The Effect of the Project-Based Seamless Learning Model on Critical Thinking of Prospective Educator Students

ABSTRACT

Aims: The aim of this study was to identify the effect of the project-based seamless learning model on critical thinking of prospective educator students.
Study design: The research method used quantitative experimental design.
Methodology: The research method used quasi experiment with research design nonequivalent pretest posttest group design, where there is an experimental group and a control group, the experimental group is given treatment and there is no treatment on the control group. The research subjects were 150 people, 75 people in the experimental group and 75 people in the control group. Data collection using tests conducted pretest and posttest. project-based seamless learning model on critical thinking skills of prospective educator students. Based on the results of hypothesis testing on the posttest, the value on the posttest of the experimental group and the control group obtained a significance value of 0.001 <0.050. And also the difference in the average value of the experimental group's posttest of 84.20, greater than the lower control group of 80.40. This proves that there are differences caused by the application of learning models in the two groups. The experimental group used a project-based seamless learning model while the control group used a conventional model.
Conclusion: There is an effectiveness of project-based seamless learning model on critical thinking skills of prospective educator students. Hopefully, the project-based seamless learning model can be applied at various levels of educational institutions, various subject matter so that the quality of learning will be better .

Keywords: Project Based Learning, Seamless Learning, Critical Thinking Skills

1. INTRODUCTION

Education plays a crucial role in the future, beginning today, in imparting knowledge and skills. It also helps develop character, expands employment opportunities, empowers people, and builds a more advanced and peaceful society—all of which must be taught and ingrained in students. As a way to prepare for the future, investing in education is therefore a very worthwhile way to ensure a brighter future for everybody. The idea of education as an investment highlights how crucial it is to view education as a way to improve the community's economic well-being [1]. An further reason states that education has long been seen of as a long-term investment in the social and economic advancement of a nation [2]. People and society at large can benefit much from investing in education. Education can help someone become more knowledgeable and skilled, which can increase their income and help them succeed in their career [3].

It is essential for students to get extensive knowledge and understanding of all facets of early childhood education, particularly for those who plan to become early childhood educators. Planning, preparing, and processing a creative, high-quality learning experience in accordance with the established needs and learning objectives is one of the primary responsibilities of an early childhood educator in the future. Early childhood education preparation requires extra care. Because early childhood learners require special attention during this time, prospective educators must also possess critical thinking skills to observe and analyze their needs during the learning process. Since successful student learning depends on their capability to comprehend the subject matter, instructors play a crucial role in education. Assessing students is one way to determine whether a lesson was successful or unsuccessful [4]. As wannabe teachers, students must comprehend the various definitions of teaching. As significant change agents, teachers' perspectives on teaching in the twenty-first century can directly affect how they instruct in the classroom [5]. Successful teaching is greatly affected by the attitudes of teachers [6]. The success of an educational system is significantly impacted by its teachers [7]. Many education professionals believe that teachers are one of the most important factors in students' learning [8]. In order to raise the standard of education in schools, teachers might innovate their teaching methods [9]. A teacher should be able to help students in working together, coordinating, sharing, discussing, and solving problems, as well as provide feedback that highlights the value of a design that prioritizes literacy development, collaboration, and discovery [10]. So, in order to become a good and professional teacher in their sector, a prospective educator must fully understand theory, concept, practice, and others.

Research in the field shows that prospective early childhood educators continue to struggle with critical thinking. Many students struggle to grasp the subject during the learning process and fall short of the standards. While some are competent in early childhood education, there is still a lack of knowledge and wisdom in this area. In order for students with prior teaching experience to comprehend and apply the material, lecturers continue to generalize their teaching materials. In contrast, students without teaching experience are limited and perform less well when it comes to comprehending and applying the materials. Lecturer-centered learning models and projects are the learning models that instructors most frequently employ. Therefore, extra care must be taken when coming up with ways to deal with this issue. According to the aforementioned description, an endeavor is required to establish a learning process that enables students to be autonomous, creative, critical, and actively involved in comprehending the course material. One way to do this is to use a project-based seamless learning model, which combines project-based learning with seamless learning and is supposed to help aspiring early childhood educators become more adept at critical thinking.

