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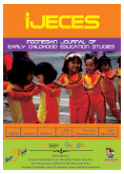

Early Childhood Educators' Attitude toward STEAM and Online Learning as 21-st Century Skills

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Abstract

Teachers must possess 21st-century skills such as integrating STEAM in daily learning through online learning in globalization. These skills can be obtained through online learning. Currently, online learning is the primary alternative for implementing learning in the era of globalization, especially during the COVID-19 pandemic. However, do all teachers understand the importance of mastering 21st-century skills through online learning and effectively conducting this online learning? This study describes the teacher's attitude towards online learning. The research method used is a survey in a questionnaire distributed to 149 teachers spread throughout Indonesia. Participants in this study were students in open and distance learning systems. The study results indicate that teachers already understand online learning, can access and use all online learning resources provided by the campus for their learning purposes. This result can be seen from the number of their access to each type of online learning service. The implication of this study is to become an evaluation and reference material for education providers, especially distance learning systems, to improve the quality of services and learning materials according to the demands and developments of technology.

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INTRODUCTION

Early childhood educators should have knowledge, understanding, and skills in the child's learning process. According to NAEYC, early childhood education educators must possess broad knowledge of development and learn throughout a child's life span, from birth to 8 years of age. Early childhood educators should be familiar with appropriate curriculum and assessment approaches in this age range. In addition, early childhood educators must also have in-depth knowledge and skills, at least two of the three periods, namely infant/toddler, preschool/ prekindergarten, and early elementary school. Other competencies include teaching for development and learning, planning a curriculum that aligns with learning outcomes, assessing student growth and development related to learning outcomes, and building positive relationships with students and other stakeholders (NAEYC, 2009).

The Government Regulation about Academic Qualification Standards and Teacher Competencies has standardized teacher competency in four main aspects: pedagogic, personality, social, and professional competencies. This standard contains the core competencies of teachers that teachers must meet in order to increase their professionalism. Mastery and applying STEAM and digital competencies in early childhood learning are included in professional competence as part of 21st-century competencies that teachers must possess. Furthermore, through advances in information and communication technology (ICT) in education and learning today, teachers must equip themselves with ICT mastery for classroom learning methodologies (pedagogic competence), such as multimedia and information resources. Teachers acquired this competency through direct participation in the online learning program. In this case, as an education provider where the majority of its students are teachers, we have provided all students with online learning media, experiences, and materials. This experience should help teachers improve their academic abilities and competencies as the 21st Century skills. For this purpose, the higher education provider has suggested their students practice various online and digital sources delivered by online learning as an alternative medium for their learning process. Furthermore, students must conduct their practical programs on-site to courses that require hands-on practical skills.

However, there were some problems in daily learning. For example, teachers cannot organize online learning effectively, so their students feel bored and cannot follow the learning provided. Teachers lack in-depth information about 21-st century skills (Putu Restu Adi Utami et al., 2021). Therefore, teachers must have and master the skills of using technology in everyday learning since early childhood educators are responsible for children's health, development, and learning (The National Academies, 2015) Moreover, we also analyzed students' skills in utilizing the learning resources and online learning assistance services and identified what factors affect the utilization of learning resources and our online learning services as part of the learning process for students.

Teacher professional development through self-directed learning strategies and approaches has been increasingly paying attention to teaching at the level of primary and secondary school education and the teaching at any level in Indonesia. The learning interactions through various media in open and distance education (ODE) have been proposed by (Swan, 2018), stating that dialogical transactions between lecturers and learners through various methods and online media constituted an independent learning structure. This situation indicates that the learning process activities, such as tracing knowledge and educational information through the internet and other learning multimedia, are steadily facilitating teachers' professionalism. The implementation of self-directed learning has been increasingly popular with teachers' using information and communication technology (ICT) in their learning process while studying.

Self-directed learning is a process of someone's initiative with or without the help of others, diagnosing their learning needs, formulating learning objectives, identifying learning resources, selecting and implementing appropriate learning strategies, and evaluating their learning outcomes (Knowles & Holton III, 2015). Moreover, they said that the learning services are intended to guide student initiatives in diagnosing their learning needs and formulating learning objectives for success as independent learners. This statement is supported by Moore and Kearsley's opinion that the physical separation between students and their teachers brings up the pattern of teacher behavior and learners leading to self-study and self-learning (Moore & Kearsley, 2012).

