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Utilizing Information and Communication Technology in Scalable Management Strategies for Teacher Development

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Abstract

INTRODUCTION: Teachers are human resources who play an important and strategic role in the success of learning so they must fulfil adequate competencies. Teachers with low competence will not be able to produce students who excel both academically and non-academically. Efforts to improve teacher competency include education and training.
OBJECTIVE: This research aims to see how information and communication technology is used in developing teachers' pedagogical and professional competencies.
METHODS: This research was carried out using a descriptive qualitative approach. The data used in this research was obtained from various relevant sources.
RESULTS: The results of this research found that increasing teacher pedagogical and professional competence through the integration of Information and Communication Technology (ICT) and scalable management strategies opens up new perspectives on the importance of investing in the development of teaching staff.
CONCLUSION: The alignment of modern pedagogical approaches with the use of technology and efficient management strategies allows teachers to develop as more effective and competitive educators. Increasing pedagogical competence allows educators to create more dynamic and relevant learning environments for students. By incorporating innovative teaching methods, such as the use of digital tools and resources, teachers can adapt learning to students' diverse learning styles.

Keywords: Information and Communication Technology, Pedagogical and Professional Competencies, Teacher Development

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1. Introduction

Teacher development is one of the deepest problems in the world of education. Although various teacher development efforts and techniques have been implemented, such as Teacher Working Groups (KKG), Subject Teacher Deliberations (MGMP), House Training (IHT), Classroom Action Research (PTK), Lesson Study, further education, certification, comparative studies, education, and training, in reality, have not been able to provide a significant impact on increasing teacher competence, both in the process aspect and the resulting learning outcomes (Evans et al., 2020).

This problem becomes increasingly critical because teachers' pedagogical and professional competence is the main pillar in shaping the quality of education. Honestly, there is a gap between expectations and reality in terms of teacher professional competence. This can be seen from the results of the initial competency test (UKA) which is used as a tool for mapping the initial conditions of teachers and selecting candidates for certification (Archambault et al., 2022). It was noted that only a small percentage of examinees obtained nationally acceptable average scores.

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These results reflect the quite clear fact that teachers' pedagogical and professional abilities are still at a very low level (O'Donnell & Sireci, 2022).

This problem becomes increasingly complex because teacher competence greatly influences the quality of education provided to students. In an era of constant change, teachers need to be able to adapt teaching approaches that are relevant to technological developments and social dynamics. Therefore, more effective steps in teacher development need to be taken to ensure that they can meet the demands of the times and provide quality education (König et al., 2020). This could include implementing more effective teacher development strategies, ongoing support in terms of training and professional development, as well as improvements in approaches to measuring teacher competency that are more accurate and relevant to current educational needs (Sims & Fletcher-Wood, 2021).

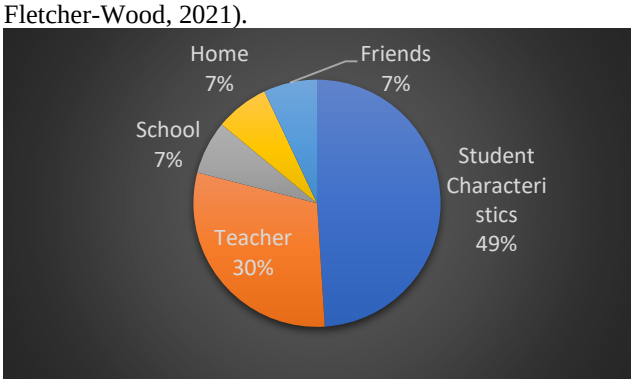

Figure 1. Teacher Influence on Student Achievement

The diagram above shows how much influence teacher competence has on student learning success, which can reach up to 30%. This means that a teacher has a very significant role in shaping student achievement. The competency and quality of teachers, therefore, is a key element in determining the extent to which students can achieve adequate academic achievement. However, the existing reality shows that teacher competence has not yet reached an adequate level or has a quality that meets expectations (Blömeke et al., 2022).

The impact of inadequate teacher quality is felt in the educational environment. This has triggered an increase in demand for courses, private tutoring, or tutoring as an effort for students to overcome deficiencies in receiving knowledge from teachers who may have limitations in their teaching abilities. Teachers not only influence students' academic aspects but also non-academic aspects, such as students' character and attitudes towards learning. Teachers with high quality tend to produce better academic achievement and student behavior, while teachers with low-quality risk producing low student achievement (Liu & Bray, 2020).

In this context, this research aims to explore how the use of technology and communication is integrated into management strategies in teacher development. By understanding the important role of teacher competence in the educational process and its impact on student learning success, this research tries to identify solutions that can make a significant contribution to increasing teacher competence through innovative and effective approaches.

2. Literature Review

2.1. Human Resource Management

Human resources play a very important role in an organization. Therefore, Human Resources (HR) must be managed well to increase organizational effectiveness and efficiency. Proof of how important human resources are, Suryadi said that human resources can determine the future of the nation and can spur the nation's excellence and competitiveness in the world arena. This statement shows that human resources are the key to a nation's success in developing and placing itself in the ranks of successful countries in the world (Dirani et al., 2020).

The key to the success of an organization is management that is managed effectively and human resources are the most important asset to have and manage well. Organizations are always required to increase their effectiveness and efficiency in line with the increasing challenges faced by an organization, so human resources as one of the main components must be managed well. Human resource management refers to the effective and efficient management of human resources with the aim of achieving organizational objectives (Azizi et al., 2021).

Numerous experts in the field of Human Resource Management (HRM) present differing perspectives on the subject. According to Marihot, HRM can be defined as the collection of actions carried out to attract, nurture, motivate, and retain a high-performing workforce within the organization. This definition suggests that human resource management encompasses the comprehensive planning and execution of diverse initiatives, policies, and programs designed to acquire, develop, and sustain a workforce that enhances organizational performance (Meijerink et al., 2021). Sedarmayanti stated that "human resource management in aspects of policies and practices relating to people in management positions, including recruiting, screening, training, rewarding and evaluating". Schuler, Dowling, Smart, and Huber state that "Human resources management (HRM) is the recognition of the importance of an organization's workforce as vital human resources contributing to the goals of the organization, and the utilization of the several functions and activities to ensure that they are used effectively and fairly for the benefit of the individual, the organization and the society" (Benevene & Buonomo, 2020).