One kind of learning strategy that could improve the students' connection with the material and enhance their comprehension of concepts is project-based learning (PjBL). Assigning homework is a way for instructors and students to work together to motivate engaged students to learn both individually and in groups. This approach to assignment distribution can be characterized as a teaching strategy in which instructors train students to support active learning in both individual and group settings [11]. Under the project-based learning paradigm, students work on projects that call for applying concepts and methods they have learnt. Students must develop, solve difficulties, make judgments, perform investigative activities, and provide opportunities for individual work in order to complete complex projects based on extremely difficult questions and challenges. Students gain an understanding of the procedure's theory as well as practical application in a relevant setting through this experience [12]. Project-based learning is becoming increasingly model since it not only gives students an engaging educational experience but also increases their motivation to study [13].

Implementing the Project-Based Learning (PjBL) model in combined with seamless learning is thought to be a beneficial learning combination. Removing the obstacles that prevent learning from being permanent is the goal of seamless learning. For instance, a class exercise may begin in class and continue at home as homework, or a chance conversation among students in an online forum may lead to a thorough comprehension of the material covered in class [14]. In order to help understand the application of procedures in designing learning plans, seamless learning emphasizes continuity in the learning process where learning occurs in various contexts, such as formal and informal, personal and social, across time and location, real world and cyberspace, digital and non-digital, and so on. Technology is not the only factor in seamless learning. Resources, activities, and technology are the most crucial components of seamless learning. Learning connectors or technological interfaces between the learner and the learning environment are the terms used to describe the technology utilized in seamless learning.[15]. The use of all available technologies, including mobile technology, to study in any setting is emphasized by seamless learning. Regardless of time or location, seamless learning is a student-centered, continuous learning approach that uses mobile devices, is connected to social and technological contexts, and occurs in both formal and informal settings [16]. According to Srisawat et al., (2021), seamless learning is a method of learning that connects countless

learning locations and times and strengthens connecting activities that occur in many locations and times. The idea of continuous or consistent learning is in accordance with the belief that it is expected that students would be assigned autonomous activities, where they will choose what has to be done, when, and how their accomplishments will be later confirmedn[18].

The combination of project-based seamless learning models to improve skills in critical thinking is supported by a variety of previous studies that support project-based seamless learning. The outcomes demonstrated that the project-based learning approach was successful and may raise students' motivation and comprehension of concepts [19]. The section on seamless learning study findings also shows how using an seamless learning technique during the learning process has been shown to enhance students' critical thinking and concept comprehension [20]. Thus, the application of project-based seamless learning is considered appropriate and effective in improving the critical thinking skills of prospective early childhood educators. Based on the results of the above research, the purpose of this study is to analyse the effect of the project-based seamless learning model on students' critical thinking skills of prospective educator students.]

2. LITERATURE REVIEW

The following is an explanation of the literature review that discusses the variable points in this research paper

2.1 Project Based Seamless Learning

Project-based learning is an inquiry-based teaching approach that involves students in the production of knowledge by having them finish worthwhile tasks and create useful products [21]. It is based on constructivist learning theory, which holds that learning is context-specific, students actively build their understanding by working on pertinent problems in the real world, and they accomplish their objectives by interacting with others and exchanging information [22]. Project-based learning adalah sebuah model yang mengorganisir pembelajaran di sekitar proyek [23]. Children are tasked with addressing real-world, contextualized problems as part of the project-based learning approach. Kids can use what they've learned and experienced, work together with classmates, and acquire a variety of skills that are necessary for the twenty-first century through PjBL. Based on constructivist concepts, problem solving, research inquiry, integrated studies, and reflection, project-based learning is an instructional style that prioritizes theoretical study and application. Children can work individually or in groups to construct a project to generate a product when they use the project-based learning technique. We can therefore conclude that project-based learning is a child-centered approach to education.

The project-based learning model is a process-centred, relatively timed, problem-focused, meaningful learning unit that integrates concepts from a number of components, be it knowledge, disciplines or fields. [24]. Also, other viewpoints highlight the project-based learning model, which teachers can use to help students develop scientific attitudes because it can engage students in learning activities, invite them to complete an activity in groups, make learning more meaningful, and empower students as learning subjects. The teacher's role is to facilitate the formation and development of knowledge, not to impart knowledge, so that students can develop their scientific attitudes [25]. Others argue the project-based learning model is an in-depth investigation of a real-world topic, which is valuable for learner attention and effort. [26]. Another literacy states project-based learning is an innovative learning model that emphasises contextual learning through complex activities, involving learners in the learning process and solving problems as a whole as well as building their own thinking patterns and finding solutions independently and realistically. Projects that are done by learners and will make learners more skilled, creative, skilled and confident with processing and drawing conclusions from projects that have been carried out which are practical-based [27]