In the 1990s, Science, Technology, Engineering, and Math (STEM) was seen as an essential learning field in the 21st century, added to art as the basis for developing creativity, so the term STEM was modified to STEAM. The implementation of STEAM aims to meet the

global challenge of continuing education that demands mastery of various essential competencies by teachers. Based on its definition, STEAM is a holistic education that integrates science, technology, engineering, art, and mathematics as an interdisciplinary learning model that can stimulate inquiry and creative thinking (Monkeviciene et al., 2020). The integration of the field of science in STEAM education includes the environment, assistance, and activities that can stimulate children to explore and explore natural objects and phenomena such as water, soil, weather, the motion of plants, animals, and humans; starting from observing, making models, asking questions, making connections between objects and events, to concluding (Campbell et al., 2018).

In the field of technology, it can be through the use of the Engage – Explore – Reflect (E-E-R) cycle, stimulating exploration of the structure and function of tools such as measuring instruments, magnifying glasses, wooden sticks; simple mechanisms such as levers and pulleys; as well as instruments such as microscopes, fans, scales. In terms of development, the integration of technology in STEAM learning is seen in the mechanism and exploration of technological processes, such as robotics, chemical reactions in the form of baking soda reactions, as well as the use of modern media and augmented reality objects (Campbell et al., 2018).

The practice of integrating engineering education into STEAM learning takes the form of steps in the engineering design process, encouraging exploration of the properties of open, structured, and semi-structured materials. Examples include blocks, Legos, robotics kits, buildings, and equipment such as bridges, roads, cities, robots, and inclined planes—building design and construction solutions and exploration, stability, connections, and distinctive structures. Art education in the integration of STEAM learning includes children's interest in new and complex artistic expression and design objects as well as in two- and three-dimensional visual models, namely representation of natural objects, photography, sculpture design, tools and structures, and the creation of 3-dimensional models (Akturk & Demircan, 2017). The practice of mathematics education in STEAM education includes activities where children use Lego, Duplo, constructors, robotics kits, natural objects, calculators, and measuring tools, which can help them find numbers and sequences and recognize scales regularities, patterns, and structures and create and measure. These activities can develop children's mathematical thinking. These practices also use coding and programming games, developing children's computational thinking skills (Campbell et al., 2018).

The use of technology in early childhood learning is usually done through computer games. According to (Chesla & Matic, 2002), various computer games are available for children and have higher educational value. An example is the game Dr. Seuss Toddler for children ages 18 months to three years; it includes several activities that teach letter recognition, counting, number recognition, shapes, matching, and colors using colorful characters familiar to children. Good computer games will interest children and teach various concepts and skills, including eye-hand coordination, listening skills, language skills, numeracy skills, and causality.

Based on the survey results conducted by (Lee & Kim, 2018) on 9986 teachers in Korea to find out about the perceptions of elementary, middle, and high school teachers on STEAM training programs at the school level, it is known that the preferred STEAM training method by teachers is the case and activity-centered approach. Teachers want knowledge, examples, and educational programs so they can apply STEAM education in the classroom. In contrast to other school levels, primary school teachers show a preference for theory-oriented training. In 2015 and 2017, Campbell et al. conducted observations on four preschools regarding the practice of using STEM in childhood through play-based learning to understand the STEM approach in education. Their observations show that STEM experiences in children increase their confidence and ability when learning STEM and appreciate STEM and its value in everyday life. In science and mathematics, STEM emerges through children's games and themes derived from children's interests. This action supports various practices and pedagogies in STEM learning (Campbell et al., 2018).

On the other hand, the ethnographic research on using the STEAM method in early childhood education classrooms conducted by (DeJarnette, 2018) involved professional development for 50 preschool teachers in urban areas northeastern the United States. Researchers explore how efforts were made to provide direct professional development, consistent support, and rich resources to implement STEAM lessons in the early childhood curriculum that impact the level of implementation for teachers. This study looks at how preschoolers receive STEAM instruction through pre-and post-surveys, teacher interviews, and field observations. The research findings showed an increase in preschool teachers' positive

character and self-confidence, although teachers' level of implementation of STEAM lessons was still limited.