Meanwhile, Tisnawati S. and Sule define human resource management as a process or effort to recruit, develop, motivate, and evaluate all human resources needed by a company to achieve its goals. This understanding includes everything from selecting anyone who has the qualifications and is appropriate to occupy a position in the company (the right man in the right place) as required by the company to how these qualifications can

be maintained and even improved and developed from time to time. The views of several experts above imply the important role of human resources in an organization, and an organization should make efforts to ensure that these human resources can function as effectively as possible (Stofkova & Sukalova, 2020).

The role of HR in achieving organizational goals is very important, so HR management must pay attention to several aspects, for example, staffing, training and development, motivation, and maintenance. De Cenzo and Robbins stated that “human resource management is the part of the organization that is concerned with the "people" or human resources aspect of management position, including recruiting, screening, training, rewarding, and appraising” (Yong et al., 2020).

In general, the HR management process is divided into five main parts consisting of:

1. Human resource planning. Planning the needs and utilization of human resources for the company.
2. Procurement personnel. The process of obtaining HR.
3. Personnel development. Human resource development includes workforce orientation programs, education, and training.
4. Maintenance personnel. Maintaining human resources includes providing awards, incentives, and health insurance.
5. Personnel utilization. Utilization and optimization of human resources including promotions, demotions, transfers, and separation (Hernita et al., 2021).

2.2. Technology and Information

The progress of human civilization coincided with the advancement of methods for transmitting information, a field that eventually became known as Information Technology. In its early stages, information technology was crafted by early humans, serving as a means to document and interpret familiar forms. They used cave walls to depict information related to their hunting activities and the animals they pursued. Today, information technology remains in a state of continuous development, with modernized methods for delivery and presentation (Gandhi et al., 2023).

Bambang Warsita's perspective on information technology is that it encompasses the facilities, infrastructure (including hardware, software, and users), systems, and methodologies required for acquiring, transmitting, processing, comprehending, storing, organizing, and meaningfully utilizing data. This viewpoint is echoed by Lantip and Rianto, who describe information technology as a discipline centered on computer-based information and emphasize its rapid evolution (Rispatiningsih, 2022). Hamzah B. Uno and Nina Lamatenggo further emphasize that information technology is a technology employed for data processing. This process encompasses actions such as acquiring, compiling, storing, manipulating, and processing data in diverse ways to generate high-quality information. This high-quality information is characterized by its relevance, accuracy, and timeliness (Shao et al., 2022).

McKeown's perspective on information technology is that it encompasses all varieties of technology employed for the creation, storage, modification, and utilization of information in its various formats. Williams, on the other hand, defines information technology as a broad category that encompasses any technology assisting in the generation, manipulation, storage, communication, and transmission of information (Pencarelli, 2020). Behan and Holme offer a complementary viewpoint, stating that information and communication technology encompasses all elements that facilitate the recording, storage, processing, retrieval, transmission, and reception of information. Taking into account the insights of these experts, one can summarize that information technology encompasses technology in the form of hardware, software, and useware, which is employed to acquire, transmit, process, interpret, store, organize, and meaningfully utilize data, ultimately leading to the acquisition of high-quality information (Masudin et al., 2021).

As per Abdulhak's classification, the utilization of Information and Communication Technology (ICT) can be categorized into three distinct types. First, ICT serves as an educational medium or tool, functioning as a supplementary aid to elucidate the presented descriptions. Second, ICT acts as a source, providing and seeking information. Third, ICT serves as a learning system in and of itself (Di Mauro & Ancarani, 2022).

In accordance with Bambang Warsita, there are generally three primary applications of information technology, including instructional computers and the internet, in the context of education and learning. These applications are as follows:

1. Learning about computers and the internet: This refers to the use of computers as educational tools or learning objects, such as in the field of computer science.
2. Learning with computers and the internet: Information technology is utilized to support and enhance the learning process based on the school curriculum. For instance, the Ministry of National Education has developed interactive multimedia CD programs for various subjects through initiatives like Pustekkom (Szymkowiak et al., 2021).

Heinich's viewpoint reinforces the idea that Information Technology (IT) encompasses all the ways computers and the internet are utilized for learning purposes. The specific forms of IT usage include:

1. A tutorial program is an instructional approach where the content is delivered in a tutorial style. This means that concepts are presented using text, as well as static or dynamic images and graphics (Chen et al., 2023)
2. Practice involves training students to develop proficiency in a particular skill or to reinforce their understanding of a concept. This type of program typically offers a series of problems or questions for students to work on (Chan et al., 2022)
3. Simulation is a format that seeks to replicate an event, whether it has occurred in reality or not. These

simulations often revolve around scenarios involving risks, such as plane crashes, disasters, and similar situations (Zhang & Mahadevan, 2021)
4. Trial or experiments are similar to the simulation format, but they are primarily focused on practical, hands-on activities, particularly in fields like science, biology, or chemistry laboratories (Lo et al., 2021)
5. Games in the context of multimedia programs pertain to the educational process, aiming to enable learning activities to take place in an enjoyable and engaging manner while playing (Syawaluddin et al., 2020).

Based on the various viewpoints mentioned above, the advantages of Information Technology (IT) can be summarized as follows:

1. IT as a source: IT serves as a valuable source of information and a means to search for the information required.
2. IT as a medium: IT acts as a tool that simplifies the delivery of information, making it more accessible and understandable.
3. IT as a developer of learning skills: It plays a role in cultivating skills based on information technology, which can be integrated into the curriculum for enhanced learning (Gherhes et al., 2021).

