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Trends of education and training teacher competency in information and communication technology

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ABSTRACT

The industrial era 4.0 is a time when all fields of work involve technology. Massive technological changes occurred in the industrial era 4.0, including the world of education. The world of education must be able to produce Human Resources (HR) that can compete in the industrial era 4.0. The development of human resources, especially educators, is one of the things that must be considered in the industrial era 4.0 and education 4.0. This research is a type of Systematic Literature Review research that seeks to describe the importance of competency-based education and training to improve Information and Communication Technology (ICT) competencies in the industrial era 4.0. In this study, the authors used a variety of written sources such as articles, books, and documents relevant to the study. This study focuses on the role of competency-based education and training curricula in enhancing teachers' ICT competencies. The results of the study show that competency-based education and training are quite effective in increasing ICT competence in teachers in facing the industrial era 4.0. Therefore, recommendations for further research could be in the form of developing a competency-based education and training curriculum in improving teacher ICT competence.

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INTRODUCTION

The industrial revolution was a massive change in various fields and had a major influence on technological civilization. We never know how much the development of technology will affect human life because technological developments are still growing today. One that becomes a reference in the industrial revolution is that all work carried out by humans will later be replaced by machines.

The history of the industrial revolution began at the end of the 18th century, which was marked by the discovery of steam engines and work mechanization. This period is referred to as the era of the Industrial Revolution 1.0. At the end of the 19th century, there was a significant change seen in the industrial world marked by the presence of factories based on electrical energy. This period is referred to as the era of the Industrial Revolution 2.0. During the Industrial Revolution 3.0, which occurred in the 20th century, a very rapid development of technology was marked by the use of

electronic equipment and information technology (IT) used in the production process in factories. In this era, there is a lot of reduction in labor or laborers because the use of human labor has been drastically reduced. In the Industrial Revolution 4.0, there was a very significant change and development. At this time there was a comprehensive change in various industrial fields through the merging of digital and internet technology with conventional industries (Gabriela Pereira Carvalho and Walmir Cazarini, 2020). These changes are innovations in the Industrial Revolution 4.0, including the Internet of Things (IoT), Big Data, Printing 3D, Artificial Intelligence (AI), vehicles without drivers, genetic engineering, robots, and smart machines.

The Era of Industrial Revolution 4.0 changed the concepts and structures of work and competencies needed by the world of work. Digitalization systems in work facilitate companies in the production process. Work becomes effective and efficient and produces more production. This condition benefits the company because there is no need to add workers (employees) and can even reduce it.

The industrial era 4.0 is dominated by digital technology. Whatever the job, almost all digital. For the millennial generation, the development of technology will be easily accepted, but for generations X and previously, it will be difficult to accept and follow the times. Therefore, the ability to operate technology in the 4.0 era is needed.

Increasing the competence of workers in the industrial era 4.0 requires the world of education to improve. The world of education does not only focus on the transfer of knowledge but also the transfer of skills. The curriculum used must also be oriented to the competencies needed to face the industrial era 4.0.

Industrial Revolution 4.0 is related to the development of Information and Communication Technology (ICT). The development of ICT plays an essential role in the development of the world of education. As time develops, learning technology has experienced development. Before digital technology entered the realm of education, all learning and school administration still used manual techniques, such as printed books, manual blackboards, written administrative journals, and other manual techniques. Nowadays, a combination of technology is often found, which helps to learn easier, more interesting, more effectively, and more efficiently, such as the combination of audio-data, video, audio-video, and the internet. The internet is beneficial in meeting learning information resources and administrative implementation, such as sending letters, tasks, etc.

Information and Communication Technology (ICT) is a technology that includes all technical equipment for processing and conveying information. ICT includes two aspects, namely Information Technology and Communication Technology. The term information technology includes all matters relating to the process, use as a tool, manipulation, and information management. While communication technology is everything related to the use of tools to process and transfer data from one device to another (Sutopo, 2012). Although ICT is often equated with information technology (IT), ICT coverage is more comprehensive. ICT often describes a broader choice of type, data format, and communication. The development of ICTs continues to increase along with human needs that also continue to increase. The use of electronic-based facilities continues to emerge, such as e-wallets, e-learning, e-government, and others.

Welcoming the Industrial Era 4.0, teachers are also required to have the following five competencies: (1) Educational Competence; (2) Competence for Technological Commercialization; (3) Competence in Globalization, the world without a bulkhead, not stuttering to various cultures, hybrid competencies, and advantages of solving problems (problem solver competence); (4) Competence in Future Strategies, the world easily changes and runs fast so that it has the competence to predict precisely what will happen in the future along with its strategy; (5) Counselor Competence. To realize this, the competence and creativity of teachers are needed to face these challenges. Teachers who master the knowledge and ability to adapt to new technology and global challenges can influence students' skills and knowledge (Zulkifli, 2020).

The challenge of teacher competence during the rapid development of technology is to have strong competence and soft skills and equip students with 21st Century Skills (Fitriyah, 2019). The reality on the ground is that many teachers still have not been able to keep up with technological developments. As happened at SMP N 1 Muaro Jambi. Where some teachers have not been able to carry out the ICT -based learning process, especially compiling and making teaching materials, so

the learning process is only traditional, namely by lectures, and a little question and answer (Yantoro and Idrus, 2021). The same thing happened in SMP N 8 Bekasi, the use of technology to help the teaching and learning process is still very minimal. Especially computers as learning media. This is because the skills in computer operation are still very minimal (Wibowo et al., 2020). There are still many teachers who use products in the 80s in the sense that teachers are still teaching in conventional ways while students used modern equipment, whereas the way to teach teachers in pre-modern periods is not suitable for the character of students today (Latif, 2020). Therefore, training is needed for teachers to improve their abilities or competencies in utilizing ICT. The training program is designed in such a way as to be adjusted to developments in the era of the Industrial Revolution 4.0 so that teachers become competent and professional (Fitriyah, 2019).

In organizing training to improve competencies participants can use competency-based training models. Competency Based Training (PBK) is a training approach that emphasizes the development of skills, knowledge, and attitudes (knowledge, skills, and attitudes) to meet a competency standard (Putra et al., 2020). Previous research, has implemented a CBT training model for training and teaching imaging and sonography, and achieved good results (Fong et al., 2021; Goniewicz et al., 2021). The same thing was experienced with employee training in the company, and the implementation of competency-based training was able to improve employee competencies and performance. Even competency-based training has significant positive management of performance improvement. That means that if the implementation of competency-based training is getting better, the performance of the employee will also increase. Then, competency-based learning can be a valuable asset for learning organizations that focus on improving the performance of their employees (Chen et al., 2022; Emerson & Berge, 2018; Hani, 2020; Octhanantha et al., 2017).

In this literature study, researchers contribute to exploring the study about (1) The conditions of Teacher ICT Competencies in Indonesia today, (2) The importance of ICT competencies for teachers, and (3) the role of competency-based education and training in improving teacher competencies. This article will further highlight the application of competency-based training that can improve teacher ICT competencies.

METHOD

This research is a qualitative study using the Preferred Reporting Item for Systematic Reviews and Meta-Analytic (PRISMA) Methods. All articles that pass the selection are then reviewed and summarized based on the title, purpose, author's name, year of publication, number of respondents, research methods used, and research results. This article highlights the concepts of competency-based education and training and improves teacher competencies in the field of ICT through competency-based training.

The literature search in this study is limited to articles published in 2017-2022 and published in Indonesian and English (IC1). Search articles are done online using the search word "Education and Training, Teacher Competencies, ICT for Education, Competency Based-Training" in Title and Keywords. Other criteria included include research on the condition of teacher competencies in Indonesia today, increasing competencies with competency-based training, and research on the Industrial Revolution 4.0 (IC2). Furthermore, the excluded criteria are research in the form of a final project (thesis, dissertation, thesis, etc.). The research database used is from Google Scholar, Eric, and Taylor & Francis. The search process begins with reviewing the title and abstract of all search results and comparing them with established criteria.

