A Study on the Sustainability of Technology Utilization Training Programs for Educators in the Post-Pandemic Era

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Abstract: The development of Information and Communication Technology (ICT) has transformed the education landscape, expanded the scope of the teaching and learning process beyond the traditional classroom. Although the utilization of technology in education brings many benefits, there are still challenges in ensuring that teachers have the necessary skills and knowledge to use it effectively. This research aims to analyze the sustainability of technology utilization training programs for teachers in the post-pandemic era in terms of influencing factors and applicable strategies. The method used is a systematic literature review following the PRISMA guidelines. After analysis, 35 articles were found to be relevant to the topic. The results indicate that factors such as relevant training materials, trainer capabilities, and participant engagement play crucial roles. Recommended strategies include online-based approaches, hierarchical training, and the formation of teacher communities. The roles of school principals, educational departments, and school communities are also crucial in supporting the sustainability of training programs. Thus, collaboration between various parties and the implementation of appropriate strategies are key in maintaining the sustainability of technology utilization training programs for teachers in the post-pandemic era.

Keywords: Teacher, Sustainability, Training, Technology

Introduction

The development of information and communication technology has fundamentally changed the educational landscape. Along with digital breakthroughs, the teaching and learning process is no longer limited to traditional classrooms. As mentioned by Hanifah - Salsabila et al. (2020) the use of technology in education is not just a concept, but a reality that has been proven to improve the quality and efficiency of learning. Educational technology exists as an answer to challenges in the learning process by providing new facilities and innovations. With this technology, learning can be adapted to individual needs, providing interesting alternatives and enriching the learning experience.

Even though technology brings many benefits, not all teachers have sufficient ability and knowledge to use it effectively in the learning process. According to 2023 data from the Ministry of Education and Culture, Research and Technology, of the total 2.9 million teachers in Indonesia, only 1.5 million of them have an account on the Belajar.id platform. Even more worrying, only half of that number, namely 500,000 teachers, have taken part in training to digitize learning. This highlights the need for further efforts in improving the digital skills and knowledge of educators to support the effective use of technology in education.

Although the government and various institutions have held various training programs to improve teachers' digital abilities, such as basic ICT training, use of learning applications, and learning online, however, there is still a glaring gap between available training programs and the actual needs felt by teachers. The results of research by (Rahargo & Jannah, 2020) regarding the challenges in developing training programs at Industrial Training Centers in the Industrial Revolution 4.0 era show that the challenges faced by Industrial Training Centers are quite large, especially in the absence of training programs that are in line with the needs of Industry 4.0. This highlights the need to develop new training programs to address the gap between actual industry needs and available training programs. The sustainability of training programs is a relevant question, considering that there are still many programs that are unable to provide long-term effects due to lack of support and monitoring from related parties. When discussing the sustainability of technology training programs for teachers, it is important to pay attention to how this can impact various aspects of learning. Ensuring that teachers can continue to develop their abilities and skills in using technology is a crucial step considering the increasingly sophisticated times.

One of the possible outcomes of this program is increasing participants' understanding regarding the use of technology. With this increased understanding, teachers can more effectively integrate technology into the learning process, thereby providing a more engaging and relevant learning experience for students. Not only that, but sustainable training programs can also produce positive changes in the educational paradigm. Teachers will be more open to innovation and technological advances, thereby encouraging the creation of a more dynamic and adaptive learning environment. Additionally, it is also important to note that the program can facilitate the formation of collaborative networks among participants. Through this collaboration, teachers can share experiences, knowledge and resources in the use of technology, which in turn will enrich their learning practices and improve the overall quality of education.

The results of research conducted by Jenita et al. (2023) emphasized the importance of continuing technology training programs for teachers. It was found that participants had increased understanding regarding the use of technology, positive changes in educational paradigms, and the formation of collaborative networks among participants. This is concrete evidence that investing in teacher technology training is the right step towards improving the quality of education in Indonesia.