2.3. Teacher Competency

Teacher competence encompasses a blend of personal, technological, social, and spiritual abilities, collectively shaping the standard competencies expected of teachers. These standard competencies encompass a strong command of subject matter, a deep understanding of students, effective educational practices, personal growth, and professionalism. Furthermore, the competencies that teachers are required to possess are defined in Law Number 14 of 2005 concerning Teachers and Lecturers, Chapter IV, Article 10 (Paragraph 91). According to this law, teacher competence is categorized into four key areas: pedagogical competence, personality competence, social competence, and professional competence. These competencies are attained through professional education (Hamsiah et al., 2022)

A person's ability to complete a job is greatly influenced by his or her abilities in that field of work. Therefore, for the work to be completed well, it must be done by someone who has competence in the field of work in question. In this context, competence is characterized as the knowledge, skills, and abilities that an individual has fully internalized, enabling them to perform cognitive, affective, and psychomotor behaviors to the best of their ability (Diab-Bahman & Al-Enzi, 2020). Teacher competence plays a crucial role in the context of teaching and learning activities and, consequently, student learning outcomes. The effectiveness of teaching and the outcomes achieved by students are significantly influenced by the competence of the teacher responsible for guiding students. In essence, competence extends beyond mere possession of knowledge, skills, and attitudes; what truly matters is the practical application of these essential elements in the teaching profession (Fauth et al., 2019).

In the learning process, it is imperative for a teacher to adhere to competency standards to ensure the effective and successful execution of the teaching and learning activities. According to Ramayulis, there are four types of teacher competency, namely:

1. Personality Competencies
   Personality competencies encompass an individual's exceptional qualities, such as resilience, resilience in the face of challenges or setbacks, and a swift recovery from failures. They also include a strong commitment to learning and work, along with a positive and constructive attitude towards others (Magano et al., 2020).
2. Social Competence
   Social competence pertains to the educator's capacity, as a member of society, to engage in effective and efficient communication and interaction with various stakeholders, including students, colleagues, educational personnel, parents or guardians of students, and the broader community (Asriati et al., 2022).
3. Professional Competency
   Professional competency is the ability to master learning material broadly and in-depth (Prasetyono et al., 2021).
4. Pedagogical competence
   Pedagogical competence is the ability to understand students in-depth and organize educational learning (Shermukhammadov, 2022).

3. Method

This research aims to describe and analyze education and training to improve teacher competence. The method used in this research is an analytical method with a qualitative approach. This method was chosen to research the conditions of natural objects, where the researcher is the key instrument. Qualitative research makes it easier to analyze problem focus and means the process of exploring and understanding the meaning of individual and group behavior, describing social problems or humanitarian problems. The method used in this research is descriptive (Abdussamad & Sik, 2021).

4. Result and Discussion

4.1. General Description of Pedagogical Competencies and Professional Competencies of Elementary School Teachers

Teachers hold a pivotal role in the school's learning process, and as such, the quality of education within a school is heavily reliant on the competence and abilities of its teachers in fulfilling their responsibilities. This notion

aligns with Minister of National Education Regulation No. 19 of 2007, Article 28, which stipulates that educators must possess academic qualifications and competence as facilitators of learning, maintain physical and spiritual well-being, and be capable of realizing the goals of national education. Furthermore, in line with Mulyasa's perspective, teachers, as facilitators, are expected to create an environment that fosters enjoyable, enthusiastic, anxiety-free learning, where students feel comfortable expressing their opinions openly (Oladejo et al., 2023).

According to Minister of National Education Regulation No. 19 of 2007, a teacher is required to possess pedagogical, personal, social, and professional competencies. Among these, pedagogical and professional competencies are particularly essential. Pedagogical competency involves the ability to effectively manage student learning, encompassing an understanding of students, the design and implementation of learning experiences, assessment of learning outcomes, and the development of students to realize their full potential. This necessitates a deep understanding of students and the ability to execute a learning process that involves planning, implementation, and evaluation stages.

Professional competency pertains to the teacher's capacity to have a comprehensive and in-depth mastery of the subject matter, enabling them to effectively guide students in attaining the competency standards specified in the National Education Standards. This competency is a necessity for a teacher, because how is it possible that a teacher who does not have broad and deep knowledge of the material to be taught will be able to produce outstanding students?

The formal legal rules above emphasize that a teacher must first have academic educational qualifications, namely a bachelor's degree or graduate of the D IV program. Second, competent in their field, meaning they must have a background in educational disciplines, and third, certified educator, meaning a teacher must be certified by going through the process of having met the requirements for passing the Portfolio or PLPG assessment or granting a certificate directly based on the Minister of Education and Culture of the Republic of Indonesia Regulation No. 5 of 2012 concerning Certification for In-Service Teachers.

Improving teacher competency is not only the responsibility of each teacher but is also the obligation of the government, in this case, the Ministry of Education and Culture of the Republic of Indonesia, and the Regional Government, in this case, the Provincial Education Service and Regency/City Education Service. The government's responsibility to improve teacher competency includes educating and training teachers on an ongoing basis following teacher needs. The Karawang Regency Government, in this case the Education Office, has provided education and training for teachers to improve teacher competency. Mulyasa stated that individually, the teacher must support their competence to enrich themselves by looking for various sources of actual and interesting material. Increasing this competency can be done by the teacher personally by accessing information from internet sources. In other words, teachers can utilize information and communication technology in learning to improve their competence.

4.2. ICT Integration in Teacher Development

Integrating Information and Communication Technology (ICT) into teacher development programs is a multifaceted approach that encompasses various dimensions of teacher growth and effectiveness. The application of ICT in teacher development begins with the design and delivery of training programs. With the advent of digital platforms and online resources, training modules can be customized to suit individual teacher needs. Online courses, webinars, and virtual workshops provide educators with the flexibility to acquire new teaching skills and methodologies. This adaptability ensures that teachers receive relevant and up-to-date information, fostering their professional growth (Yurtseven Avci et al., 2020).

In addition to training, ICT plays a pivotal role in the continuous monitoring of teacher performance. Through data analytics and digital tools, educational institutions can collect real-time information on teachers' classroom practices. This data can be invaluable for assessing the efficacy of training programs, identifying areas where teachers excel or struggle, and offering personalized support. The ability to track progress and provide targeted feedback enhances the overall quality of teacher development initiatives. Evaluation of teacher development programs also benefits from ICT integration. Digital assessment tools, often interactive and adaptive, enable a comprehensive analysis of teachers' competencies. Standardized tests, peer reviews, and self-assessments can be conducted more efficiently using technology. The data collected from these evaluations assists in identifying areas of improvement and tailoring future development strategies to address specific needs.