Another form of STEAM integration training in early childhood learning that uses two languages is carried out by (Brenneman et al., 2019) through workshops, reflective training cycles, and professional learning communities. The workshop was conducted for four full days to deliver material that focuses on mathematical and science concepts such as geometry and the senses used as observation tools. During the activity, the teacher was given an overview of the content and strategies for implementing learning. Next, the second component is reflective training, where teachers apply STEM learning based on the learning materials provided at the workshop. At the same time, the professional learning community consists of teachers in the same area and gathers every 6-8 weeks. The meeting focused on learning issues presented by teachers who wanted to get input from other members.

The effectiveness of using STEM in early childhood education learning is known through the *Little Scientists* program evaluation of 600 educators (Macdonald et al., 2020). The Little Scientists program is based on professional development workshops for early childhood educators in their education and caregiving services. The workshop uses a multidisciplinary approach and covers some STEM topics, such as water, engineering, computer science, introducing two new topics each year. The pedagogic approach is based on the scientific method or *"Cycle of Inquiry,"* which encourages educators to answer children's questions and explore their shared environment. This program is adapted for children from 3 to 6 years old. The program evaluation results showed that educators considered the Little Scientists program a positive thing to build a community of inquiry where children and educators learn and research together by providing independent exploration and play-based space. Adults can take on various roles, including director, assistant, or a child's study companion. Educators' confidence in teaching STEM increased, and participants reflected on their beliefs and attitudes towards the program. With the Little Scientists program, teachers realize that STEM can be done and found in daily activities. Participants are more aware of what they are doing and change their self-perception and understand that they act as researchers and learning partners of children.

Based on the background of the problem and various previous research results, we can see that both researchers and experts have made various efforts and methods to improve teacher skills in integrating STEAM in learning. So, to fill the gap of previous research, this study aims to analyze and describe student attitudes toward 21-st century skills through online learning.

METHOD

This study used a survey questionnaire adopted from (Al-Musawi, 2014) to gain information about teachers' attitudes and competencies in online learning, while STEAM integration data is gained by literature review. The online questionnaire was distributed to 150 early childhood student teachers, and the sampling technique used in this study was purposive sampling because participants are selected based on research needs. The structure of the survey questions is seen in table 1.

Tabel 1. Structure of the questionnaire survey

Part	Group of Questionnaire
A	Student information on: online resources online learning services digital courses
B	Student attitudes towards online learning
C	Students' ICT competencies

Instrument Validity and Reliability

Before discussing the survey results, this section describes the reliability and validity testing of the survey instrument. Golafshani (2003) and Aiken (1996) implied that reliability and validity constitute a tool to represent an instrument's degree of consistency and authenticity. The instrument of this study was composed of rating scale items (scaling in four categories).

This study used SPSS v.23 to gain reliability coefficients of internal consistency for the instrument. For this purpose, a value of Cronbach's Alpha was determined based on item-total correlational testing to reveal if any item in the set of instruments was inconsistent with the averaged responses of the others. The reliability testing shows that Cronbach's Alpha value of the instrument was 0.975. This result demonstrated a high level of internal consistency for the instrument. As for critical r_Table (2-tailed) at 0.05 level of significance with the amount of data (N) = 150 was 0.1603, then it was found that the Alpha value of 0.975 was higher than the r_Table value of 0.1603. Therefore, the overall research questionnaire was considered reliable.

Further detailed analyses show the item-total correlation calculating results for each instrument's item. All the Alpha values are higher than r_Table, suggesting that none of the items of the instrument set were inconsistent with the total averaged responses. The results signified that all items of the instrument have strong validity.

RESULT AND DISCUSSION

The primary data of this measurement was about access to advanced data given. The data in Table 2 shows that students already know and have accessed various online learning resources with no constraints occurred.