A literature search can be seen in Figure 1. Search for research databases based on predetermined criteria obtained 100 research articles consisting of Google Scholar 54 articles, Eric as many as 20 articles, and Taylor & Francis as many as 20 articles. After scanning the title, abstract, and keywords 60 articles can be processed, two articles cannot be processed because they are final project research and 32 articles that cannot be processed. After all, they are not by IC2. In addition, the process that can be processed is filtered again by looking at the entire text. Twenty-six (26) articles are not processed because they are not by IC2 after being seen as all text and 34 articles can be processed as literature review material.

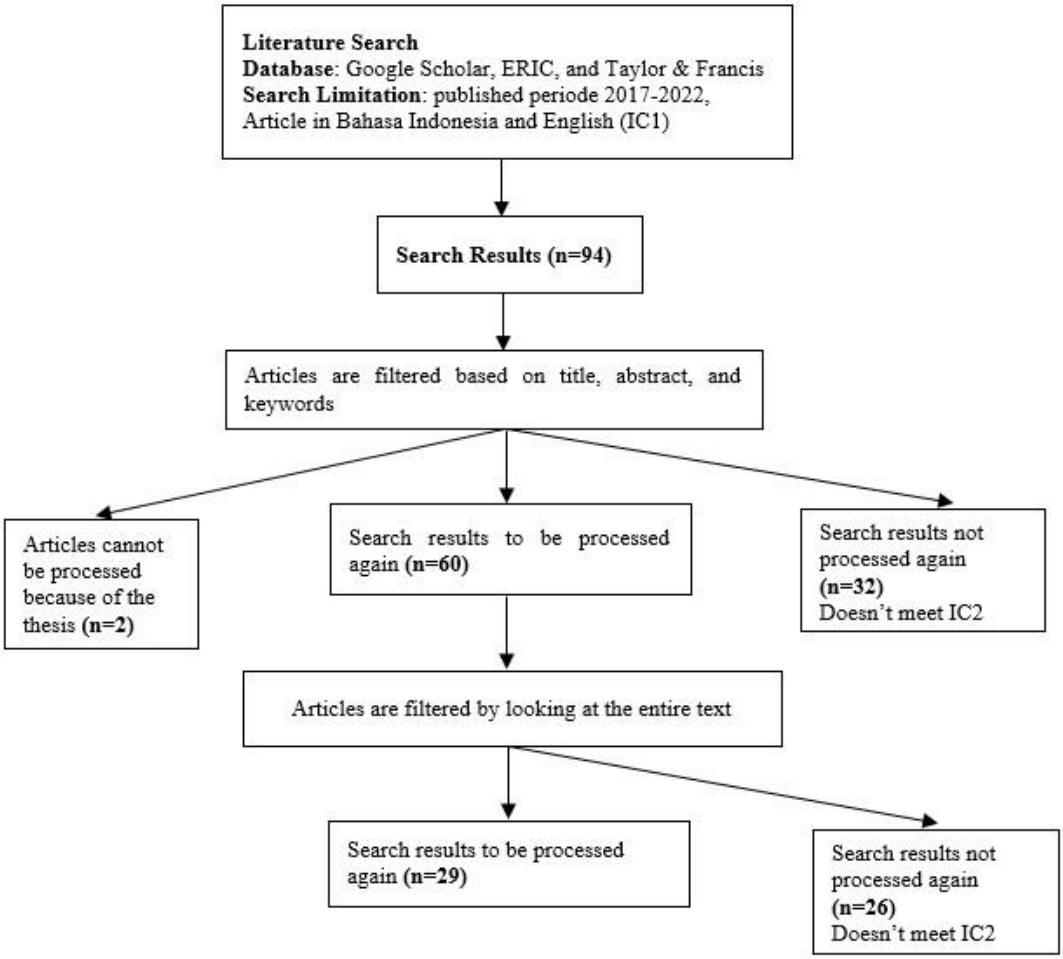

Figure 1. The Literature Search

RESULTS AND DISCUSSION

Results

Research conducted by Thabit Saleh Ahmed and T. A. Qasem (2020) with the title "Computer-Assisted Language Instruction in South Yemeni Context: A Study of Teachers' Attitudes, ICT Uses, and Challenges" gives the results that South Yemeni teachers' lack of implementing ICTs in their EFL classes. This can be attributed to many factors such as the lack of ICT tools in their departments, unavailability of the internet, and lack of computer competence and training. The study concluded with some recommendations that may help in implementing ICTs better in EFL education at the concerned universities particularly and at Yemeni universities generally. This study used a qualitative method with a sample of 81 EFL teachers.

Research conducted by Ahmed and Sayed (2020) with the title "Development of competency-based training system in Assiut ITEC: A case study" gives the results that the implementation of competency-based training not only gives students evidence to recognize their skills and knowledge but also provides information that school institution needs to improve teaching and learning. This study used a case study method. The sample used in this research is the Vocational School of ITEC, Egypt.

Research conducted by Ahmed and Sayed (2021) with the title "An extensive model for implementing competency-based training in technical and vocational education and training teacher training system for Assiut- Integrated Technical Education Cluster, Egypt" gives the results that the main feature of each competency-based training is to measure the learning that occurs in the training

program, not the time. This study used a case study method. The sample used in this research is the teacher of ITEC Assiut.

Research conducted by Amilia and Maiziani (2020) with the title "The competency of learning media based on information and communication technology by teachers in high school" gives the results that the average score of competency or mastery of ICT-based learning media in SMA Koto Tangah Padang City is included in the medium category of 45.06 %. Based on the data obtained, it is known that most of the teachers in the Koto Tangah District High School in Padang City are in the medium category (58.5%). From the survey, it was also found that the teacher still has not mastered the use of Microsoft Word and Microsoft PowerPoint applications. This will impact the optimization of ICT -based learning media in the learning process by the teacher. This study used a mixed method with a sample from the teacher at SMA Koto Tangah, Kota Padang.

Research conducted by Ardıç, Ö., and Çiftçi, H. (2019) with the title "ICT Competence and Needs of Turkish EFL Instructors: The Role of Gender, Institution, and Experience" gives the results that indicated that EFL instructors perceived their current ICT competence as low in the seven major areas. However, gender and previous PD (Performance Development) experience in ICT played a role in their perceived ICT competence. The study also revealed that regardless of gender, type of institution, previous PD experience in ICT, and teaching experience, EFL instructors reported a medium and higher amount of ICT training needs. The most preferred modes of PD in ICT were immersion or internship activities while the least preferred modes of PD were workshops/conferences/seminars. The implications of the study are also presented. This study used a quantitative method with a sample of 193 teachers of EFL.

Research conducted by Bahrissalim and Fauzan (2018) with the title "Evaluation of the training curriculum in improving the pedagogical competencies of PAI teachers at the Jakarta Religious Education and Training Center" gives the results that (1) The formulation of the training objectives and competencies of training participants in the curriculum design needs to be improved; (2) Training teaching staff guarantees the qualifications that have been determined by The Ministry of Religion Training; (3) Evaluation of the process and evaluation of post-training needs to be increased and added to monitoring and evaluation, and mentoring programs; (4) The education and training process can improve PAI teacher competencies. This study used a survey method. The sample used in this study is the Elementary School PAI Teacher Training at Jakarta Religious Training Center.

Research conducted by Batubara (2018) with the title "Competency of Information and Communication Technology for Elementary/MI Teacher (Portrait, Factors, and Efforts to Leave it)" gives the results that overview of the Competency of ICT Elementary/MI Teachers in Indonesia is in a good category and needs improvement, especially teachers in the outer regions. Some aspects of the teacher's ICT competency that are of concern are mastery of ICT devices, understanding of the design of teaching material development using ICT, and the method of using ICT devices in the classroom. ICT competency improvement strategies Teachers must involve the government, schools, teachers, professional organizations, and the community. This study uses the literature review method with the object of research being Elementary Schools Teachers in Indonesia.