Based on the description above, this research was conducted to analyze the sustainability of technology utilization training programs for teachers in this era post pandemic based on factors that influence the sustainability of the training program and strategies that can be implemented. It is hoped that the results of this research can provide input to related parties in formulating policies and training programs for the use of technology that are more effective and sustainable so that they have an impact on improving the quality of education.

Method

This research was prepared based on a literature review using the method Systematic Literature Review (SLR). Researchers systematically review articles relevant to the research topic. To ensure that this research was carried out systematically, this research referred to PRISMA guidelines. The literature search process was carried out on February 21, 2023, from Google Scholar using the application Publish or Perish (PoP) with the keywords mentioned in table 1. Researchers limited the number of articles to 201 from 2022 to 2024. After analysis, there were 35 relevant articles.

Table 1. Research strategy

Google Scholar (n= 201)
Keyword : (1) Knowledge enhancement, Skills enhancement, Digital Pedagogy, Technology integration, Innovative learning, (2) Support and commitment, Motivation and participation, Sustainability of funding, Accessibility and infrastructure, Professional development, (3) Continuous training, Community learning, Coaching and mentoring, Technical support, Innovation and adaptation, (4) Intrinsic and extrinsic motivation, Self-confidence and self-efficacy, Positive attitude towards technology, Courage in experimenting, (5) Culture of resistance, Lack of infrastructure, Policies and regulations, Inequality of access, Organizational readiness, (6) Program differentiation, Individual needs, Learning styles, Technology readiness, (7) Digital literacy, Needs analysis, Contextualization of material, Participatory approach, (8) Transformative leadership, supportive policies, collaboration and partnership.

Table 2. Eligibility criteria

| Inclusion	Exclusion
Published between 2022 and 2024	1.The content is not related to the topic and research questions, namely: 1. What are the factors that influence the sustainability of the training program?
The article can be in the form of a journal or proceedings	1. What are the appropriate strategies to enhance the sustainability of technology utilization training programs for teachers in the post-pandemic era?
Writing can be in Indonesian or English	2. What are the roles of school principals, education departments, and school communities in supporting the sustainability of training programs?
	Outside the field of education
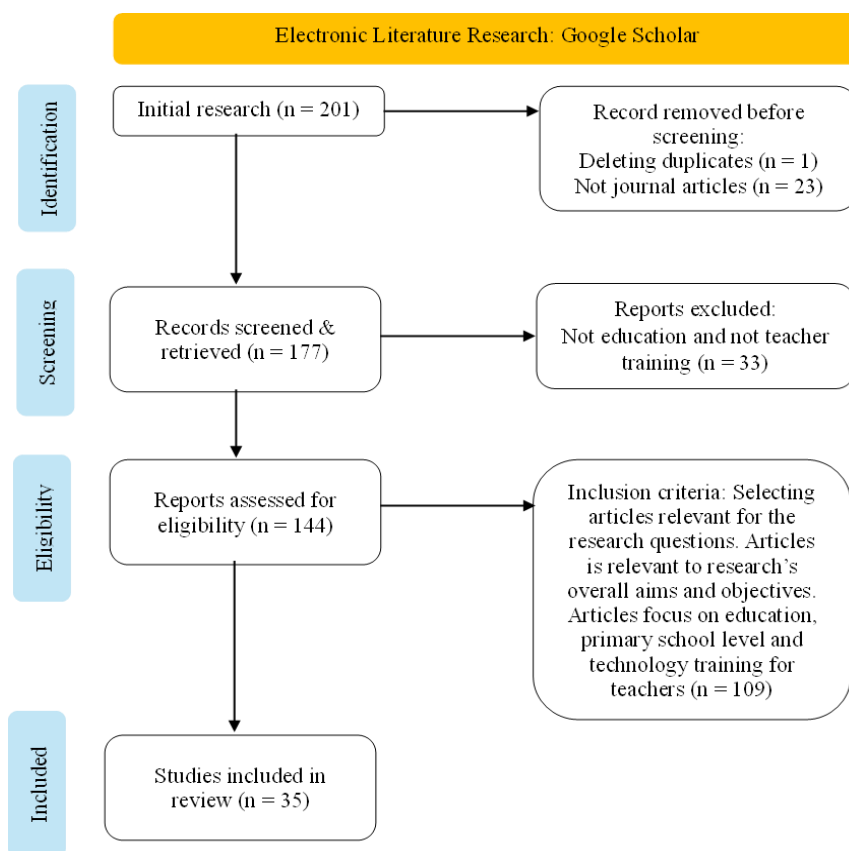
Figure 1. PRISMA graph systematic literature review