Tabel 2. Online learning resource accessed by participants

Online learning resources	Percentage (%)
Electronic diaries	24.2
Virtual library	48.3
Smart Teacher Portal	23.5
Online enrichment materials	34.9
MOOCs	10.7
University's TV channel	14.8
University's Radio channel	4.7
Others	2.7
Online instructional assignment	56.4

Furthermore, the students studied were solicited a number from inquiries concerning the view of web-based learning assets and administrations, all in all, online instructional exercise courses, and the advantages of utilizing web-based learning assets and administrations. For the most part, the students' mentalities angle to web-based learning, 73.08% of students said that web-based learning administrations could help students tackle learning issues; 73.2% said that web-based learning assets and administrations give chances to improve students' data aptitudes in a specific field. Moreover, 72.05% of students believed web-based learning assets and administrations could enhance students' capacity to understand the topic. Learning assets and web-based learning help administrations benefit students in the learning procedure (61.07%).

Besides, the majority of students feel that internet learning is helpful to them. They said that internet learning assets and administrations could enhance students' learning accomplishment (71.01%). They can partition their time between learning and investing energy with family through web-based learning (64.04%), making the learning procedure increasingly adaptable (68.05%). Students who cause this condition can pursue course material on many occasions (67.01%). Different components bolster the students' achievement in following the online instructional exercise, such as self and friend inspiration, capacity to utilize PC and website get to, arrange association, and excellent correspondence among coaches and students themselves. They said that peer inspiration is a primary part of their achievement in joining web instructional exercises. They welcome their companions to utilize the web while considering (61.01%). They can discuss successfully with other online instructional exercise members (55.07%), and it has little impact on collaboration and correspondence among mentors and students (51.07%). In this manner, they are keen on joining the online instructional exercise (55%). Students feel that web-based learning can assist them with solving learning issues (59.07%) and feel great in concentrating on the material and doing errands through it. Also, concerning time devoured, online instructional exercise can spare much time for coaches and students (67.08%).

Nonetheless, the most significant obstruction of students in internet learning is the limitation on the poor system association (77.09%). In terms of students' ICT skills, students have home computers (25.5%) and can use computers well (73.2%), although 61.1% of students state that they are accustomed to using computer-related tasks. They can access the internet easily (71.8%). Only 20.1% of students answered that they found it challenging to use the internet. Usually, students access using smartphone/HP, laptop, computer/PC, and their tablets.

Tabel 3. Tools used to access the internet

Students access the internet through:		∑	%
a	Computer / PC	38	25.5
b	Laptop	102	68.5
c	Smartphone / HP	105	70.5
d	Tablet	20	13.4

Based on measurement data, most participants in this study already can use the computer well and feel the benefits of open learning resources and online learning assistance services. As a provider of online learning resources and sup-

port services, it strongly supports students to use technology by participating and improving their knowledge and skills. The student respondents who took the most online tutorial course were in the islands' demographic region and scattered, making it challenging to form study groups as a requirement for forming study groups through face-to-face tutorials. With the online tutorial, students are beneficial in learning.

Regarding STEAM implementation in learning, the innovations and changes that have resulted in existing STEAM training programs in various countries are that teachers can improve professional competence through specially designed courses or training and independently seek innovative STEAM implementation practices and seek to apply them in daily learning. The STEAM training can improve teacher competence, expand knowledge in the STEAM field, develop pedagogy in the STEAM field, design the STEAM curriculum, and develop children's achievements related to the STEAM field. In terms of implementing training programs, educational institutions pay attention to and consider the accessibility of teachers to new media and ICT equipment and develop communication networks that teachers can use. Thus, the development of teacher competencies in the STEAM field will positively impact the implementation of STEAM (Monkeviciene et al., 2020).

The importance of STEM in early childhood learning is seen in the conceptualization of STEM education organized by early childhood education professionals related to its constituent disciplines, direct play-based learning experiences, and the development of children's thinking habits. STEM is considered necessary in early childhood, even though it is behind the socio-emotional development of children. Children's thinking habits in the STEM context are shown in figure 1 (Simoncini & Lasen, 2018).