Research conducted by Briones (2018) with the title "Teachers' Competency in the Use of ICT in Teaching Physics in the Junior High School" gives the results that (1) The ICT competency level of the Grade-8 Physics Teachers is proficient. The teachers are at the basic level both in Pedagogy and Organization and Administration domains; (2) The ICT-based innovative practices performed by the teachers in teaching Physics which were categorized into three themes such as (a) lesson preparation, (b) lesson implementation, and (c) collaboration; (3) There is a moderate positive correlation that exists the between the teachers' level of competency in the use of ICT and the student's performance in Physics. The relationship is found to be significant; (4) The teachers perceived that the use of ICT; helped improve students' understanding of science ideas, increases students' motivation in learning science ideas, stimulates students' interest to scientific ideas, facilitates the teaching of and learning process, and provides the teacher the opportunity to be innovative in delivering the lesson. The teachers also enumerated the top five most pressing challenges encountered that include the following; poor/no internet connection, lack of seminars and

training in ICT, lack of technical support, lack of time to plan and prepare lessons using ICT, and unavailability of ICT tools and software: and (5) An Enhancement Program entitled "ICT Competency Enhancement Program for Physics Teachers." was proposed to address the advancement of the competency level of the teachers in the use of ICT for a more innovative teaching and learning process. This study uses the descriptive-correlational design with a sample of 10 SPVs, 23 teachers, and 920 students.

Research conducted by Fajar et al. (2017) with the title "Improve the competence of high school teachers and equivalent through ICT -based learning training" gives the results achieved from the training activities that participants have increased knowledge about Microsoft Excel and learning that uses Prezi's software. This study used Descriptive Quantitative. The sample in this study is 38 students in Senior High School.

Research conducted by Calderón-Garrido et al. (2021) with the title "Music Education Teachers' Knowledge and Use of ICT at Spanish Universities" gives results that indicate that teachers are aware of the benefits of ICT in their teaching and the professional future of students. They kept the educational needs of the students very much in mind when choosing each resource. Despite knowing the benefits, the teachers did not train their students to learn how to use ICT. The biggest concern was the technological and gender gap identified. This study used Descriptive Quantitative. The sample in this study is 112 teachers.

Research conducted by Hasibuan (2021) with the title "Madrasah Ibtidaiyah Madrasah Teacher Competency Analysis in the Utilization of Information and Communication Technology in Learning (Case Study on MIN 4 Langkat)" gives the results that teacher competence in ICT is very low in the ability to use and use applications which is 52%. Furthermore, a very low indicator is found in the aspect of experience following the training, 57%. This shows that training activities are the most dominant factors that are the causes of teacher competencies in the use of ICTs in learning and therefore become the most effective solution to overcome. This study used Descriptive Quantitative. The sample in this study is teachers in MIN 4 Langkat.

Research conducted by Herliani and Wahyudin (2018) with the title "Mapping of Teacher Information and Communication Technology Competencies (ICT) in the pedagogical dimension" gives the results that ICT competencies have been mapped that can be achieved by teachers through the development of sustainable professionalism in stages in three levels of competency that are equipped with competency descriptions at each level. This research is a preliminary study of development research using the RnD method. This research develops an ICT competency framework for teachers.

Research conducted by Hidalgo et al. (2020) with the title "Digital and Media Competences: Key Competences for EFL Teachers" gives the results that training centers must provide ESL/EFL teachers with ample instruction to develop their digital and media competencies so that they can promote the active use of languages among students, motivate them towards learning, and help them become fully-prepared citizens of the 21st century. This research is a literature review research. The literature review used 68 articles relating to EFL teacher training for the development of their digital competencies.

Research conducted by Japar et al. (2020) with the title "Training in making ICT -based learning media to improve the competence of PPKn Junior High School teachers" gives the results that there are still many PPKn teachers who only rely on the lecture method so that learning becomes less interactive and seems to be centered on the teacher. In addition, the ability of PPKn teachers is still limited in utilizing and making ICT -based learning media. This study used Descriptive Quantitative. The sample used in this study was a junior high school PPKn teacher.

Research conducted by Kuşcu and Zaimoğlu (2022) with the title "The Perceptions of Turkish EFL Lecturers on Teaching through Information and Communication Technology" gives the results that the training positively affected the participants' perceptions of teaching through ICT and helped them utilize ICT implementations such as digital tools, in-class activities, lesson plans, and evaluation types. This study used Descriptive Quantitative. The sample used in this study was 15 EFL teachers.

Research conducted by Malik et al. (2018) with the title "The Competency-Based Training Model For Vocational High School Teachers From Electrical Expertise Programs" gives the results

that (1) the training model fulfilled the criteria of validity so that the model might be implemented for the training activities of electricity program vocational high school teachers; (2) the training model had fulfilled the criteria of practicality that were measured from the level of model stage (syntax) implementation; (3) the training model had fulfilled the criteria of effectiveness that had the following indicators: (a) the level of knowledge and understanding exposed by the training participants, (b) the level of teaching skills exposed by the training participants, (c) the quality of training participants' portfolio and (d) the response of the training participants and the trainers. This study uses the RnD method. The sample used in this study was 22 teachers of the electrical study program at the Vocational High School.

Research conducted by Nurbaiti (2021) with the title "Improvement of teacher competencies in making learning videos through in-house training (IHT) in SMP Negeri 26 Depok" gives the results that IHT can increase teacher competence in mastering ICTs for learning. The ability of IT teachers in SMP Negeri 26 Depok, in general has been above the average in some ways, only for making learning media that can bridge between teachers and students still a few are able. This research is a school action research, so it uses a qualitative method with data collection, namely observation and self-reflection. The research sample used was 40 teachers.

Research conducted by Nuryani and Handayani (2020) with the title "Teacher Competency in the 4.0 era in improving the quality of education" gives the results that (1) The problem of education in Indonesia today is the low quality of education compared to other countries, (2) Education 4.0 is the answer from the era of the industrial revolution 4.0 in the world of education. (3) The role of teachers is irreplaceable in the industrial revolutions 4.0 era. This research is a literature review research. The articles analyzed are those related to increasing teacher competency in the 4.0 era.

Research conducted by Özgür (2020) with the title "Improving Teachers' Qualifications for Preparing ICT-Based Educational Materials" gives the results that teachers' scores on the TPACK-deep scale increased significantly compared to the pre-study. It was also shown that the in-service training activity that was carried out increased the knowledge and skills of teachers about current technologies that can be used in the learning-teaching process, as well as increasing their self-confidence and self-efficacy for developing ICT-based educational material. As they adopted the use of ICT-based educational materials prepared within the scope of in-service training during school courses, teachers have also been shown to report that students' interest, desire to participate, curiosity and excitement, and motivation towards the lesson had increased. On the other hand, teachers who teach lessons with ICT-based educational materials stated that they felt their selves more useful in lessons, their performance increased, and that such materials facilitated the teaching in crowded classrooms. This research is an action research study with 40 samples used.

Research conducted by Puspita et al. (2019) with the title "Implementation of Information and Communication Technology (ICT) State High School Teachers in North Banjarmasin District" gives the results that the teacher has implemented ICT in learning, including a high category of 84.4%. ICT implementation in communication includes the teacher communicating with students, parents of students, fellow teachers, school committees, and residents around the school environment, including low categories, namely 62.5%, because teachers rarely socialize with school committees, school environment, students, and parents. This research uses a quantitative descriptive method. The sample in this study is 123 teachers of SMA Negeri in Banjarmasin Utara.

Research conducted by Putrawangsa and Hasanah (2018) with the title "Integration of Digital Technology in Learning in the Industrial Era 4.0 (Study from the Perspective of Mathematics Learning)" gives the results that the basic principle in the integration of digital technology in learning mathematics, namely the use of technology does not result in poor understanding of conceptual or replacing the role of students' intuition in mathematics. Conversely, the technology aims to improve students 'conceptual understanding and develop students' intuition abilities in mathematics. Three Dedactic Functions of Digital Technology in Mathematics Learning; (a) Technology for Doing Mathematics; (b) Technology for Practicing Skills; (c) Technology for Developing Conceptual Understanding. This research is a literature review study. The articles analyzed are articles related to the implementation of ICT in learning, especially mathematics to face the industrial revolution 4.0.