The selected articles are then analyzed by following the steps, namely (1) Sorting data using Microsoft Excel to facilitate selection and focus on important points relevant to the research topic, (2) Displaying data in the form of tables, narratives and diagrams. have been previously formulated, (3) Draw conclusions that aim to answer research questions that have been previously formulated.

Results and Discussion

Based on the data collection process, there are 35 articles that are the subject of discussion which corresponds to a detailed discussion about the sustainability of technology utilization training programs for teachers with sub-themes of factors influencing the sustainability of training programs, appropriate strategies to increase the sustainability of technology utilization training programs for teachers in this era post pandemic as well as the role of school principals, education offices and school communities in supporting the sustainability of training programs.

Table 3. Results of literature review

| No	Author and Year	Subject
1	Gatembu (2023)	The role of the school principal, education department and school community
2	Apriani et al. (2024)	Training participants
3	Karim & Anriani (2024)	Training Materials, Trainer Abilities, Training Methods
4	Nuryanti et al. (2023)	Tiered training
5	Muneja et al. (2023)	Training participants
6	Sudarti et al. (2022)	Training participants
7	Fathullah et al. (2023)	Trainer Ability
8	Leoste et al. (2022)	Based approach online
9	Atmojo et al. (2023)	Training participants
10	Sadikin et al. (2023)	Training participants
11	Palennari et al. (2023)	Training participants
12	Hikmah et al. (2023)	Training participants
13	Nurhidayat et al. (2022)	Training participants
14	Rofi'i et al. (2023)	Tiered training
15	Sartika et al. (2023)	Training participants
16	Nursalam et al. (2022)	Based approach online
17	Syukriady & Patimah (2023)	Training Materials, Trainer Abilities, Training Methods
18	Purnomo et al. (2023)	Based approach online
19	Ratna Dewi et al. (2023)	Training Materials, Trainer Abilities, Training Methods
20	Dwi Salwa et al. (2023)	Integrating Technology in the Curriculum
21	Aswan et al. (2023)	Training participants
22	Haniko et al. (2023)	Based approach online
23	Mwangi et al. (2023)	Awards and Recognition
24	Balalaieva et al. (2023)	Integrating Technology in the Curriculum
25	Petrenko (2024)	Integrating Technology in the Curriculum
26	Alam et al., (2023)	The role of the school principal, education department and school community
27	Mona Bădoi-Hammami (2023)	Based approach online
28	Pinto-Santos et al. (2022)	Training participants
29	Alsaleh & Berhanu (2023)	Training participants
30	Setiyaningsih et al. (2023)	Use of Interactive Learning Modules
31	Rahayuningsih et al. (2023)	Formation of a Teacher Community
32	Astuti et al. (2024)	Formation of a Teacher Community
33	Yahya Bandung Ratnadewi et al., (2023)	Training Materials, Trainer Abilities, Training Methods
34	Susilawati et al. (2022)	Based approach online
35	Helmie et al. (2022)	Training participants
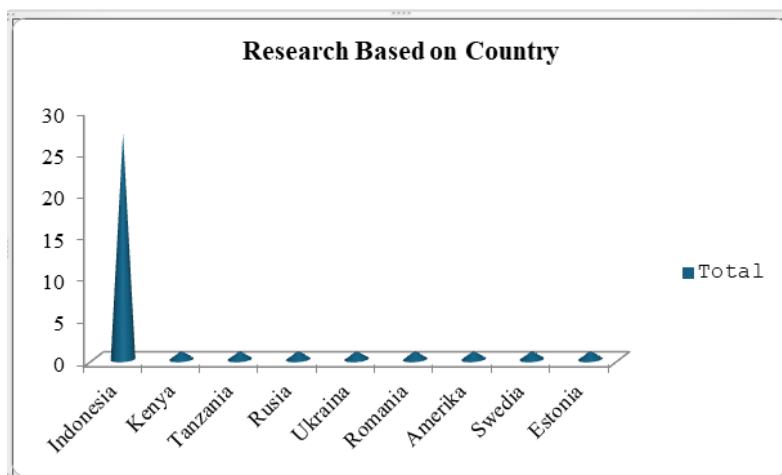
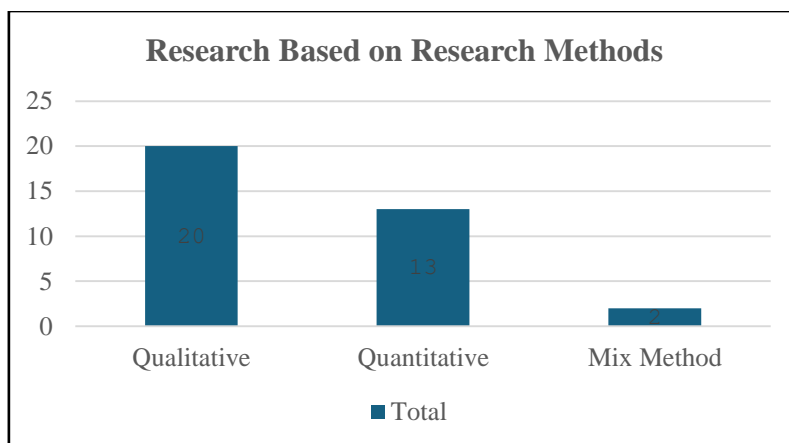Chart 1. Literature review by country