PjBL is an active, student-centered method that emphasizes student independence, critical thinking, communication, teamwork, and reflection in real-world or practical assignments. Driven by the desire to produce a final product, PjBL usually consists of a range of individual or collaborative tasks over an extended period of time (planning, research, and reporting) [28]. PjBL as a teaching strategy presupposes the involvement of all participants, with the aim of solving real-life and authentic problems of common interest to those participating in the project [29]. In this learning environment, the teacher acts as a facilitator, offering guidance and support to encourage student enquiry [30]. Such project work contributes to giving meaning to learning by engaging participants in problem-solving, decision-making and searching for answers. This process enables the development of important lifelong learning competencies, such as data collection and

processing, social learning from group work, decision-making, and a spirit of initiative and creativity. Project-based learning represents a shift in education from traditional passive learning to a dynamic student-centred approach. It empowers students to take responsibility for their learning journey, from planning to project execution, thus fostering a sense of ownership and motivation [31]. Project-based learning presents a promising approach, proven to enhance language learning through real-world projects that encourage active participation and collaboration, offering exposure to diverse cultural and rhetorical contexts [32].

The concept of seamless learning enables students to learn continually in a variety of settings and scenarios, both within and outside of the classroom. The term "smooth" suggests the blending of disparate elements to create a cohesive whole. Seamless learning refers to unbroken individual learning through direct communication with their surroundings using online, wireless, and mobile devices without regard to time or location restrictions; quick and easy access to learning materials; and the unbroken integration of formal school learning experiences with everyday life outside of school [33]. Continuous, seamless learning happens on digital and physical platforms, as well as in formal and informal settings, as well as in social and individual contexts. By expanding the learning environment from home to school, it seeks to broaden the scope of learning and describes the smooth integration of learning experiences in various dimensions and situations. Anywhere and at any time, learning can occur in a borderless network known as seamless learning [20]. A seamless learning model enables the learner to rapidly and easily switch between several learning scenarios while having access to the appropriate information at the appropriate time and location using one or more personal devices [34].

Implementing Seamless Learning can be done in various ways, depending on the specific educational context and needs [35]. One example of this implementation is to use an online learning platform that is integrated with apps and mobile devices, so that students can access learning materials anywhere. For example, schools can use online learning platforms that allow students to access learning videos, online assignments and discussion forums from their own devices. The implementation of Seamless Learning also involves the proactive role of teachers in designing and structuring technology-integrated learning [36]. Teachers need to be facilitators who are able to direct students in using various learning resources available, both online and offline [37]. In addition, the role of schools and educational institutions in supporting the implementation of Seamless Learning is also very important [38].

With seamless learning, learning is no longer limited to the classroom, but extends to the child's immediate environment, including home and community [39]. This means that learning is no longer interrupted when children leave the classroom, but continues and is integrated with everyday activities. This creates opportunities to deepen understanding of concepts, apply knowledge in real contexts and broaden children's horizons. However, despite the promising potential of Seamless Learning, its application is still limited and not fully optimised, especially at the primary education level. Seamless learning is a continuation of learning and an attempt to connect multidimensional learning. The main features of seamless learning; it is formal and informal, personal and social, spans infinite places, encompasses both the physical and digital worlds, incorporates the use of multiple devices and multiple learning styles that can be constantly shifting, as well as generating knowledge synthesis and incorporating multiple teaching styles. [40]. Seamless Learning can address the challenges faced in basic learning, more effective and relevant learning strategies can be created. [41]. Seamless Learning allows students to determine when and where they will learn. In addition, the desire or emotional mood to learn can be done anytime and anywhere. So when this happens, students need to be accommodated in order to learn immediately, including the provision of learning resources, learning media and learning environments. This happens because Seamless Learning allows students to choose how they learn. They can choose the material they are curious about and move between different contexts such as between formal and informal contexts and between individual and social learning. Students can also expand their social space which allows them to interact with each other [38].