Research conducted by Susilo and Rohman (2018) with the title "Increasing the teacher's ICT competency as a learning innovation in the digital age" gives the results that there is an increase in teacher competence in developing and creating an IT-based learning media. This shows that the teacher's ICT competence is a provision to innovate in developing children's learning in digital times that have developed so far. This research is an action research study with Early Childhood teachers as samples used.

Research conducted by Syahrial et al. (2022) with the title "Professional teachers: Study of ICT capabilities and research competencies in urban and rural" gives the results that there is a relationship between teacher professionalism, ICT competence, and research competence. This finding is that there is a relationship between ICT competence and research competence simultaneously on teacher professionalism. It was stated that the ICT competence of teachers and the insight into teachers' research abilities affected teacher professionalism. It shows that teacher competence is the spearhead of students' understanding and implementation of teaching in schools. This research uses mixed methods. The sample used was 120 teachers.

Research conducted by Ulandari and Santaria (2020) with the title "Teacher Professionalism Development Strategies Through Education and Training" gives the results that in carrying out education and training there are several stages carried out, namely analysis of needs, determination of targets, determination of program content and program evaluation. Education and training is a development strategy that aims to improve teacher competence both from knowledge, skills, and attitudes. This research is a literature study in which the articles analyzed are related to the development of teacher competence through training.

Research conducted by Vilppola et al. (2022) with the title "Teacher Trainees' Experiences of the Components of ICT Competencies and Key Factors in ICT Competence Development in Work-Based Vocational Teacher Training in Finland" gives the results that work-based VET teacher training has the potential to develop teacher trainees' ICT competencies because it allows immediate implementation and experimentation concerning new ICT ideas and tools. By aligning this research with prior research, it is possible to construct a comprehensive ICT competence framework to support VET teacher training and workplace development. Six main ICT competence components were identified during the work-based training: (1) The use and creation of digital learning materials, (2) the planning and use of digital learning environments, (3) synchronous digitally enhanced teaching, (4) general ICT competencies, (5) digital interaction, and (6) digital assessment. This research uses a descriptive qualitative method with 44 teachers as a sample.

Research conducted by Wenely (2018) with the title "Efforts to improve the ability of teachers in the use of Information and Communication Technology (ICT) in TK Aisyiyah Dumai City" gives the results that the implementation of ICT workshops in improving teacher competencies in terms of use of ICTs as a teaching medium in the second cycle has been running as expected. This research is an action research study with 5 Early Childhood teachers as samples used.

Research conducted by Wibowo et al. (2020) with the title "Utilization of ICT learning in optimizing the teaching and learning process of junior high school teachers" gives the results that the use of technology to help the teaching and learning process is still very minimal. Especially computers as learning media. This is because the skills in computer operation are still very minimal. The results show that this activity can familiarize the teacher to use several additional programs in learning such as macro media, movie makers, power points, and Microsoft word, the average results of both theory and practice are good enough. It can be concluded that community service activities can help teachers and learning processes in class. This research is an action research study with 69 Junior High School teachers as samples used.

Research conducted by Yantoro and Idrus (2020) with the title "Training on improving teacher competencies in improving the quality of ICT -based learning at SMP Negeri 1 Muaro Jambi" gives the results that some teachers at SMP N 1 Muaro Jambi have not been able to carry out the ICT -based learning process, especially compiling and making teaching materials, so that the learning process is only traditional, namely by lectures, a little question, and answer. This research is an action research study with 37 teachers at SMP N 1 Muaro Jambi as samples used.

Research conducted by Yoon (2018) with the title "The effectiveness analysis for the education and training of research equipment in South Korea" gives the results that the education and

training characteristics, particularly the education and training environment and the educator and trainer, were found to influence learner satisfaction. Job creation, treatment improvement, the certificate system, and an education and training program were also found to be needed to boost the effectiveness of education and training on research equipment handling. Education and training on research equipment handling can contribute to the more effective and efficient operation of research equipment, and the national research equipment management system. This study uses a qualitative method. The sample used in this study was 50 people.

Discussion

The Current Condition of The Teachers' ICT Competency

Education 4.0 is education that is much influenced by the Industrial Revolution 4.0, where the learning process implements the existence of digital technology (cyber system). Implementing learning with digital technology is possible not limited by space and time. Students can learn anytime and wherever they want. Utilization of digital technology for learning is still homework for the world of education in Indonesia. The challenge of education in the era of the industrial revolution 4.0 is how to change the way students learn, think, and act while developing creative innovations in various fields. There is no choice in facing the challenges of the industrial revolution, where all lines of society must move forward and develop, not just stand still. That is the condition of the Indonesian education system that should follow the times or will be lagging. Because the world has chosen to advance digital technology in all fields, including education.

The role of the teacher as a facilitator in the implementation of education must be able to provide convenience for students to learn the learning delivered. The convenience obtained by students, namely the teacher provides learning media. Learning media functions to help teachers in delivering material and attracts the attention of students to learn. The problem that occurs lies in the ability of teachers who are less optimal in developing media, especially ICT which is a more interesting learning media. This is a teacher's need to always innovate with technology so that it can create real and interesting learning media that can stimulate optimal child development (Susilo and Rohman, 2018).

ICT competencies that need to be possessed by teachers can refer to the framework of ICT competencies for teachers that have been developed by United Nations Educational Scientific and Cultural Organization (2018), as in Figure 2.

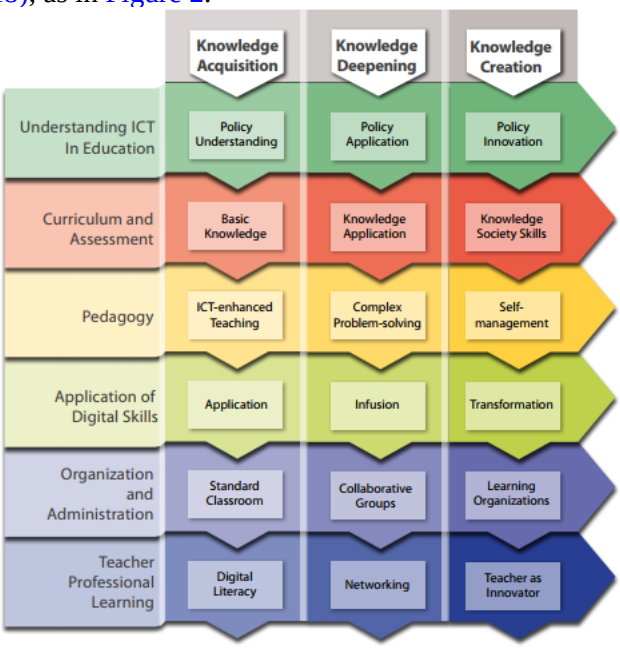

Figure 2. Framework ICT for Teacher

The study also explained the ICT competency that the teacher must have in Table 1 (Herliani and Wahyudin, 2019).

Table 1. ICT Competency Framework

Component	ICT Competency		
	Technology Literacy	**Knowledge Deepening**	**Knowledge Creation**
Teacher Competence	The teacher must know where with whom, when (and when not), and how to use ICTs for learning and presentation activities.	Teaching in this approach is centered on students. The teacher's role is to provide structured tasks, guide students to understand, and support students in collaborative projects. The teacher must have the skills to help students create, apply, monitor, and provide solutions in their project plans.	The teacher's role in this approach is that explicitly model the learning process and create a situation in which students apply cognitive skills and guide them in achieving skills. The teacher also collaborates with colleagues in applying an educational setting that is activated with ICT.