Chart 2. Literature study based on research methods

Of the 35 included studies, seven were published in 2022, twenty-four in 2023, and four in 2024. The studies were conducted in Indonesia (n = 27), and one study each from Kenya, Tanzania, Russia, Ukraine, Romania, America, Sweden and Estonia. Twenty were qualitative methods, thirteen studies were quantitative methods, and two studies were researchmix method.

Discussion

At this stage, various factors that influence the continuation of training will be explained, the appropriate strategies to use and the role of the principal of the education department and the school community based on the results of the research above. Continuous training is an important foundation for the development of individuals and society. It should be noted that continuous training not only influences individual development, but also shapes the direction of development of society.

The right strategy for implementing ongoing training can increase the effectiveness and relevance of training to community needs. The role of the principal and school community in supporting ongoing training is also very important. School principals can play an important role in planning and implementing effective training strategies. They can also collaborate with industry and other educational institutions to ensure that the training provided is relevant and of high quality. The school community, including teachers, support staff, and parents, can contribute to creating an environment that supports continuous learning. They can provide support, motivation, and access to the resources needed for training.

Factors Influencing Training Sustainability

Continuous training is at the heart of our progress as individuals and as a society. This theme shows how important it is to consider various factors that can influence the sustainability of the training itself.

Training Materials

The results of 4 previous studies highlight the importance of paying attention to the relevance and depth of training material to the needs of teachers in the field. Ensure that the material taught is not only related to theory but can also be applied practically in a classroom context. Research articles that correspond to this sub-theme are articles 3, 17, 19, and 33. In these articles, the authors discuss the importance of paying attention to the relevance and depth of training materials to the needs of teachers in the field. They emphasized that training material should not only be related to theory, but also be practically applicable in a classroom context. The results of the cited studies show that when the training material directly relates to the challenges faced by teachers daily, the level of participation and engagement in the training increases significantly. In addition, research also highlights teachers' enthusiasm for continuing training in the future, especially after attending certain training such as Quizizz Training. This shows that selecting relevant and interesting material can arouse trainees' interest and motivation to learn further. Apart from being relevant and interesting, the demands of the times are increasingly encouraging the renewal of contextual material.