2.2 Critical Thinking Skills

Critical thinking is the art of analysing and evaluating to improve thinking, critical thinking can also be referred to as a set of skills to analyse facts, generate and organise ideas, compare, draw conclusions, evaluate arguments, and solve problems, many definitions explain about these skills. Critical thinking can be defined as a reflective, reasonable, and functional way of thinking used by individuals when deciding what to believe or what to do, and critical thinking is not only about cognitive skills but also some dispositions such as innovative, confident, open-minded, objective, or willing to seek the truth [42]. Critical thinking can enhance creative problem-solving options by encouraging students to seek new strategies when solving mathematical problems [43]. Salah satu keterampilan yang sangat penting dan mapan untuk memenuhi tuntutan pekerja

di abad ke-21 adalah berpikir kritis [44]. In this era, it is very important to teach and train students' critical thinking skills even since elementary school because there will be differences in the mastery of students who are trained to think critically and those who are not [45]. Critical thinking is a way of thinking in which prejudices, assumptions, and knowledge are tested, evaluated, and assessed and their various aspects, extensions, meanings, and consequences are discussed, ideas are analysed and evaluated, reasoning, logic, and comparison are used, resulting in a particular idea, theory, or behaviour[46]. Critical thinking is a reflective and rational thinking process, one of the higher order thinking that should be at the centre of learning development because it makes humans have the life skills, creativity and innovation to deal with complex real-life problems. [47].

Critical thinking is a clear and purposeful process used in activities such as problem solving, decision making, persuasion, analysing assumptions, and conducting scientific research. Those who think critically can summarise their knowledge, understand how to use information to solve problems, and search for relevant sources of information to support problem solving. Critical thinking is a reflective ability; students need this skill to deal with various personal and social problems [48]. Critical thinking consists of various interconnected components of thinking, the requirements of critical thinking include clarity, precision, logic, rigour, importance, fairness, depth, breadth, and accuracy [49]. Critical thinking methods require individual learner competencies to interpret, analyse, evaluate, rationalise, and investigate data. Then critical thinking tactics involve problem recognition, analysing facts and evidence, and questioning sources of information. In other words, the critical thinking approach uses verified information and observations [50].

Critical thinking skills are very important for students because these skills play a role in the development of students' thinking. Critical thinking skills are one of the basic and intellectual needs that must be fulfilled by every individual [51]. Students' critical thinking skills must be trained in the learning process because it has many benefits in children for their future. Critical thinking strategies help active listeners communicate with other students by listening to other students' speeches, assessing these discussions and making the best decision based on what is said in the dialogue. In fact, critical thinking strategies help students consider all the characteristics of a good conversation when speaking in class. Students fully understand what other students are saying and what they want to interact with. [52]. Critical thinking skills are the ability to think wisely and support arguments with sound reasoning and students should possess them. [53]. Another benefit is that critical thinking is linked to quality thinking and, if adequately developed, helps learners communicate with others, acquire knowledge, handle ideas, beliefs and attitudes more skilfully. [54]. Critical thinking can not only improve students' academic abilities, but it can also prepare students to become professionals in the world of work. Students can benefit from developing critical thinking skills by acquiring knowledge and then using that knowledge to solve problems. [55]. A person who has critical thinking skills will have careful consideration to gather various evidence/information before making a decision or setting an attitude [56].

The habit of critical thinking in education needs to be applied and realised in learning activities, so that students can be trained and accustomed to being sensitive to events, information, news and even problems that exist around them to then process everything with analysis and reasoning to determine a decision that is good, appropriate, appropriate, relevant to the situation and can be accounted for. With critical thinking as part of education, it can be said that students become more academically successful and more useful, positive and socially sensitive [57]. The importance of critical thinking is increasing along with efforts to develop students' creativity, independence, and scientific thinking [58]. Educational institutions should encourage their students to learn, think, and reason critically, are required to contribute to the development of critical thinking skills because in this educational context, people are expected to increase their cognitive potential and motivation to reflectively construct their knowledge in a critical, autonomous, proactive, independent, and sustainable manner [59]. The importance of critical thinking as an essential skill and its development cannot be denied in today's educational environment [60].

3. METHOD

3.1 Research Design

This design uses a quantitative approach, with the type of experimental research. The experimental research conducted was a quasi-experiment. Quasi experiments test whether there is a causal relationship between independent and dependent variables. The independent variable is tested as a variable that affects the dependent variable, i.e. the affected variable, in this quasi-experimental research. Nonequivalent pretest-posttest control group design is the type of quasi-experimental design used.

This design uses an empirical comparison of two groups. Specifically, the experimental group and the control group have been divided. The experimental group and control group are naturally gathered groups, such as a classroom, and can be tested using a pretest. One group can then receive treatment under the supervision of the researcher, and after receiving the treatment, another test can be given using a posttest. The control group in a pretest-posttest nonequivalent control group design is matched to the group receiving the intervention, rather than randomly assigned. Here is the framework design:

Table 1. Framework Design

O1	**X**	**O3**
O2	-	O4

Notes:
O1 : Pretest experiment group
O2 : Posttest experiment group
O3 : Pretest control group
O4 : Posttest control group
X : Experimental group treatment on project-based seamless learning model
- : Control group no treatment (using conventional learning)

3.2 Research Subject

This study examines the influence of the independent variable on the dependent variable. The independent variable is project-based learning model. While the dependent variable is concept understanding. The participants of this study were 150 prospective early childhood educator students. The research object was divided into two treatment groups, namely the experimental group of 75 students and the control group of 75 students.