Other research from Vilppola et al., (2022) explained that six components of ICT competencies must be mastered by the teacher in training, namely (1) the use and manufacture of digital learning materials; (2) Planning and use of the digital learning environment; (3) teaching synchronous that is digitally increased; (4) General Competence of ICT; (5) Digital interaction; (6) Digital assessment. The competency of ICT utilization is also found in pedagogical competencies and professional competencies, namely the indicator "Utilizing Information and Communication Technology for the sake of implementing an educational development activity" contained in pedagogical competencies and indicators "Utilizing Information and Communication Technology for Communicating and Developing Self" on professional competence. Both of them can be concluded that teachers must be able to use ICTs in the learning process, communication, and self-development

But based on the results of the researcher's analysis, there are still teachers who do not have ICT competencies and have not used optimal ICT in their learning activities. Research from (Hasibuan, 2021) also shows that teacher competencies in ICT are very low, reaching a percentage of 52%. The very low ability in the study lies in the ability to use and use applications. Furthermore, a very low indicator is found in the aspect of experience following the training, 57 %. This shows that training activities are the most dominant factors that are the causes of teacher competencies in the use of ICTs in learning and therefore become the most effective solution to overcome these problems. The results of other studies (Batubara, 2018) say that the description of the competency of ICT Elementary/MI teachers in Indonesia is in a sufficient category and needs to be improved, especially for teachers who are in the outer regions. Junior high school teacher competence also has the same condition, which is necessary to increase ICT competencies. In the learning process in junior high school based on the results of the article analysis shows that the lack of optimal use of ICTs, especially in the use of learning media (Japar et al., 2020; Nurbaiti, 2021; Wibowo et al., 2020; Yantoro and Idrus, 2021). Likewise, high school-level teachers are also less optimal in the use of ICT -based learning media (Amilia and Maiziani, 2020; Fajar et al., 2017). Utilization of ICT not only in the learning process, but in the communication process in schools can also use ICTs, but what happens in public high schools in North Banjarmasin District also has not utilized ICT optimally in the communication process (Puspita et al., 2019).

The Importance of ICT Competence for Teachers

At present students are used to the rapid flow of information and industrial technology 4.0. This shows that students who graduate must be able to answer the challenges of industry 4.0. The results of educational products must be able to print and produce quality generations to be able to

compete with the flow of technology and information development. Therefore, educators are required to be able to increase their competence to meet the teaching criteria in the education era 4.0.

The development of technology in the era of the Industrial Revolution 4.0 is very fast, and it brings significant changes to the education system in Indonesia. This significant change in the education system affects the role of the teacher as an educator. Teachers are required to have technological competencies and information that are qualified to be able to produce graduates of students who can adjust to the development of technology today.

Some studies have shown that ICT competencies are important for teachers, in addition to optimizing learning and also for teacher self-development. The teacher realizes that there are many benefits of ICT in the learning process and also aware of good practices in the use of ICT because it can help the future of their students (Calderón-Garrido et al., 2021). The use of ICTs in learning is very important, as stated by Palacios Hidaldo in his research that there are many learning resources available as teaching teacher material, and their benefits in learning language are very good because of the communicative nature of the learning resources. However, students will not get maximum results if the teacher cannot integrate it in the right way. Therefore, training is needed for teachers to develop their ICT competencies (Hidalgo et al., 2020). Furthermore, one of the benefits of ICT is an interesting material for various types of learning. If students experience obstacles in material, other materials can help them in overcoming these obstacles (Kuşcu and Zaimoğlu, 2022). ICT can also be a trigger for student interaction in learning both written and verbal when learning English. Not only in English lessons, and in mathematics learning, but ICT can also increase students 'conceptual understanding and develop students' intuition abilities in mathematics. They also said there were three didactic functions of digital technology in learning mathematics, namely (1) Technology for doing mathematics; (2) Technology for Practicing Skills; (3) Technology for Developing Conceptual Understanding (Putrawangsa and Hasanah, 2018).

Teachers in the era of the Industrial Revolution 4.0 must have five competencies, namely: (1) Educational competence, namely the ability of teachers in internet-based teaching as basic skills, (2) competence for technological commercialization, namely the ability of teachers to educate students to have an entrepreneurial attitude based on technology innovation, (3) Competence in Globalization, i.e., teachers must have the competence to apply learning by taking more global topics and the latest issues related to globalization so that students do not stutter on various cultures, have hybrid competencies and excellence in solving problems (Problem Solver Competition). (4) Competence in Future Strategies, namely the ability of teachers to teach that refers to the future, the teacher can implement a learning strategy that helps students to prepare themselves to deal with a world that quickly changes. (5) Counselor Competence, which is a competency where the teacher can become a counselor, not only the problem of students in learning but also related to psychological problems because in the future the process that is faced by children not only learning difficulties but also psychological problems (Nuryani and Handayani, 2020).

Teachers are pillars of education, therefore the success of education in a country is greatly influenced by the strategic role of teachers. Therefore, it is necessary to increase teacher competence to face an age that continues to develop. Supported by the pattern of education in the 21st century where education is required to guarantee students have learning skills and innovation, skills to use technology and information media, and can work and survive by using life skills (life skills). The teacher is required to create creative and innovative learning by integrating ICT into learning activities to equip students to develop themselves as lifelong learners by having information literacy skills, media literacy, and ICT literacy (Herliani and Wahyudin, 2019).

Improved ICT competencies can help teachers communicate with colleagues online, can make teaching materials by utilizing internet sources, and also help in completing administration. In addition, using ICTs in learning can increase students' understanding of teaching materials, increase motivation, stimulate interest, and provide learning process facilities (Briones, 2018). These benefits must, of course be accompanied by adequate resources so that the implementation of learning is more optimal. The use of ICT is very meaningful when implemented into the learning process, as evidenced by learning in public high schools in Edirne Province, Turkey. The results showed that when the teachers adopted the use of ICT-based material that was prepared during in-service training,

the teachers reported that interest, desire to participate, curiosity, excitement, and motivation of students towards the lesson had increased. On the other hand, teachers who teach ICT -based lessons state that they feel more useful in lessons, their performance increases, and the material facilitate learning in classrooms full of students (Özgür, 2020). The development of teacher ICT competencies also affects the professionalism of teachers. If the teacher's professionalism is optimal, the learning carried out will also be optimal and can achieve optimal educational goals as well. This shows that teacher competence is the spearhead of students' understanding and the implementation of learning in schools (Syahrial et al., 2022).

Improved teacher competencies related to the use of Information and Communication Technology (ICT) are an urgent need to become a professional teacher in the 21st century (Herliani and Wahyudin, 2019). However, not all teachers can use ICT. Therefore, the development of learning with the existence of technology must be followed by the development of resources for educators. To support the development, facilities or facilities related to technology, information, and communication are also needed so that synchronization will occur, when teachers are required to develop to face technological developments, the infrastructure needed must be available.

The Role of Competency-Based Education and Training on Improving Teacher Competencies

Development of Educators' Resources can be done by conducting education and training in competency-based teaching staff. Competency-based education and training (education) or in English known as competency-based training (CBT) is a structured training and assessment approach that allows individuals to obtain skills and knowledge to carry out simple or complex tasks for certain standards. CBT focuses on (a) Implementation of tasks and obligations by individuals; (b) conditions in which they must carry out these tasks and obligations; and (c) their standard for performing (International Labour Organization, 2020).

Education and Training must be competency-based because training is an activity to improve one's competence so that there is no employee competency gap in an organization or institution. His activities are competency-based because it focuses on mastering work competencies to improve work performance. State Training Board Victoria Australia (Brown, 1994) views competency-based training as a system consisting of: outcomes, namely the specific skills standards that will be produced; Curriculum, which is a package of material that will be obtained during the training; Delivery, which is the training method, which was chosen by adjusting the abilities that the participants had because in general participants who took part in the training had previous abilities but were not optimal so it needed to be improved by following the training; Assessment, which is an assessment to find out what competencies have been mastered by participants as a result of training; Record, which is a note about the competencies that have been obtained from training.

According to the Confederation of Australian Industry (CAI) (Brown, 1994), competency-based training is training that exercises what is needed in work (outcomes). Thus competency-based training does not care about how the training is carried out (input). In other words, competency-based training is more concerned with the special standards demanded by the world of work than a person's relative achievements than members of his group. Meanwhile, according to Veetac (Brown, 1994), competency-based training is regarding the acquisition of the ability to demonstrate special skills and special knowledge and their applications according to the minimum industrial capability standards (the world of work) as stated by the Australian National Training Council (NTB).