Trainer Abilities

The trainer's ability is very important in influencing the sustainability of a training program. This is evidenced by the many studies that highlight the importance of the trainer's ability in influencing the sustainability of training programs, namely, articles 3, 7, 17, and 19, included in the journal, specifically discuss the evaluation of training organizers and instructors. In this case, aspects such as readiness, facilities, equipment, curriculum, time allocation, learning methods, teaching performance, mastery of material, and instructor communication are the focus.

Research shows that the quality of instruction delivered by trainers greatly influences the effectiveness and sustainability of training programs. For example, training using platforms such as Quizizz has been shown to help teachers learn technology, as revealed in focus group discussions that provided positive responses to their experiences. This confirms that the trainer's ability to teach and deliver material in a way that is interesting and useful for the trainees is key in maintaining the sustainability of the program.

Based on findings from the field, the ability of the presenter to explain is very important, as was the case in technology training related to Canva which was held at a private elementary school in Surabaya. When the material is presented in an interesting way, it is easier for participants to understand and follow the steps. This illustrates that it is not only the content of the material that is important, but also how an interesting delivery method can significantly increase the effectiveness of training.

Training Methods

Research findings state that training methods are one of the factors that greatly influence the sustainability of training programs as evidenced in articles 3, 17, 19 and 33. In this research, the importance of choosing learning methods that suit the needs and characteristics of training participants is emphasized. Interactive and engaging methods such as game-based training, simulations, and group discussions have been shown to increase engagement and retention of the material taught.

Training Participants

The next factor that also greatly influences the sustainability of a training program is the commitment and involvement of training participants. Nearly 50% of research findings discuss the importance of participant commitment and involvement as influential factors. This is proven by the discovery of 15 studies highlighting the importance of training participant involvement and commitment as one of the factors that influence the success of the program. The articles that explain are articles 2, 5, 6, 9, 10, 11, 12, 13, 15, 17, 19, 22, 29, 30, and 35. The problems that arise usually are that teachers feel less motivated and less active in development professionalism, and lack of proficiency in technology and art. Other problems include a lack of seriousness, self-awareness, and collaboration.

The success of this training program was also supported by the participants' initial knowledge and insight into digital literacy competencies. Participants who have a good initial understanding will find it easier to follow the training material and apply it in practice. Thus, it is important to evaluate participants' initial understanding and devise a training program appropriate to their level of knowledge.

Additionally, aspects such as training location, practical learning preferences, and desire for workshops outside their region also reflect the importance of engaged and committed participants. By taking into account participants' preferences and needs, training can be tailored to be more effective and engaging for them, thereby increasing the likelihood of long-term sustainability of the training program.

Based on findings from the field, training participants have a significant role in the sustainability of a training, especially in the context of technology training. In Surabaya private schools, teacher age diversity is a relevant factor. This age variation can influence how the material is absorbed and the level of enthusiasm for learning new things related to technology. Younger teachers may be more familiar with technology and quicker to accept new information. However, for older teachers, it may take them longer to understand and adopt new technology.

Strategies to Improve the Sustainability of Technology Utilization Training Programs for Teachers

In an effort to increase the sustainability of technology training programs for teachers, it is important to design appropriate and sustainable strategies. Based on literature findings, several strategies were found including:

Based Approach Online

With the rapid progress of technology, supported by the massive use of technology during COVID-19, one strategy that is very easy and supports the training program is to carry it out online. Many research results show that approach online This is quite popular and successful. This is proven by the findings of 5 research articles highlighting the positive results of implementing an online-based approach in technology training programs for teachers. Articles 8, 16, 18, 23, 28, and 34. consistently show that course participants online and face-to-face showed almost the same increase. In addition, the findings from the article above also provide a comprehensive background regarding the digital divide, the importance of digital inclusion, and strategies used in community service projects. With the development of technology, new opportunities arise to improve the practical training of teachers through learning online, virtual simulations, and other methods, which will ultimately improve the overall quality of education.