3.3 Data Collection and Data Analysis Techniques

Data were collected using a test, this research was conducted on both treatment groups, namely the experimental group and the control group. The experimental group was treated using a project-based seamless learning model and the control group used a conventional model. The research gave a pretest with the aim of knowing the initial ability of students in each class, both classes were given a pretest-posttest with the same test tool.

Data analysis using prerequisite tests, namely normality and homogeneity tests, was carried out to ensure that parametric assumptions were met. Normality test used Kolmogorov-Smirnov technique and homogeneity test used Levene's test technique. Descriptive statistical test and independent sample t-test were used to analyse the data. This study aims to determine the statistical significance of the effectiveness of project-based seamless learning on critical thinking skills.

4. RESULTS

The results of the research findings in the form of the results of the pretest and posttest of the two groups are described below, following the results of the normality test on the pretest and posttest scores of the experimental group and control group:

Table.2 Normality Test

One-Sample Kolmogorov-Smirnov Test

		Pretest_Experiment	Pretest_Control	Posttest_Experiment	Posttest_Control
N		75	75	75	75
Normal Parameters[a,,b]	Mean	32.67	32.93	84.20	80.40
	Std. Deviation	7.182	7.671	7.168	6.915
	Absolute	.151	.140	.144	.147

Most Extreme Differences	Positive	.151	.129	.136	.129
	Negative	-.129	-.140	-.144	-.147
Kolmogorov-Smirnov Z		1.312	1.208	1.251	1.274
Asymp. Sig. (2-tailed)		.064	.108	.088	.078

a. Test distribution is Normal.

b. Calculated from data.

Based on table 2, the normality test results on the experimental group pretest obtained a significance value of 0.064, on the control group pretest obtained a significance value of 0.108. The value on the posttest of the experimental group obtained a significance value of 0.088, on the posttest of the control group obtained a significance value of 0.078. Thus all the results of the normality test on the pretest and posttest of the experimental and control groups above the significance value> 0.05, so the data results of the two groups were declared statistically normally distributed.

The results of the homogeneity test on the pretest and posttest of the experimental and control groups are as follows:

Table.3 Homogeneity Test

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
Pretest	.743	1	148	.390
Posttest	.099	1	148	.753

Based on table 3, the results of the homogeneity test on the pretest of the experimental group obtained a value and the control group obtained a significance value of 0.390. The value on the posttest of the experimental group and control group obtained a significance value of 0.753. Thus all the results of the homogeneity test on the pretest and posttest of the experimental and control groups above the significance value> 0.05, so the data results of the two groups were declared statistically homogeneous.

The following are the mean results on the pretest and posttest of the experimental and control groups after statistical testing as follows:

Table.4 Mean Pretest Posttest

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Pretest	Experiment	75	32.67	7.182	.829
	Control	75	32.93	7.671	.886
Posttest	Experiment	75	84.20	7.168	.828
	Control	75	80.40	6.915	.798

Based on table 4, the mean on the pretest of the experimental group obtained 32.67 and the control group obtained 32.93. The mean on the posttest of the experimental group obtained 84.20, on the posttest of the control group obtained 80.40. Thus, the mean pretest of the two groups is not much different, while the mean on the posttest in the two groups is much different.

The following are the results of hypothesis testing on the pretest and posttest of the experimental and control groups after statistical testing as follows:

Table.5 Hypothesis Test

Independent Samples Test						
			Pretest		Posttest	
			Equal variances assumed	Equal variances not assumed	Equal variances assumed	Equal variances not assumed
Levene's Test for Equality of Variances		F	.743		.099	
		Sig.	.390		.753	
t-test for Equality of Means		t	-.220	-.220	3.304	3.304
		df	148	147.361	148	147.809
		Sig. (2-tailed)	.826	.826	.001	.001
		Mean Difference	-.267	-.267	3.800	3.800
		Std. Error Difference	1.213	1.213	1.150	1.150
	95% Confidence Interval of the Difference	Lower	-2.664	-2.665	1.527	1.527
		Upper	2.131	2.131	6.073	6.073

Based on table 5, the results of the independent sample t test on the pretest of the experimental group and the control group obtained a significance value of 0.826> 0.050, thus there was no difference in the initial ability of students in the sense that the critical thinking skills were not much different. The value on the posttest of the experimental group and the control group obtained a significance value of 0.001 <0.050, thus critical thinking skills of prospective educator students increased by applying the project based seamless learning model.