Based on the curriculum model (Brown, 1994) there are three main components of competency-based training (CBT) that we should pay attention to. First, the existence of competency standards firmly formulated by professional organizations or by users of training graduates compiled based on real needs in the work to be undertaken. Second, there is a quality training program design (curriculum). Third, the implementation of quality training uses methods or approaches that provide the greatest opportunity to achieve training goals.

Foyster (Brown, 1994) revealed that in essence when talking about CBT, it should fundamentally re-seen the role of the participants in the training process. He more clearly stated that: In PBK the study needs of the training not first see the needs of the individual training participants solely, but try to bring up descriptive about what the community needs or the needs of the world of

work (school). Veetac (Brown, 1994) revealed that in Australia competency-based training could be viewed from two points of view, namely as a vocational education system and training, as well as a learning approach.

As a CBT system consists of a series of interrelated processes, which include: (1) Development of National Competency Standards, (2) Competency-Based Curriculum Development to meet the above competency standards, (3) training accreditation, (4) training (4 Delivery), (5) ability test system, (6) certification.

As a learning approach, CBT has the following uniqueness: gives a strong emphasis on what can be carried out by the training participants (what the learner can do), more focusing on achieving learning outcomes (outcomes) than the learning process or time achieved to achieve the learning outcomes (Mastery Learning); It is very concerned about the acquisition of the ability of learning outcomes and the ability to demonstrate it through the application of knowledge and skills by the level of competency that has been set and recognized nationally. CBT is closely related to concern for the achievement and use of national competency standards flexibly at the company level, while not ignoring aspects of competency transfer at the national level.

Table 2 shows some differences between competency-based training and traditional training (Blank, 1982).

Table 2. The Difference Between Competency-Based Training With Traditional Training

No	Characteristics	CBT	Traditional
1	WHAT (Material learned)	1. Competencies that will be owned by participants after the training program is firmly formulated by the tangible needs of the work that will be undertaken by the participants. 2. The training program is designed with competency units that must be mastered by participants.	1. The results of the training are more theoretical, textbook oriented and do not refer to the needs of real participants in their work. 2. Training programs are designed with units, blocks, or other units.
2	HOW (How to learn participants)	1. Training is designed well. 2. Participant oriented. 3. Learning media are designed so that participants master each competency. 4. Feedback from participants is used as a reference for improving the training process.	1. The course of the training depends on the instructor. 2. The training method is more directed to lectures, discussions, and other activities that are lecture centered. 3. Opportunities to request feedback for small participants during the training process.
3	WHEN (Participants switch from one skill to another skill)	Each participant is provided with adequate time by his ability to master certain competencies completely before switching to the next competency.	Usually, the group is used as a basis for determining the time or mastery of the training unit to switch from one unit to the next.
4	IF (The results obtained if the participants practiced consequently)	1. It takes a high ability of each participant to master a competency according to their work needs. 2. The results of the training are referred to the competency standards that have been designed at the beginning of the training program.	The training results are determined by the results of the test that is usually compared to other participants in groups (NRT) although maybe someone has not fully mastered the training material or failed in a training unit.

Blank (1982) also stated that if it were developed and carried out carefully, competency-based training would be better than traditional training, especially related to outcomes for training participants. Of course, there were many other advantages. More detailed Blank also stated that some things that seemed to be increasing or better than the traditional approach, including that participants learn better, also get higher test scores, participants gain a high level of ability, the experience achieving success in the participants is experienced faster So that their learning motivation becomes high, feeling comfortable with training and their concepts to increase, at the same time can be obtained better learning outcomes, low learning outcomes can be increased, drop out can be reduced, the participants are more responsible for themselves, Instructors can further serve participants according to their needs, even though the instructor is disturbed, the program continues to run well, the participants are busier with their duties than doing less useful things. More than all that has been stated above, the implementation of the training program becomes more professional, more providing to improve morality in instructors, participants, and also the administrative staff. However, an increase in many things stated above is very dependent on the effectiveness of the programs carried out and how hard the efforts made by all the elements involved in the training program to carry out their respective duties.

Implementation of Competence-Based Training Teachers not only provide teacher participants describe information related to the skills and knowledge they have, but also provide the information education unit they need to improve teaching and learning (Ahmed and Sayed, 2020). Because the main principle of every competency-based training is to measure the learning that occurs in the training program instead of the length of time attending training (Ahmed and Sayed, 2020). The competency-based training model applied in the Teacher Training of Makassar City Electricity Vocational School and Gowa Regency showed that the ability of teachers to increase. The level of knowledge and understanding of the training participants of training materials included in the high category based on pre-test and post-test results. The level of teaching skills of teacher participants is included in a good category based on peer-teaching activities. The quality of the portfolio results of the development of learning devices is included in the good category. These results can be concluded that the training model used is effective to improve the competence of the SMK Teacher Electricity Program (Malik et al., 2018).

Competency-based training is training that implements a competency-based curriculum based on the need for the competency of the training participants. To meet the demands for the development of the era and conditions in the community, the development of the training curriculum needs to be carried out. Its development remains in the delay of curriculum development foundations, namely the foundation of philosophy, psychology, sociology, and science and technology. Research from some of the experts above about the effectiveness of competency-based training in improving the competencies of participants can be concluded that applying competency-based training in learning can improve participant competencies

Regarding the organization of training, the implementation of ICT workshops for teachers in Aisyah City Dumai City can improve teacher competencies in terms of the use of ICTs as teaching media. The results showed that there was an increase in teacher competency in the use of ICT after one week of taking part in the ICT and teaching workshop using ICT (Wernely, 2018). EFL instructors in Turkey also agreed that the self-development model they interested in attending a workshop/conference/seminar, which was a form of training (Ardıç and Çiftçi, 2019).

The use of ICT in teaching EFL at South Yemen University during observations shows that there is still a lack of implementation of ICT by teachers in learning because of infrastructure that does not support and lack of competence of ICT teachers. Then, one of the recommended ways to improve the teacher's competence is to provide training on computer skills and how to use ICT for teaching and learning language (Thabit Saleh Ahmed and T. A. Qasem, 2020).

The Jakarta Religious Education and Training Center which has a goal, one of which is to analyze the results of increasing pedagogical competencies after participants attended the training, showed that the education and training process could improve the competency of PAI teachers (Bahrissalim and Fauzan, 2018). The same thing was also shown in the results of research related to the implementation of training for handling research equipment to increase professionalism that there is an influence between the training environment and instructors with participant satisfaction. Even

so, training infrastructure also affects the satisfaction of participants and needs to be improved so that the competencies of participants also increase (Yoon, 2018).

The same research on the training of corpse maintenance workers from the National Function Directors Association (NFDA) and Cremation Association of North America (CANA) in the mitigation and management of diseases is very contagious and important to do. This is to improve workers' competencies to minimize transmission, it is even expected that transmission from the very infectious disease (Le et al., 2017). Therefore, education and training are the development strategies that aim to improve competence in terms of knowledge, skills, and attitudes. Training will be able to improve the professionalism of teachers so that things that can be done a teacher must have the competence and improve which will later help them to carry out their duties (Ulandari and Santaria, 2020).