In one of the articles, it was found that the course online have advantages in achieving STEAM learning outcomes (Science, Technology, Engineering, Art, and Math) more quickly. In addition, interactive teaching materials in the model e-Learning Web-based is considered good by students and has the potential to be adopted in other schools by the Konawe Regency Education and Culture Office.

In another article, usage is also found podcast as a learning tool also shows potential to improve education, but this requires good implementation, relevant materials, and support from schools. Well-organized discussions are also necessary in this context. From this it can be interpreted that the media podcast it is very suitable when applied in the right conditions.

Then the findings of research conducted in Surabaya found that the approach was based on online has emerged as an effective solution for providing training, especially during the COVID-19 pandemic where physical contact is limited. In the midst of these limitations, private elementary schools in Surabaya responded by holding online literacy training. This is of course a solution amidst the current conditions which require limiting direct meetings and maintaining social distance between one person and another.

Through various video applications conference, teachers and participants can interact directly, even virtually. This allows them to discuss, exchange ideas and learn together without needing to meet physically. This approach not only allows continuity in the learning process and teacher professional development, but also shows flexibility and adaptation to changing situations. This online training is an example of how technology can be utilized to continue providing educational services effectively, even in the midst of unexpected challenges such as a pandemic. Initiatives like this emphasize the importance of having the courage to try new and flexible approaches to providing quality education.

Until the approachonline can be used as a strategy in training programs because of its flexibility in accommodating various needs and situations. With online training, participants can access learning materials anytime and anywhere, without being bound by certain geographic or time restrictions. This allows more people to access quality education, regardless of the physical or logistical obstacles they may face.

With unlimited access to learning materials, participants can continue to develop their skills independently after completing the core training program. Additionally, online platforms often provide evaluation and feedback features that can help participants track their progress and identify areas where they need to improve their understanding or skills. Thus, online training opens the door to ongoing ongoing learning, allowing individuals to continually hone their skills to suit their needs and prepare them for future challenges in an ever-changing job market.

Tiered Training

Tiered training is the right strategy to increase the sustainability of technology training programs for teachers. The authors of the 2 studies highlight the effectiveness of this approach in articles 14 and 4. In the articles, it is discovered how a tiered training approach allows teachers to gradually acquire the technological skills needed to improve the quality of their learning. From an introduction to basic concepts to the application of more

advanced technology, tiered training allows teachers to learn progressively according to their level of understanding and readiness. This not only strengthens their understanding of the technology, but also increases their confidence and motivation to continue develop their skills in integrating technology in learning.

Use of Interactive Learning Modules

One of the findings from previous research highlights the effectiveness of using interactive learning modules in improving the sustainability of technology training programs for teachers, namely article 31. By integrating interactive modules into the training curriculum, teachers can more easily adapt the material to their individual needs and learning styles. -each participant. These modules can be designed with various features, such as learning videos, interactive simulations, and quizzes online, which makes learning more interesting and rewarding. This is proven to encourage active participation of trainees, increase engagement, and prolong the positive effects of the training program itself.

Formation of a Teacher Community

The formation of a teacher community is very important for the sustainability of the training program. There are at least two research results that highlight this problem. The findings from articles 32 and 33 emphasize how important the formation of a teacher community is in increasing the sustainability of technology training programs. The study highlights that the implementation of PKM (Managerial Competency Improvement) is successful when partners are actively involved in the process of forming and optimizing learning communities in schools. In this context, awareness of the importance of collaboration between teachers and continuous learning becomes the main basis. It has been proven that when teachers feel they have a supportive community and encourage the exchange of knowledge and best practices, they tend to be more motivated to engage in training and apply the technology learned in daily activities in the classroom.