While the integration of ICT in teacher development presents several advantages, it also brings forth challenges. One notable challenge is the digital divide, which may exacerbate disparities in access to training resources. Teachers in underserved areas or with limited access to technology may be at a disadvantage. Moreover, the rapid evolution of technology necessitates continuous teacher training to ensure proficiency in ICT tools, which can be resource-intensive. The impact of ICT on teacher development extends beyond training, monitoring, and evaluation. It has the potential to significantly enhance both pedagogical and professional competencies. The use of digital resources allows teachers to employ innovative teaching methods, engage students more effectively, and adapt to diverse learning styles. Furthermore, by streamlining administrative tasks, ICT empowers educators to allocate more time to instructional activities, contributing to their professional growth.

Nevertheless, the adoption of ICT in teacher development is not without its pitfalls. Over-reliance on

technology may diminish the personal and human aspects of education, impacting the teacher-student relationship. Additionally, data privacy and security concerns need to be addressed to ensure the responsible use of digital tools in educational settings. The integration of ICT into teacher development offers a promising pathway to improve pedagogical and professional competencies. By leveraging technology for training, monitoring, and evaluation, educators can continuously enhance their skills and adapt to the evolving educational landscape. However, it is imperative to address the challenges, including the digital divide and concerns about data privacy, to harness the full potential of ICT in teacher development.

4.3. Scalable Management Strategies

Scalable management strategies often begin with the development of standardized frameworks for teacher development. These frameworks outline the core competencies and learning objectives that educators should achieve, allowing for consistency across diverse contexts. The utilization of a common set of standards enables educators to adapt their approaches to local conditions while maintaining alignment with overarching educational goals. One common approach to scalability is the use of online platforms and digital resources. These tools facilitate the dissemination of educational materials and resources, providing educators with convenient access to training modules and professional development content. The scalability of these digital platforms allows teachers in various geographical locations to participate in training and access resources at their own pace (Busch & Barkema, 2021).

One model for scalable management in teacher development is the "train-the-trainer" approach. In this model, a select group of educators receives intensive training, becoming proficient in specific teaching techniques and strategies. These trained individuals then disseminate their knowledge and skills to a larger network of teachers, thus scaling the impact of the program. This approach has the advantage of building local capacity and expertise while reaching a broader audience. Scalability is, however, not without its challenges. One of the primary difficulties lies in maintaining the quality and effectiveness of teacher development as programs expand. Ensuring that training remains relevant, engaging, and aligned with evolving educational needs is a constant concern. Additionally, cultural and contextual differences in various school and community settings may require adaptability in the implementation of scalable strategies.

In some instances, scalability may lead to the dilution of the program's impact. As programs expand, there is a risk of losing the personalized support and individualized attention that educators may need. Striking a balance between scalability and tailored support is an ongoing challenge. The success of scalable management strategies in teacher development can be measured by their reach and impact. When effectively designed and implemented, scalable strategies can extend the benefits of teacher development to a larger number of educators. Success is also evident when participants in the program demonstrate improved pedagogical and professional competencies, leading to better student outcomes.

Scalable management strategies are a vital component of teacher development initiatives. They encompass a range of approaches, methodologies, and models that enable the effective expansion of programs to a wider audience. While the benefits are evident in their ability to reach more educators, challenges such as maintaining program quality and addressing contextual differences must be considered to ensure their success. The discussion of scalable management strategies highlights their significance in improving teacher development on a broader scale while acknowledging the complexities that come with scalability.

4.4. Enhancing Pedagogic Competencies

The enhancement of pedagogic competencies among teachers is a critical aspect of improving the quality of education. Pedagogic competencies encompass a wide range of skills and knowledge related to teaching and instruction. Through the integration of ICT in teacher development, educators can gain a deeper understanding of modern pedagogical approaches (Falloon, 2020). This includes learning to use digital tools and resources to create engaging and interactive lessons, adapting instruction to cater to diverse learning styles, and effectively using technology to support teaching and learning. Scalable management strategies, such as the "train-the-trainer" model, play a significant role in enhancing pedagogic competencies. Teachers who receive advanced training through this model often become mentors and resource persons within their communities, sharing their enriched pedagogical knowledge with their peers. This collaborative approach fosters the exchange of effective teaching strategies, further elevating the collective pedagogic competencies of educators.

Enhanced pedagogic competencies are closely linked to improved student learning outcomes. As teachers become more adept in utilizing technology and modern teaching methods, students often benefit from more engaging and effective instruction. Students are better equipped to comprehend and retain knowledge, as well as apply critical thinking skills to real-world situations. The impact of enhanced pedagogic competencies is not limited to academic achievement; it also extends to the development of essential 21st-century skills such as problem-solving, digital literacy, and communication. Measuring the impact of enhanced pedagogic competencies on student learning outcomes requires a multifaceted approach. Quantitative assessments, such as standardized test scores and academic performance metrics, provide valuable insights into the effectiveness of pedagogical improvements. Additionally, qualitative assessments, like classroom observations and feedback from students and parents, offer a well-rounded

perspective on the impact of enhanced teaching competencies.

Enhancing pedagogic competencies not only equips teachers with the necessary tools to engage students effectively but also cultivates a culture of continuous improvement within the education system. Through the integration of ICT and scalable management strategies, educators can undergo professional development that encourages reflection, adaptation, and innovation. This dynamic approach to teaching encourages teachers to evolve with changing educational landscapes and adapt to the unique needs of their students. By continually honing their pedagogic competencies, teachers can create learning environments that inspire curiosity, critical thinking, and a passion for knowledge. Furthermore, the impact of enhanced pedagogic competencies extends beyond the classroom and student performance. It influences the overall quality of the education system, promotes teacher satisfaction and retention, and enhances the reputation of schools and institutions. Effective pedagogic competencies create a ripple effect, ultimately fostering a community of educated, informed, and motivated individuals who contribute to societal development and progress. Therefore, investing in strategies that enhance pedagogic competencies represents an investment not only in the present but also in the future of education and society at large.