Research from several experts on the Effect of Education and Training on the Improvement of Participants' Competencies can be concluded that education and training influence increasing the competencies of participants. However, the positive influence and effectiveness of the implementation of education and training must be accompanied by an analysis of comprehensive training needs. Often organizations fail to organize training that makes a real contribution to the organization's goals because it is not to the actual needs of the field (Fisher and Frank, 1992). The role of needs analysis in the development of training is very crucial. Analysis of needs plays a role in determining the allocation of training effectively (Schuler and Huber, 1993). In addition, needs analysis is also a way to predict the possibility of various employee performance problems and alternative solutions (Cline and Seibert, 1993). Needs analysis is one of the things that need to be considered in developing the training curriculum, in addition to other contextual factors such as the company's financial factors (Arogundade et al., 2019). As with research on CSL teacher training, this activity is carried out before organizing training and is an integral part of designing training to obtain a comprehensive picture of the skills, knowledge, and behavioral attitudes needed to improve their performance. From this analysis, it will be known what training is relevant to an organization at this time and also in the future. The organization cannot just determine the training without first analyzing the needs and objectives of what to achieve. The needs assessment is a road map to achieve organizational goals and also a basis for policymakers in their efforts to improve the quality of human resources (Cai, 2017).

CONCLUSION

Teachers are pillars of education, therefore the success of education in a country is greatly influenced by the strategic role of teachers. Therefore, it is necessary to increase teacher competence to face an age that continues to develop. The utilization of ICTs that are less optimal by teachers in learning becomes a challenge that must be completed to improve the quality of education. Increasing teacher competencies related to the use of Information and Communication Technology (ICT) is an urgent need to become a professional teacher in the 21st century. Development of Educators' Resources can be done by conducting education and training in competency-based teaching staff. Competency-based education and training (education) or in English known as competency-based training (CBT) is a systematic learning approach. Research Some experts on the effectiveness of competency-based training can be concluded that the application of competency-based training in training can improve the competencies of training participants. Likewise with research on the effect of education and training that can be concluded that education and training influence increasing the competencies of participants. However, the positive influence and effectiveness of the implementation of education and training must be accompanied by an analysis of comprehensive training needs. Analysis of Training Needs or Training Needs Assessment (TNA) is a step taken before carrying out training and is an integrated part of designing training to obtain a comprehensive picture of the material, time allocation of each material, and learning strategies that should be applied in organizing training so that training is useful for trainees. Therefore, further research recommendations can be in the form of the development of a competency-based training curriculum in improving teacher ICT competencies

REFERENCES

Ahmed, A., & Sayed, K. (2020). Development of competency-based training system in Assiut-ITEC: A case study. *The Journal of Competency-Based Education*, *5*(3). https://doi.org/10.1002/cbe2.1217

Ahmed, A., & Sayed, K. (2021). An extensive model for implementing competency-based training in technical and vocational education and training teacher training system for Assiut-Integrated Technical Education Cluster, Egypt. *The Journal of Competency-Based Education*, *6*(2). https://doi.org/10.1002/cbe2.1245

Amilia, W., & Maiziani, F. (2020). Kompetensi Media Pembelajaran Berbasis Teknologi Informasi dan Komunikasi oleh Guru di SMA. *Jurnal E-Tech*, *8*(2). https://doi.org/https://doi.org/10.24036/et.v8i2.110984

Ardıç, Ö., & Çiftçi, H. (2019). ICT Competence and Needs of Turkish EFL Instructors: The Role of Gender, Institution, and Experience. *Eurasian Journal of Applied Linguistics*, *17*(1), 153–173. https://doi.org/10.32601/ejal.543791

Arogundade, L., Akinwumi, T., Molemodile, S., Nwaononiwu, E., Ezika, J., Yau, I., & Wonodi, C. (2019). Lessons from a training needs assessment to strengthen the capacity of routine immunization service providers in Nigeria. *BMC Health Serv Res 19*, 664. https://doi.org/10.1186/s12913-019-4514-2

Bahrissalim, B., & Fauzan, F. (2018). Evaluasi kurikulum pelatihan dalam meningkatkan kompetensi pedagogik guru PAI di balai diklat keagamaan Jakarta. *Edukasia : Jurnal Penelitian Pendidikan Islam*, *13*(1), 25. https://doi.org/10.21043/edukasia.v13i1.2779

Batubara, D. S. (2018). Kompetensi Teknologi Informasi dan Komunikasi Guru SD/MI. *Muallimuna*, *3*(1), 48–65. https://ojs.uniska-bjm.ac.id/index.php/jurnalmuallimuna/article/view/954/806

Blank, W. E. (1982). *Handbook For Developing Competency-Based Training Programs*. Prentice Hall, Inc.

Briones, C. B. (2018). Teachers' Competency on the Use of ICT in Teaching Physics in the Junior High School. *KnE Social Sciences*, *3*(6), 177. https://doi.org/10.18502/kss.v3i6.2380

Brown, M. (1994). *An introduction to the discourse on competency-based training (CBT)*. Deakin University.

Cai, W. (2017). Competency-Based Education: A New Perspective on CSL Teacher Training Mode Construction. *Proceedings of the 2017 2nd International Conference on Humanities and Social Science (HSS 2017)*. https://doi.org/10.2991/hss-17.2017.43

Calderón-Garrido, D., Carrera, X., & Gustems-Carnicer, J. (2021). Music education teachers' knowledge and use of ICT at Spanish universities. *International Journal of Instruction*, *14*(2), 831–844. https://doi.org/10.29333/iji.2021.14246a

Chen, S., Zhang, C., & Li, W. (2022). The effects of competency-based training model in the training of new nurses: A meta-analysis and systematic review. *PLoS ONE*, *17*(11 November). https://doi.org/10.1371/journal.pone.0277484

Cline, E. B., & Seibert, P. S. (1993). Help for First-Time Needs Assessors. *Training & Development*.

Emerson, L. C., & Berge, Z. L. (2018). Microlearning: Knowledge management applications and competency-based training in the workplace. *Knowledge Management & E-Learning: An International Journal (KM&EL) Knowledge Management & E-Learning*, *10*(2), 125–132. https://doi.org/10.34105/j.kmel.2018.10.008

Fajar, M. Y., Rohaeni, O., Permanasari, Y., A, A. I., & Mulkiya, K. (2017). Meningkatkan kompetensi guru SMA dan sederajat melalui pelatihan pembelajaran berbasis TIK. *ETHOS (Jurnal Penelitian Dan Pengabdian)*, *5*(2), 175. https://doi.org/10.29313/ethos.v5i2.2347

Fisher, S. A., & Frank, G. B. (1992). Gaining the most from your training dollars: A systems approach to staff training. *National Public Accountant*.

Fitriyah, R. N. (2019). Pengembangan kompetensi guru di era revolusi industri 4.0 melalui pendidikan dan pelatihan. *Prosiding SENDI_U*.

Fong, H. C., Sohal, J. L., Crosson, J. A., & Hendrix, C. (2021). A Competency-Based Orientation (CBO) Protocol Enhances Competency Among Newly Hired Perianesthesia Nurses. *Journal of PeriAnesthesia Nursing*, *36*(5), 445–451. https://doi.org/10.1016/j.jopan.2020.09.017

Gabriela Pereira Carvalho, N., & Walmir Cazarini, E. (2020). Industry 4.0 - What Is It? In *Industry 4.0 - Current Status and Future Trends*. IntechOpen. https://doi.org/10.5772/intechopen.90068

Goniewicz, K., Goniewicz, M., Burkle, F. M., & Khorram-Manesh, A. (2021). Cohort research analysis of disaster experience, preparedness, and competency-based training among nurses. *PLOS ONE*, *16*(1), e0244488. https://doi.org/10.1371/journal.pone.0244488

Hani, A. (2020). Efektifitas pelatihan berbasis kompetensi terhadap peningkatan kinerja. *Jurnal AgriWidya*, *1*(2), 1–9. https://repository.pertanian.go.id/handle/123456789/10153

Hasibuan, M. F. (2021). Analisis Kompetensi Guru Madrasah Ibtidaiyah Dalam Pemanfaatan Teknologi Informasi Dan Komunikasi Pada Pembelajaran (Studi Kasus Pada MIN 4 Langkat). *Jurnal Analisa Pemikiran Insaan Cendikia*, *4*(2), 44–53. https://doi.org/10.54583/apic.vol4.no2.63

Herliani, A. an, & Wahyudin, D. (2019). Pemetaan kompetensi teknologi informasi dan komunikasi (TIK) guru pada dimensi pedagogik. *Jurnal Penelitian Ilmu Pendidikan*, *11*(2), 134–148. https://doi.org/10.21831/jpipfip.v11i2.19825

Hidalgo, F. J. P., Parra, E. G., & Abril, C. A. H. (2020). Digital and media competences: key competences for efl teachers. *Teaching English with Technology*, *20*(1), 43–59. http://www.tewtjournal.org

International Labour Organization. (2020). *Competency-Based Training (CBT): An Introductory Manual for Practitioners*. www.ilo.org/publns.