Based on findings from the field, the teacher community approach has been proven to be an effective solution in overcoming learning challenges during the pandemic. At a private elementary school in Surabaya, technology training focuses on using applications Microsoft Teams was held to address problems that emerged during the pandemic. During this period, learning is less than optimal due to physical restrictions and limited delivery of material. However, through use Teams, teachers can continue to provide understanding to students by utilizing pictures, videos and practice questions, so that learning activities can continue well and learning objectives can be achieved. However, it cannot be ignored that not all teachers are able to quickly master the application teams. Therefore, a teacher community approach was used to ensure the sustainability of the training program. Through this approach, teachers can share knowledge and experience with each other, so that they can understand and use it Teams optimally.

The result is not only teachers who benefit, but also students who can continue to receive quality learning even in less than ideal situations due to the pandemic. This teacher community approach proves that collaboration and support between fellow teachers can be the key to success in facing learning challenges in difficult times like these.

Integrating Technology in the Curriculum

The integration of technology in the curriculum is also likely to be quite influential in the sustainability of the training program. The articles that explain this are articles 21, 25, and 26, where these articles emphasize that the relevant agencies are now implementing modern learning media, while educators have been trained to master the tools. The author confirms this technology enables self-expression, independent learning and the formation of a flexible information culture. This article emphasizes the importance of creativity, adaptability, and digital literacy for prospective teachers. With innovative approaches to training, teachers can better interact with diverse students, utilize new technologies, and encourage lifelong learning in the future. Thus, integrating technology in the curriculum not only increases the effectiveness of learning, but also ensures that teachers continue to develop and be relevant in facing the demands of ever-changing times.

Awards and Recognition

Awards and recognition should be included in one of the strategies for increasing the sustainability of a training program. This is proven by the findings of the 24th article which shows a large difference in the use of technology in schools between LPTKs in Nyeri and Nairobi. In their findings, researchers revealed that teachers need to improve their abilities in using technology to teach. This is not only important for their career development but is also an important requirement for promotion. In this context, rewarding teachers who successfully apply technology in learning can be an effective strategy to increase the sustainability of training programs. Rewards can take the form of public appreciation, certificates of appreciation, or even financial incentives. In this way, teachers feel recognized for their efforts and are motivated to continue developing their technological skills, so that the training program can have a long-term impact in improving the quality of learning in schools.