The enhancement of pedagogic competencies among educators is a vital component of teacher development. This improvement is facilitated through the integration of ICT and scalable management strategies, which empower teachers to employ modern pedagogical techniques. The resultant positive impact on student learning outcomes underscores the significance of investing in teacher development as a means to improve the overall quality of education. Measurement and assessment methods play an essential role in gauging the effectiveness of pedagogical enhancements and ensuring that they result in tangible benefits for students.

4.5. Enhancing Professional Competencies

The enhancement of professional competencies among teachers is a crucial component of teacher development, and it is significantly influenced by the integration of Information and Communication Technology (ICT) and scalable management strategies. These factors contribute to lifelong learning, collaborative practices, and career development, ultimately shaping the broader landscape of education. The utilization of ICT in teacher development fosters lifelong learning by providing educators with easy access to the latest pedagogical research, instructional resources, and best practices (Valverde-Berrocoso et al., 2021). This digital empowerment allows teachers to engage in ongoing professional development, enabling them to stay abreast of educational trends, innovative teaching techniques, and emerging technologies. Continuous learning through ICT ensures that teachers remain current, adaptable, and equipped to meet the evolving needs of their students.

In tandem with ICT, scalable management strategies promote collaboration among educators. By facilitating the exchange of ideas, strategies, and experiences, these approaches foster a collaborative professional community. Collaborative practices enhance teachers' professional competencies by encouraging the sharing of successful teaching methodologies, addressing challenges collectively, and creating a supportive network for mentorship. This collaborative environment nurtures a sense of belonging and purpose, motivating teachers to strive for excellence in their careers. The impact of increased professional competencies extends beyond the individual teacher. It positively affects the entire school and education system. Teachers with enhanced competencies contribute to a more dynamic and innovative educational environment, where students benefit from the latest teaching techniques and resources. Furthermore, educators who continuously develop their professional skills become role models for their peers, inspiring a culture of lifelong learning within the institution.

On a broader scale, the collective impact of professionally competent teachers contributes to the overall advancement of the education system. A well-trained teaching force ensures that students receive quality education, which, in turn, fosters societal progress. The knowledge, skills, and innovative practices shared by teachers influence the broader educational landscape, promoting systemic improvements in curriculum, teaching methods, and educational policies. Ultimately, the enhancement of professional competencies among teachers is an investment in both the individual and the educational community, with far-reaching implications for the broader education sector and society.

Moreover, the enhancement of professional competencies has a direct impact on the career development of teachers. As educators continually improve their skills and knowledge through ICT-facilitated learning and collaborative strategies, they become more versatile and adaptable professionals. This adaptability opens up new career opportunities within the education sector, such as leadership roles, curriculum development, and educational research. Professional growth can also result in increased job satisfaction and motivation, which, in turn, positively influences career longevity and retention in the teaching profession.

In addition to the individual benefits, the collective professional competence of teachers has the power to influence educational policies and practices. Educators who are well-versed in the latest research and pedagogical innovations can advocate for evidence-based approaches and contribute to the improvement of curriculum and assessment standards. By participating in decision-making processes and offering informed perspectives, teachers can play a pivotal role in shaping the direction of the education system, leading to a more effective and student-centered educational experience for all. In this way, the impact of enhanced professional competencies extends far beyond

the confines of the classroom and contributes to the ongoing development and improvement of the educational sector as a whole.

The integration of ICT and scalable management strategies in teacher development plays a pivotal role in enhancing professional competencies. These enhancements are not limited to the individual teacher; they create a culture of lifelong learning and collaboration that benefits the entire education system. The collective impact of professionally competent teachers reverberates through the educational landscape, shaping a brighter future for students and society as a whole.

5. Conclusion

Increasing teachers' pedagogical and professional competence through the integration of Information and Communication Technology (ICT) and scalable management strategies opens up new perspectives on the importance of investing in the development of teaching staff. The alignment of modern pedagogical approaches with the use of technology and efficient management strategies allows teachers to develop as more effective and competitive educators. Increasing pedagogical competence allows educators to create more dynamic and relevant learning environments for students. By incorporating innovative teaching methods, such as the use of digital tools and resources, teachers can adapt learning to students' diverse learning styles. This has a positive impact on student's learning outcomes and helps them develop critical skills that are much needed in the 21st century. Increasing professional competence also plays an important role in motivating educators to follow curriculum developments, face new challenges, and contribute to improving the education system as a whole. In addition to the benefits for teachers as individuals, improving pedagogical and professional competence has a far-reaching impact on the education system as a whole. Competent teachers act as models of change, motivating their colleagues to participate in lifelong learning and creating a collaborative work environment. In this way, developing teacher competency is an investment in improving the quality of education, establishing a culture of sustainable learning, and has the potential to make a significant contribution to the social, economic, and intellectual development of wider society. In this view, the incorporation of ICT and scaled management strategies in teacher development is the right step to unlock the potential of a brighter education in the future.

References

[1] Abdussamad, H. Z., & Sik, M. S. (2021). *Metode penelitian kualitatif*. Syakir Media Press.

[2] Archambault, L., Leary, H., & Rice, K. (2022). Pillars of online pedagogy: A framework for teaching in online learning environments. *Educational Psychologist*, *57*(3), 178-191.

[3] Asriati, S., Nappu, S., & Qalbi, N. (2022). Professional Education Program for Junior High School In-Service Teachers' Social Competence. *AL-ISHLAH: Jurnal Pendidikan*, *14*(2), 2563-2570.

[4] Azizi, M. R., Atlasi, R., Ziapour, A., Abbas, J., & Naemi, R. (2021). Innovative human resource management strategies during the COVID-19 pandemic: A systematic narrative review approach. *Heliyon*, *7*(6).

