knowledge in a real-world context.

The use of various technological devices in learning is an important thing to do as an effort to answer the times. However, it should be noted that the use of technology as a learning media must pay attention to several things, namely the media used must be easy to obtain, the media used is not complicated, understand the character of students, see the class situation, and master the tools to be used (Suminar, 2019). Therefore, the use of technology in the learning process must be considered as a comprehensive and coordinated approach, especially in terms of training and professional development for teachers. The importance of technology training for teachers cannot be underestimated, as they need to be equipped with the skills and knowledge to effectively use various digital tools and platforms in learning. This included mastering the technical aspects of software and hardware, as well as developing strategies to incorporate these technologies in their lesson plans. In addition, continuous professional development was essential, allowing teachers to stay up-to-date with the latest developments in educational technology through activities such as workshops, webinars, conferences, and participation in online communities (Amin, 2019).

The results of the analysis showed that the use of smartwatches in an educational context supported the research objective of exploring the utilization of this technology as an innovative learning medium. Data showing teachers' understanding and utilization of smartwatch features (mean: 2.94) and students' positive responses (mean: 3.40) underscore how wearable technology can be integrated into education. This responds to the main research problem, which is how to adapt wearable technology in education to create more effective and engaging learning methods after the COVID-19 pandemic. In Table 2, the use of smartwatches is enough to develop student's abilities, especially in increasing curiosity to find new information, encouraging confidence in expressing the information obtained, and making interesting reports on learning outcomes. From that, it can be seen that the use of smartwatches in the learning process provides new experiences for students so that they can increase their knowledge. The use of smartwatches as an interactive learning tool shows a correlation with modern learning theories that emphasize the active exploration, discovery, and active involvement of students in the learning process (Sipahutar et al, 2023). According to the theory of constructivism, as expressed by Piaget and Vygotsky, the best learning occurs when students are actively involved in the process of building their knowledge (Vygotsky, 1978). The sense of curiosity cultivated through the use of smartwatches (mean: 2.91) and increased student self-confidence (Mean: 2,94) are manifestations of this theory in practice. The smartwatch's ability to provide direct feedback and exciting interaction encourages students to engage in a deeper learning process, the importance of a tool in learning is becoming increasingly relevant in the context of modern education.

This concept, rooted in the theory that students learn most effectively when they are slightly outside their comfort zone but still within the range of understanding, underscores the importance of the right tools in supporting the learning process. These tools can be used as digital resources of interactive tools or specially designed educational materials that bridge the gap between what students already know and what they are trying to learn. By providing this support, they enable students to achieve deeper understanding and internalize more complex knowledge. This was particularly important in helping students develop critical skills and problem-solving abilities, allowing them to move through their zone of proximal development more effectively. In practice, the use of these tools requires a structured and reflective approach from educators, who must be able to identify the specific needs of each student and provide resources that can help them on their learning journey.

This approach not only supports students' cognitive development but also increases their engagement in constructing their knowledge from their experiences (Sugrah, 2019). Technology can significantly increase student engagement in learning. Appropriate use of technology helps students in improving their learning outcomes (Budiyono, 2020). That way, students actively explore and find their own understanding in the learning process by using various available technologies, especially the use of smartwatches. The use of technology in the learning process is unavoidable. The use of technology-based learning media was an innovation that can be done in the learning process so that teachers and students are ready to face various technological developments. Teachers need to train students to have the ability to think critically and be more creative, innovative, and communicative in expressing their opinions, they could work together and collaborate to further increase students' self-confidence (Surani, 2019). This is where the teacher's role is increasingly important because the teacher is a facilitator, as well as a companion in learning who helps students understand their knowledge appropriately until they can use technology wisely and be able to share information obtained as new knowledge through concrete learning experiences with others. Learning using smartwatches can be done if subject teachers know in advance the benefits of using smartwatches in the learning process (Quintana et al, 2016). The use of smartwatches in the learning process is currently only done by science and sports teachers. In fact, by using smartwatches, students can monitor heart rate, track sleep time, and get stress management interventions (Jerath et al, 2023). By knowing these things, students can increase physical activity, monitor sleep, and manage stress better (Sieniawska et al, 2024).

In addition, some smartwatches have features for breathing exercises, which can help students manage stress and improve focus. This feature can be used as an important activity such as meditation to start learning so that students can be more prepared and focused in following the lesson. This is important because good sleep timing and effective stress management allow students to focus more on learning, which in turn can improve academic performance and reduce behavioral problems that may occur (Mitru et al, 2002). With a good understanding of the benefits of smartwatches, teachers can integrate this technology into their learning methods. Heart rate monitoring can help students understand their health conditions and make better decisions regarding physical activity. Stress management interventions through breathing exercises and meditation features can help students be calmer and prepared for academic and social challenges at school. Overall, the use of smartwatches in the learning process is not only limited to science and sports but it can be applied in a variety of subjects to support students' health and well-being. As such, smartwatch integration can create a more holistic learning environment and support students' all-round development. These findings provide important insights for educational leadership in formulating technology integration strategies. Smartwatches as learning tools offer new ways to manage teaching and learning processes that are more interactive and engaging, showing potential in education policy and planning. In the context of education economics, investment in wearable technology can be a valuable step to improve the quality of teaching and learning, offering a more personalized and engaging learning experience for students. From an educational politics perspective, the findings support initiatives to modernize curricula and teaching methods, It also could demonstrate the importance of technological innovation in education. Technological innovation helps learning by utilizing existing technology to facilitate the learning process (Rahmawati, 2022).

CONCLUSSION

Based on the results of research conducted to determine the use of wearable technology, especially smartwatches as one of the supporting media in the learning process, it can be concluded that teachers need to recognize the potential use of smartwatches in the learning process. That way, teachers' understanding of how to use smartwatches especially provides an understanding of MAPEL teachers, it was not only limited to science and sports teachers to use smartwatches in the learning process. There was great potential especially in students because they showed a good understanding of using smartwatches as learning media. They can utilize smartwatch features to support learning activities, such as accessing learning materials, setting study schedules, and

participating in interactive learning activities. In addition, the use of smartwatches is proven to provide a fun and interactive experience for both teachers and students. By engaging students in the learning process, teachers can present course content in a more interesting way. It was important for teachers to master the use of smartwatches in order to utilize them effectively to provide different and innovative learning experiences for students. Not only that, smartwatches contribute to the development of students' abilities, such as creativity and initiative. This happened because students were encouraged to actively seek and explore information, as well as apply knowledge in different contexts, which ultimately increased learning independence. However, the study also identified some areas for further research. It was important to explore the most suitable subjects and learning materials to be integrated with smartwatch use. Determining the right content will help teachers in making the learning process more innovative and in line with the technological developments taking place. The use of smartwatches should be viewed as an additional component that enriches, not replaces, traditional learning methods. A learning approach that is tailored to the needs of students, the characteristics of learning media, and the socio-emotional conditions of students is the key to achieving the main goal of education, which could develop human potential to be better prepared to face the challenges of life, especially in the face of technological advances. In conclusion, this study shows that smartwatches can play an important role in modern education and provide an optimal learning experience for students. However, its integration should be done by considering equality of access, teacher training, and diverse learning needs to ensure that all students get the optimal benefit from this technology.

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