The Role of the Principal, Education Department, and School Community

Policy makers are very influential in determining whether a training program will have a sustainable effect or not. In this case, articles 1 and 27 illustrate how important the role of the Principal, Education Department and school community is in supporting the sustainability of the training program. In the research, the findings show that the principal has a key role in facilitating and encouraging teacher participation in training programs. They are not only responsible for the allocation of resources required for training, but also need to ensure that the school atmosphere supports continuous learning. In addition, the Department of Education has the responsibility to provide institutional and policy support that supports the implementation of training programs. They need to work together with schools and other relevant parties to ensure that training programs are well integrated into the curriculum and other school activities. The school community also has an important role in supporting the sustainability of the training program. They can provide moral and practical support to teachers in training, as well as assist in facilitating collaboration and exchange of experiences between teachers. With the active involvement of the Principal, Education Department, and school community, training programs can be more effective and sustainable in improving teachers' skills in utilizing technology to improve learning.
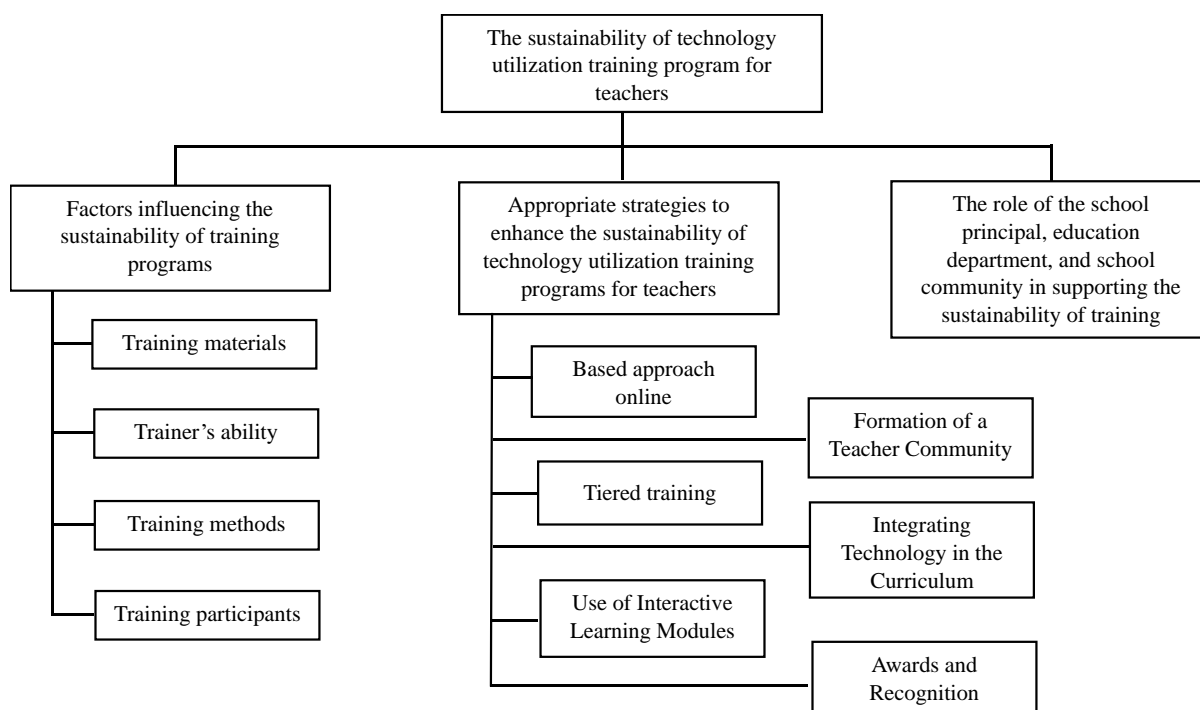

Figure 2. Summary of themes and sub-themes

Conclusion

Based on the results of the analysis of the factors that influence the sustainability of technology utilization training programs for teachers, the strategies that can be implemented, as well as the role of school principals, education offices and school communities in supporting training sustainability programs, it can be concluded that the sustainability of this program is strongly influenced by several factors. key.

First, factors such as relevant and in-depth training material, the trainer's ability to deliver the material effectively, various interesting training methods, and the involvement and commitment of training participants play a major role in determining the sustainability of the training program. Second, the right strategy to increase the sustainability of training programs includes, among other things, a strategy-based approach online, tiered training, use of interactive learning modules, formation of teacher communities, integration of technology in the curriculum, as well as providing awards and recognition for teacher efforts. Third, the role of the school principal, education office and school community is very important in supporting the sustainability of the training program. School Principals have a key role in facilitating and encouraging teacher participation, while the Education Office is responsible for providing institutional and policy support that supports the implementation of training programs. The school community also has a role in providing moral and practical support to teachers and facilitating collaboration between teachers. Thus, collaboration between various parties and implementing appropriate strategies is the key to maintaining the sustainability of technology training programs for teachers in this era post pandemic.

Recommendations

To the further researcher, particularly those who have the same problem and interested in conducting research, it is suggested that this study can be a reference. Hopefully, there will be any further research of how to complete this technique.

Scientific Ethics Declaration

* The authors declare that the scientific ethical and legal responsibility of this article published in EPESS journal belongs to the authors.

* We, the undersigned, pledge to uphold the highest standards of integrity, honesty, and transparency in all scientific research endeavors, ensuring the well-being of participants, the accuracy of data, and the responsible dissemination of findings for the betterment of society.

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