[5] Aasawari Boxey, Anushri Jadhav, Pradnya Gade, Priyanka Ghanti, & Dr.A.O. Mulani. (2022). Face Recognition using Raspberry Pi. Journal of Image Processing and Intelligent Remote Sensing(JIPIRS) ISSN 2815-0953, 2(04), 15–23. https://doi.org/10.55529/jipirs.24.15.23

[6] Ahmed Hasballa Khateeb, Qutaiba Abdulwahhab Nsaif, & Mudhar A. Al-Obaidi. (2022). Agricultural Drought Assessment in Diyala Integrating Remote Sensing and GIS Technique. Journal of Image Processing and Intelligent Remote Sensing(JIPIRS) ISSN 2815-0953, 2(04), 24–34. https://doi.org/10.55529/jipirs.24.24.34

[7] Akanksha Rajora. (2021). Exploring the Connection among Character and Occupation Execution with Exceptional Reference to North Western Railline Association. Journal of Multidisciplinary Cases (JMC) ISSN 2799-0990, 1(01), 1–10. https://doi.org/10.55529/jmc.11.1.10

[8] Benevene, P., & Buonomo, I. (2020). Green human resource management: An evidence-based systematic literature review. *Sustainability*, *12*(15), 5974.

[9] Blömeke, S., Jentsch, A., Ross, N., Kaiser, G., & König, J. (2022). Opening up the black box: Teacher competence, instructional quality, and students' learning progress. *Learning and Instruction*, *79*, 101600.

[10] Busch, C., & Barkema, H. (2021). From necessity to opportunity: Scaling bricolage across resource-constrained environments. *Strategic Management Journal*, *42*(4), 741-773.

[11] Chan, S. M. H., Mamat, N. H., & Nadarajah, V. D. (2022). Mind your language: the importance of english language skills in an International Medical Programme (IMP). *BMC medical education*, *22*(1), 405.

[12] Chen, J., Chen, H., & Li, Y. (2023). Transitions in daily search tactics: during the cross-app interaction search process. *Information Technology & People*.

[13] Di Mauro, C., & Ancarani, A. (2022). A taxonomy of back-shoring initiatives in the US. *International Business Review*, *31*(5), 102006.

[14] Diab-Bahman, R., & Al-Enzi, A. (2020). The impact of COVID-19 pandemic on conventional work settings. *International Journal of Sociology and Social Policy*, *40*(9/10), 909-927.

[15] Dirani, K. M., Abadi, M., Alizadeh, A., Barhate, B., Garza, R. C., Gunasekara, N., ... & Majzun, Z. (2020). Leadership competencies and the essential role of human resource development in times of crisis: a response to Covid-19 pandemic. *Human resource development international*, *23*(4), 380-394.

[16] Dr. Nimisha Beri, & Shivani Gulati. (2022). Cyberloafing As A Challenge For Integration Of Ict In Education. Journal of Image Processing and Intelligent Remote Sensing(JIPIRS) ISSN 2815-0953, 2(01), 1–5. https://doi.org/10.55529/jipirs21.1.5

[17] Dr. Dinesh kumar, & Abdulhamid Sanusi Ahmad2. (2022). Theoretical Models Of Technology Acceptance: A Critical Analysis & Design For Future Research. Journal of Image Processing and Intelligent Remote Sensing(JIPIRS) ISSN 2815-0953, 2(01), 6–17. https://doi.org/10.55529/jipirs.21.6.17

[18] Dr. Sobha Manakkal, Rajeenamol P T, & Sundaramoothi P. (2022). A Comparative Study of Different Topologies of Transformer less AC-DC Converters. Journal of Image Processing and Intelligent Remote Sensing(JIPIRS) ISSN 2815-0953, 2(03), 1–9. https://doi.org/10.55529/jipirs23.1.9

[19] Dr. Barsha Kalita, & Dr. Kaivalya T. Desai. (2021). Geriatric Social Work Practice: A Case Study of an Elderly Woman Tea Plantation Worker. Journal of Multidisciplinary Cases (JMC) ISSN 2799-0990, 1(01), 19–25. https://doi.org/10.55529/11.19.25

[20] Evans, J. C., Yip, H., Chan, K., Armatas, C., & Tse, A. (2020). Blended learning in higher education: professional development in a Hong Kong university. *Higher Education Research & Development*, *39*(4), 643-656.

[21] Falloon, G. (2020). From digital literacy to digital competence: the teacher digital competency (TDC) framework. *Educational Technology Research and Development*, *68*, 2449-2472.

[22] Fauth, B., Decristan, J., Decker, A. T., Büttner, G., Hardy, I., Klieme, E., & Kunter, M. (2019). The effects of teacher competence on student outcomes in elementary science education: The mediating role of teaching quality. *Teaching and teacher education*, *86*, 102882.

[23] Fatima Akther. (2022). Impact of Information and Communication Technology (Ict) On the Curriculum Upgradation and Career Aspiration of Students. Journal of Image Processing and Intelligent Remote Sensing(JIPIRS) ISSN 2815-0953, 2(05), 1–9. https://doi.org/10.55529/jipirs.25.1.9

[24] Fowsiya P A, Rajesh P, Rajkumar G, & Maheswaran K. (2022). Optimization of Energy Conversion Efficiency of PV System. Journal of Image Processing and Intelligent Remote Sensing(JIPIRS) ISSN 2815-0953, 2(02), 1–10. https://doi.org/10.55529/jipirs22.1.10

[25] Gandhi, A., Adhvaryu, K., Poria, S., Cambria, E., & Hussain, A. (2023). Multimodal sentiment analysis: A systematic review of history, datasets, multimodal fusion methods, applications, challenges and future directions. *Information Fusion*, *91*, 424-444.

[26] Gherheș, V., Stoian, C. E., Fărcașiu, M. A., & Stanici, M. (2021). E-learning vs. face-to-face learning: Analyzing students' preferences and behaviors. *Sustainability*, *13*(8), 4381.

[27] Hamsiah, A., Muzakki, A., Nuramila, N., & Fauzi, Z. A. (2022). The Role of the Professional Teacher as the Agent of Change for Students. *Al-Ishlah: Jurnal Pendidikan*, *14*(4), 6887-6896.

[28] Hernita, H., Surya, B., Perwira, I., Abubakar, H., & Idris, M. (2021). Economic business sustainability and strengthening human resource capacity based on increasing the productivity of small and medium enterprises (SMES) in Makassar city, Indonesia. *Sustainability*, *13*(6), 3177.