5. DISCUSSION

Based on the results of the research, the experimental group and control group data were normally distributed and statistically homogeneous. As based on the independent sample t test on the pretest, it shows that there is no difference in the initial ability of students in the sense that critical thinking skills are not much different. Meanwhile, based on the independent sample t test on the posttest, it shows that critical thinking skills of prospective educator students increase by applying the project based seamless learning model.

Examining the difference between the experimental and control groups' pretest scores, which were 32.67 and 32.93, respectively, reveals that there is little variation in the two groups' pretreatment means or students' starting skill levels. Regarding the difference, the experimental group's mean posttest score was 84.20, which was greater than the lower control group's score of 80.40. This is because, whereas the control group employed a traditional learning paradigm, the experimental group adopted a different one the project based seamless learning model. This is the reason why the two groups' averages differed following the research process.

The results of other studies show that the project-based learning (PjBL) model has a significant effect on critical thinking skills [61]. Other research results show that project-based learning can improve or affect the critical thinking skills of students [62]. Other research results mention that project-based learning models affect students' critical thinking skills [63]. Other research results state that the project-based learning model affects students' critical thinking skills [64]. Other research results explain that the project-based learning model affects critical thinking skills [65]. Other research results show that the project-based learning (PjBL) model has a significant effect on critical thinking skills [66]. In the seamless learning research results section, it also shows that the learning process with SL strategy is proven to improve students' concept understanding and critical thinking [20]. The results of another study show the great potential of using seamless learning in improving student engagement and learning achievement in primary schools [67]. This shows that both

project-based learning and seamless learning can improve learning quality, enhance students' critical thinking skills and innovate learning models.

The effect obtained is due to the advantages of PjBL and seamless learning. The advantages of PjBL are one of the choices of learning models to be used because PjBL is learning that connects academic content with real-world contexts in accordance with the demands of the 21st century which can involve students in designing learning, arouse students' enthusiasm in problem solving, and decision making. PjBL is learning where students respond to questions around the real world or solve problems through a process of inquiry, developing thinking skills, creativity, and encouraging them to work together in a team [68], [69]. PjBL can also create an environment that helps students to build meaningful knowledge and be active in student-centred learning, as well as encourage them to collaborate and solve problems with relevant knowledge and skills. [70]. PjBL can encourage the development of higher cognitive levels and offers various forms of performance assessment [71], [72], [73]. The project-based learning method had a positive and high level effect on the visual arts lesson achievements and attitudes [74]. That PjBL can increase students' motivation in learning science, problem-solving skills and improve learning achievement. [75].

The advantages of seamless learning are the scenario where learners are active, productive, creative and can collaborate across different learning environments at any time and wherever they are [76]. Seamless learning allows students to learn in various settings and transition smoothly from one setting or context to another (informal and formal, personal and social learning) using personal media. Therefore, in seamless learning, students get the same learning experience, even in different locations [77]. Another opinion mentions the benefits of using seamless learning, among others: 1) students can learn in unlimited classes and times; 2) students can learn anytime and anywhere; 3) integrated learning between formal and non-formal education. [78]. Similarly, another view states seamless learning is learning that has the concept of continuity of learning without any time and space limits with children's learning experiences leading to using mobile devices. [79]. Another review explains seamless learning supports learners to learn when they want to learn, even in different scenarios and they can move from one scenario to another quickly and easily [80]. Another advantage is that seamless learning means that learning is no longer confined to the classroom, but extends to the child's immediate environment, including home and community [39]. And another said th seamless learning encourages students to implement learning materials learnt in the formal environment into daily activities outside the classroom [81].

6. CONCLUSION

The results of the research and discussion show that the implementation of project-based seamless learning model can improve critical thinking skills of prospective educator students. The results of the normality test showed statistically significant normally distributed data, the results of the homogeneity test showed statistically significant homogeneous data and the results of the independent sample t test on the posttest showed a significant value greater than 0.050, and the average difference between the posttest of the experimental group and the control group provided evidence that prospective educator students' critical thinking skills increased. Because the control group used a conventional model, while the experimental group used a project-based seamless learning model.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI and text-to-image generators have been used during writing or editing of manuscripts.

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