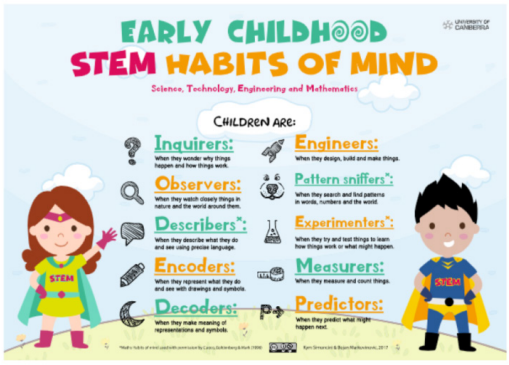

Fig. 1 Early Childhood STEM Habits of Mind

One of the six strategies teachers can do is involve families and communities in understanding and supporting children's STEM success (Olson & Labov, 2014). Another form of innovation to integrate STEAM in early childhood learning by (Jurado et al., 2020), namely by introducing robotics to improve interdisciplinary learning. The teacher considers this a helpful step and can increase self-confidence by using a robotic platform (KIBO).

Various forms of competency development for early childhood educators in the STEAM field in training, workshops, community service activities, and other activities are carried out to answer global challenges regarding sustainable education and have competencies following these demands. The training activities carried out by (Raodah & Subhan, 2020) for early childhood teachers provided theoretical and practical benefits in increasing competence in using digital media technology in learning and administration. It is known through the pre-test and post-test conducted during the training. Previously, teachers had not received literacy about technology. After they attended the training, there was a significant change in teachers' knowledge, expertise, and skills in using digital media.

Another activity related to STEAM is community service in training workshops on developing science teaching materials according to a play-based curriculum. This activity produces a daily learning plan (RPPH) based on STEAM or SLAMETS content, which is strengthened by using loose part teaching materials from natural sources, recycled materials, and manufactured materials (Hapidin & Pujianti, 2019). The learning problems encountered by these teachers are the limited 4c (creativity, communication, collaboration, and critical thinking) students' competencies. It can be seen when the learning process takes place. Children have low communication skills and have not been able to express opinions and collaborate in groups. With the selection of loose part media, critical, creative thinking skills, the ability to work together and communicate in playing can be sharped (Prameswari & Lestariningrum, 2020).

The arrangement of space at early childhood education institutions in STEM can be made by developing children's learning through free play indoors (indoor) and outdoors (outdoor), both formal and informal. Materials that can be used are building blocks or connecting materials, calculating or measuring tools, cooking utensils, magnifying glasses, exploration tables, magnets, and other equipment. STEM-focused

activities are presented primarily on learning science or mathematics. One of these activities asked the children given several plastic animals to arrange them from the smallest to the largest. The educator tells the children the biological name of the animal. Another activity is giving children colored beads to make patterns (Campbell et al., 2018).

CONCLUSION

In order to fulfill challenges in the digital era and 21st-century learning, early childhood educators are inevitably required to have pedagogical, personality, social, and professional competencies in carrying out the learning process. One form of mastering the professional competence of early childhood educators is integrating STEM or STEM in the early childhood curriculum. This ability can be achieved through various forms of training activities or courses held by formal and informal educational institutions, which can be selected according to the conditions of early childhood educators. One form of the application of STEAM is the use of loose part media in early childhood learning. In addition, teachers can develop simple media and manage the learning environment according to the characteristics and needs of children so that children understand the concept of STEAM in learning through play and hone creativity, communication skills, collaboration, and children's critical thinking.

This study concludes that students already know and can access online learning resources using smartphones, laptops, PCs, and tablets based on data processing results. Students' online learning resources are digital libraries, Smart Teacher Portals, MOOCs, online-based enrichment materials, and other open learning resources. Students find online learning resources beneficial in their daily work as teachers. Students' attitude towards online learning assistance services is that they feel their benefits, especially during the COVID-19 pandemic. In addition, they said that the online learning they took could add to their 21st-century insight and skills, especially in digital skills or the use of ICT and STEM integration in everyday learning.

We recognize the weaknesses of this study from various perspectives, especially in collecting data on the integration of STEAM in learning in schools. Thus, the limitation of this study is that the method used is only a survey in the form of a questionnaire, so it is necessary to examine more deeply the experiences and forms of obstacles found in the learning process, both as students and as teachers who teach early childhood in the classroom.

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