Japar, M., Irawaty, I., Syarifa, S., & Fadhillah, D. N. (2020). Pelatihan Pembuatan Media Pembelajaran Berbasis ICT Untuk Meningkatkan Kompetensi Guru PPKn SMP. *Jurnal Karya Abdi Masyarakat*, *4*(2), 264–269. https://doi.org/10.22437/jkam.v4i2.10534

Kuşcu, C. N., & Zaimoğlu, S. (2022). The Perceptions of Turkish EFL Lecturers on Teaching through Information and Communication Technology. *Asian Journal of Distance Education*, *17*(1), 148–163. http://www.asianjde.com/

Latif, A. (2020). Tantangan Guru dan Masalah Sosial Di Era Digital. *JISIP (Jurnal Ilmu Sosial Dan Pendidikan)*, *4*(3). https://doi.org/10.36312/jisip.v4i3.1294

Le, A. B., Witter, L., Herstein, J. J., Jelden, K. C., Beam, E. L., Gibbs, S. G., & Lowe, J. J. (2017). A gap analysis of the United States death care sector to determine training and education needs pertaining to highly infectious disease mitigation and management. *Journal of Occupational and Environmental Hygiene*, *14*(9), 674–680. https://doi.org/10.1080/15459624.2017.1319570

Malik, M. N., Soenarto, S., & Sudarsono, FX. (2018). The competency-based training model for vocational high school teachers from electrical expertise programs. *Jurnal Pendidikan Vokasi*, *8*(3), 313. https://doi.org/10.21831/jpv.v8i3.19877

Nurbaiti, F. (2021). Peningkatan Kompetensi Guru dalam Pembuatan Video Pembelajaran Melalui In House Training (IHT) di SMP Negeri 26 Depok. *Jurnal Pendidikan Indonesia*, *2*(3), 375–386. https://doi.org/10.36418/japendi.v2i3.113

Nuryani, D., & Handayani, I. (2020). Kompetensi guru di era 4.0 dalam meningkatkan mutu pendidikan. *Prosiding Seminar Nasional Pendidikan Program Pascasarjana Universitas PGRI Palembang*, 224–237. https://garuda.kemdikbud.go.id/documents/detail/1628323

Octhanantha, A., Al, M., Mochammad, M., & Mukzam, D. (2017). Pengaruh hasil pelatihan berbasis kompetensi terhadap kinerja Studi pada Karyawan Bagian Frontliner PT. Bank Mandiri (Persero) Tbk. Area Tangerang Bintaro. In *Jurnal Administrasi Bisnis (JAB)|Vol* (Vol. 51, Issue 2). http://administrasibisnis.studentjournal.ub.ac.id/index.php/jab/article/view/2139

Özgür, H. (2020). Improving Teachers' Qualifications for Preparing ICT Based Educational Materials. *Malaysian Online Journal of Educational Technology*, *9*(1), 48–69. https://doi.org/10.17220/mojet.2021.9.1.245

Puspita, R., Adyatma, S., & Arisanty, D. (2019). Implementasi Teknologi Informasi dan Komunikasi (Tik) Guru SMA Negeri di Kecamatan Banjarmasin Utara. *JPG (Jurnal Pendidikan Geografi)*, *6*(1). https://doi.org/10.20527/jpg.v6i1.7032

Putra, S. A., Widyaswari, S. G., Puspitasari, Rr. D., & Parmino, D. V. (2020). Dampak Pelatihan Berbasis Kompetensi Bagi Guru Kejuruan Bidang Kemaritiman di Indonesia. *Jurnal Widyaiswara Indonesia*, *1*(3), 120–129. https://ejournal.iwi.or.id/ojs/index.php/iwi/article/view/18

Putrawangsa, S., & Hasanah, U. (2018). Integrasi teknologi digital dalam pembelajaran di era industri 4.0. *Jurnal Tatsqif*, *16*(1), 42–54. https://doi.org/10.20414/jtq.v16i1.203

Schuler, R. S., & Huber, V. L. (1993). *Personnel and Human Resource Management*. West Publishing Company.

Susilo, P. H., & Rohman, M. G. (2018). Peningkatan kompetensi TIK guru sebagai inovasi pembelajaran di era digital. *Seminar Nasional Sistem Informasi (SENASIF)*, *2*, 1487–1494. https://jurnalfti.unmer.ac.id/index.php/senasif/article/view/204

Sutopo, A. H. (2012). *Teknologi Informasi dan Komunikasi Dalam Pendidikan*. Graha Ilmu.

Syahrial, S., Kurniawan, D. A., Asrial, A., Sabil, H., Maryani, S., & Rini, E. F. S. (2022). Professional teachers: Study of ICT capabilities and research competencies in urban and rural? *Cypriot Journal of Educational Sciences*, *17*(7), 2247–2261. https://doi.org/10.18844/cjes.v17i7.7590

Thabit Saleh Ahmed, S., & T. A. Qasem, B. (2020). Computer-assisted language instruction in South Yemeni context: A study of teachers' attitudes, ICT uses and challenges. *International Journal of Language Education*, *4*(1), 59–73. https://doi.org/10.26858/ijole.v4i2.10106

Ulandari, W., & Santaria, R. (2020). Strategi pengembangan profesionalitas guru melalui pendidikan dan pelatihan. *Kelola: Journal of Islamic Education Management*, *5*(1), 57–68. https://doi.org/10.24256/kelola.v5i1.1412

United Nations Educational Scientific and Cultural Organization. (2018). *UNESCO ICT Competency Framework for Teachers : Version 3* (Ver.3). United Nations Educational, Scientific and Cultural Organization. https://unesdoc.unesco.org/ark:/48223/pf0000265721

Vilppola, J., Lämsä, J., Vähäsantanen, K., & Hämäläinen, R. (2022). Teacher Trainees' Experiences of the Components of ICT Competencies and Key Factors in ICT Competence Development in Work-Based Vocational Teacher Training in Finland. *International Journal for Research in Vocational Education and Training*, *9*(2), 146–166. https://doi.org/10.13152/IJRVET.9.2.1

Wernely, W. (2018). Upaya peningkatan kemampuan guru dalam penggunaan teknologi informasi dan komunikasi (TIK) di TK Aisyiyah kota Dumai. *JURNAL PAJAR (Pendidikan Dan Pengajaran)*, *2*(3), 415. https://doi.org/10.33578/pjr.v2i3.5539

Wibowo, A. N., Supandi, A., Andri, A., & Widiyarto, S. (2020). Pemanfaatan Pembelajaran ICT Dalam Optimalisasi Proses Belajar Mengajar Guru SMP. *Jurnal Pengabdian UntukMu NegeRI*, *4*(2), 228–230. https://doi.org/10.37859/jpumri.v4i2.2148

Yantoro, Y., & Idrus, A. (2021). Pelatihan peningkatan kompetensi guru dalam meningkatkan mutu pembelajaran berbasis ict pada SMP Negeri 1 Muaro Jambi. *DEDIKASI: Jurnal Pengabdian Masyarakat*, *2*(2), 312. https://doi.org/10.32332/d.v2i2.3153

Yoon, D. (2018). The effectiveness analysis for the education and training of research equipment in South Korea. *Cogent Education*, *5*(1). https://doi.org/10.1080/2331186X.2018.1478514

Zulkifli. (2020). Analisis Kompetensi Guru Menghadapi Era Revolusi Industri 4.0. *Jurnal Ilmu Sosial Dan Pendidikan*, *4*(3), 597–604. http://ejournal.mandalanursa.org/index.php/JISIP/index