[29] Hemang Desai, & Birajkumar V. Patel. (2022). A Model for Gujarati News Search Engine by Link Builder and Web Crawler Algorithms. Journal of Image Processing and Intelligent Remote Sensing(JIPIRS) ISSN 2815-0953, 2(03), 10–13. https://doi.org/10.55529/jipirs.23.10.13

[30] Ida Ayu Putu Anggie Sinthiya, & Sri Ipnuwati. (2022). Ethics of Internet Use (Digital Netiquette) in UU ITE Perspective: Building a Courteous Digital Culture in the Era of Digital Transformation. Journal of Image Processing and Intelligent Remote Sensing(JIPIRS) ISSN 2815-0953, 2(04), 8–14. https://doi.org/10.55529/jipirs.24.8.14

[31] Ibrahim Najmadeen Qasim. (2022). Determine the Emotional States of People by Taking a Picture of Their Faces Using Artificial Intelligence. Journal of Image Processing and Intelligent Remote Sensing(JIPIRS) ISSN 2815-0953, 2(06), 38–46. https://doi.org/10.55529/jipirs.26.38.46

[32] Jamge S. B, Pooja N. Kalal, Preeti S. Togare, Ruchika A. Vallamdeshi, & Probhodhini P.Waghe. (2022). Wireless Power Transmission Technology. Journal of Image Processing and Intelligent Remote Sensing(JIPIRS) ISSN 2815-0953, 2(06), 32–37. https://doi.org/10.55529/jipirs.26.32.37

[33] König, J., Jäger-Biela, D. J., & Glutsch, N. (2020). Adapting to online teaching during COVID-19 school closure: teacher education and teacher competence effects among early career

teachers in Germany. *European journal of teacher education*, *43*(4), 608-622.

[34] Kadam Akanksha, Zodage Utkarsha, Kashid Sneha, Chavan Sanika, & Dr. Kazi K. S. (2022). Email Security. Journal of Image Processing and Intelligent Remote Sensing(JIPIRS) ISSN 2815-0953, 2(06), 23–31. https://doi.org/10.55529/jipirs.26.23.31

[35] Liu, J., & Bray, M. (2020). Private subtractory tutoring: The negative impact of shadow education on public schooling in Myanmar. *International Journal of Educational Development*, *76*, 102213.

[36] Lo, C. M., Han, J., Wong, E. S., & Tang, C. C. (2021). Flexible learning with multicomponent blended learning mode for undergraduate chemistry courses in the pandemic of COVID-19. *Interactive Technology and Smart Education*, *18*(2), 175-188.

[37] Magano, J., Silva, C., Figueiredo, C., Vitória, A., Nogueira, T., & Pimenta Dinis, M. A. (2020). Generation Z: Fitting project management soft skills competencies—A mixed-method approach. *Education sciences*, *10*(7), 187.

[38] Masudin, I., Lau, E., Safitri, N. T., Restuputri, D. P., & Handayani, D. I. (2021). The impact of the traceability of the information systems on humanitarian logistics performance: Case study of Indonesian relief logistics services. *Cogent Business & Management*, *8*(1), 1906052.

[39] Meijerink, J. G., Beijer, S. E., & Bos-Nehles, A. C. (2021). A meta-analysis of mediating mechanisms between employee reports of human resource management and employee performance: different pathways for descriptive and evaluative reports?. *The International Journal of Human Resource Management*, *32*(2), 394-442.

[40] Md. Jannatul Ferdous, Nayan Sarker, Chinmoy Das, Md. Tabil Ahammed, & Zayed Mohammad. (2022). Design and Analysis of A High Frequency Bow-tie Printed Ridge Gap Waveguide Antenna. Journal of Image Processing and Intelligent Remote Sensing(JIPIRS) ISSN 2815-0953, 2(02), 11–23. https://doi.org/10.55529/jipirs.22.11.23

[41] Md. Tabil Ahammed, Shadat Hossain, Md. Mehedi Hasan, Golam Rabby, & Nazmul Huda. (2022). Superior Short circuit & Overcurrent Protection of Devices Like Alternator, Transformer etc. Journal of Image Processing and Intelligent Remote Sensing(JIPIRS) ISSN 2815-0953, 2(02), 24–31. https://doi.org/10.55529/jipirs.22.24.31

[42] Madhupriya Sagar Kamuni, Tulsi Pandit Devasani, Lavanya Ramesh Nalla, & Dr Kazi Kutubuddin Sayyad Liyakat. (2022). Fruit Quality Detection using Thermometer. Journal of Image Processing and Intelligent Remote Sensing(JIPIRS) ISSN 2815-0953, 2(05), 20–27. https://doi.org/10.55529/jipirs.25.20.27

[43] Mohammed Ibrahim Mahdi. (2022). Refining Medical Image Steganography Scheme Based on Pixels Disparity Value and Huffman Coding. Journal of Image Processing and Intelligent Remote Sensing(JIPIRS) ISSN 2815-0953, 2(05), 28–52. https://doi.org/10.55529/jipirs.25.28.52

[44] Md. Saidur Rahman, Md. Abdullah Kawser, Rumman, K. M. ., Fahrin Rahman, & Rubab Ahmmed. (2022). Design and Implementation of Intelligent Railway System. Journal of Image Processing and Intelligent Remote Sensing(JIPIRS) ISSN 2815-0953, 2(05), 53–62. https://doi.org/10.55529/jipirs.25.53.62

[45] Ms. Ritu Bhatiya. (2022). A Study and Analysis on Color Coded Cryptography on Textual Data. Journal of Image Processing and Intelligent Remote Sensing(JIPIRS) ISSN 2815-0953, 2(04), 1–7. https://doi.org/10.55529/jipirs.24.1.7

[46] O'Donnell, F., & Sireci, S. G. (2022). Language matters: teacher and parent perceptions of achievement labels from educational tests. *Educational Assessment*, *27*(1), 1-26.

[47] Oladejo, A. I., Okebukola, P. A., Nwaboku, N., Kola-Olusanya, A., Olateju, T. T., Akinola, V. O., ... & Ogunlade, I. (2023). Face-to-Face and Blended: Two Pedagogical Conditions for Testing the Efficacy of the Culturo-Techno-Contextual Approach on Learning Anxiety and Achievement in Chemistry. *Education Sciences*, *13*(5), 447.

[48] Pencarelli, T. (2020). The digital revolution in the travel and tourism industry. *Information Technology & Tourism*, *22*(3), 455-476.

[49] Prasetyono, H., Abdillah, A., Djuhartono, T., Ramdayana, I. P., & Desnaranti, L. (2021). Improvement of Teacher's Professional Competency in Strengthening Learning Methods to Maximize Curriculum Implementation. *International Journal of Evaluation and Research in Education*, *10*(2), 720-727.

[50] Peer Amir Ahmad. (2021). Cyber Security Is More Than Just a Question of Information Technology. Journal of Image Processing and Intelligent Remote Sensing(JIPIRS) ISSN 2815-0953, 1(02), 1–7. https://doi.org/10.55529/jipirs12.1.7

[51] P.Rajalakshmi. (2021). A Dual-Transformer DC–DC with Variable Frequency Modulation Technique. Journal of Image Processing and Intelligent Remote Sensing(JIPIRS) ISSN 2815-0953, 1(02), 8–16. https://doi.org/10.55529/jipirs.12.8.16

[52] Payal, & Dr. Pradeep Kumar Gupta. (2021). Library Learning and Information Services of Library, its Setup, and Type of Library. Journal of Multidisciplinary Cases (JMC) ISSN 2799-

0990, 1(01), 11–18. https://doi.org/10.55529/jmc.11.11.18

[53] Qutaiba A. Nsaif, & Mudhar A. Al-Obaidi. (2022). Site Selection of Fire Station Based on GIS Approach for Baquba District Eastern Iraq . Journal of Image Processing and Intelligent Remote Sensing(JIPIRS) ISSN 2815-0953, 2(03), 14–22. https://doi.org/10.55529/jipirs.23.14.22

[54] RISPATININGSIH, D. M. (2022). The Role Of Technology In Supporting English Learning In Elementary Schools. *AKSELERASI: Jurnal Ilmiah Nasional*, *4*(3), 183-192.

[55] Rashid Manzoor Bhat, & Peer Amir Ahmad. (2022). Social Media and the Cyber Crimes Against Women-A Study. Journal of Image Processing and Intelligent Remote Sensing(JIPIRS) ISSN 2815-0953, 2(01), 18–22. https://doi.org/10.55529/jipirs.21.18.22

[56] Rasheed Ahmed R, & Siddharth. (2022). DC Microgrid - Review. Journal of Image Processing and Intelligent Remote Sensing(JIPIRS) ISSN 2815-0953, 2(05), 10–19. https://doi.org/10.55529/jipirs.25.10.19

[57] Shao, C., Yang, Y., Juneja, S., & GSeetharam, T. (2022). IoT data visualization for business intelligence in corporate finance. *Information Processing & Management*, *59*(1), 102736.

[58] Shermukhammadov, B. (2022). Creativity of a Teacher in an Innovative Educational Environment. *Journal of Higher Education Theory & Practice*, *22*(12).

[59] Sims, S., & Fletcher-Wood, H. (2021). Identifying the characteristics of effective teacher professional development: a critical review. *School effectiveness and school improvement*, *32*(1), 47-63.

[60] Stofkova, Z., & Sukalova, V. (2020). Sustainable development of human resources in globalization period. *Sustainability*, *12*(18), 7681.

[61] Syawaluddin, A., Afriani Rachman, S., & Khaerunnisa. (2020). Developing Snake Ladder Game Learning Media to Increase Students' Interest and Learning Outcomes on Social Studies in Elementary School. *Simulation & Gaming*, *51*(4), 432-442.

[62] Szymkowiak, A., Melović, B., Dabić, M., Jeganathan, K., & Kundi, G. S. (2021). Information technology and Gen Z: The role of teachers, the internet, and technology in the education of young people. *Technology in Society*, *65*, 101565.

[63] S.Renukadevi. (2021). Switching Sequence Control 31-Level Asymmetric Cascaded of Reduced Switch Count Multilevel Inverter with Multi Carrier Pulse Width Modulation. Journal of Image Processing and Intelligent Remote Sensing(JIPIRS) ISSN 2815-0953, 1(02), 17–26. https://doi.org/10.55529/jipirs.12.17.26

[64] Salunke Nikita, Chavan Sanika, Karanje Nagveni, Kalbhor Sakshi, & Dr. Kazi K.S. (2022). Announcement System In Bus. Journal of Image Processing and Intelligent Remote Sensing(JIPIRS) ISSN 2815-0953, 2(06), 1–10. https://doi.org/10.55529/jipirs.26.1.10

[65] Shweta Kumtole, Pranjali Suryawanshi, Rutuja Pawar, Aayesha Sayyed, & Dr. Kazi Kutubuddin Sayyad Liyakat. (2022). Automatic Wall Painting Robot Automatic Wall Painting Robot. Journal of Image Processing and Intelligent Remote Sensing(JIPIRS) ISSN 2815-0953, 2(06), 11–22. https://doi.org/10.55529/jipirs.26.11.22

[66] Vivek Thoutam. (2021). Physical Design, Origins and Applications of IOT. Journal of Multidisciplinary Cases (JMC) ISSN 2799-0990, 1(01), 26–33. https://doi.org/10.55529/jmc11.26.33

[67] Valverde-Berrocoso, J., Fernández-Sánchez, M. R., Revuelta Dominguez, F. I., & Sosa-Díaz, M. J. (2021). The educational integration of digital technologies preCovid-19: Lessons for teacher education. *PloS one*, *16*(8), e0256283.

[68] Yong, J. Y., Yusliza, M. Y., Ramayah, T., Chiappetta Jabbour, C. J., Sehnem, S., & Mani, V. (2020). Pathways towards sustainability in manufacturing organizations: Empirical evidence on the role of green human resource management. *Business Strategy and the Environment*, *29*(1), 212-228.

[69] Yurtseven Avci, Z., O'Dwyer, L. M., & Lawson, J. (2020). Designing effective professional development for technology integration in schools. *Journal of Computer Assisted Learning*, *36*(2), 160-177.

[70] Zhang, X., & Mahadevan, S. (2021). Bayesian network modeling of accident investigation reports for aviation safety assessment. *Reliability Engineering & System Safety*, *209*, 107371.