EFFECTIVENESS OF STEAM CODING (ANIMATION AND GAME) APPLICATION THROUGH WEB SCRATCH ON 4C SKILLS

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ABSTRACT

This study aims to determine the effectiveness of the application of digital coding media from several STEAM disciplines (Science, Technology, Engineering, Art, and Math) based on scratch in the form of animated coding and games on 4C skills (Critical Thinking, Creative, Collaborative, and Communication). Researchers examined this because the school under study already has a coding curriculum whose application has not been seen for its effectiveness. In addition, coding learning there has not used the STEAM approach learning method. Whereas implementing coding learning with the STEAM method can foster, even develop computer skills and 4C students. This research was conducted at English Program Phrathom (Elementary) Sangkhom Islam Wittaya School, Sadao, Songkhla, Thailand with a total of 32 students using the total sample technique. The type of research used is experimental quantitative research with comparative and descriptive statistics. The research approach used a quasi-experimental posttest only design. Data collection used observation, interview, and documentation techniques. The data obtained in this study is ordinal data, so the data analysis technique is Nonparametric Inferential Design using paired sample t test from the application of animated coding and STEAM games and descriptive statistical tests to determine the effectiveness of each learner's 4C skills. The results of this study show that 1. There is a significant difference in the application of STEAM coding seen from the correlation of the two of 0.77 and a significance number of 0.00 and the mean application of STEAM Animation coding of 91.71 is more effective than the application of digital media coding STEAM game of 84.06. 2. Knowing the 4C skills of students in the application of animation and games through the average value in each section, so it can be seen that in the application of coding STEAM animation 4C skills are honed starting from Critical Thinking of 22.03, creative of 23.28, Communication of

22.96, and Collaboration of 23.43 and the application of coding STEAM games 4C skills are honed starting from Critical thinking of 20.62, Creative of 21.87, Communication of 20.31, and Collaboration of 21.25.
Keywords: Media, STEAM, 4C, Animation, Game

INTRODUCTION

Education is always changing as the industrialized world changes. The way teachers teach and the curriculum in schools actually adjusts to the needs of the economy or industrial revolution that is developing throughout the world. Although each country has different developments in each revolution, all countries must experience changes according to the capabilities and progress of their countries which will eventually affect other countries.

The world has experienced the industrial revolution 5.0 after changes in the 21st century where the development of artificial intelligence (AI) and technology that is utilized for the welfare of society (Setyawan, 2023). This makes the world of education required to prepare for a better future and develop in all fields. However, of course this is still a challenge for teachers in their learning.

Teachers often convey material to students using the lecture method without the help of media or intermediary tools (even if there is, only using simple technology), so that the learning process seems monotonous, limited, passive, difficult, and one-way coercion. Learning that is still limited and seems monotonous will make students less developed (Indra W., & Fitria Y., 2021). Therefore, learning requires teaching materials in the form of complex fun media as well as the right learning method to support the learning process to make it easier for teachers to convey material to students and make it easier for students to understand learning material. (Ngazizah, N., Hidayati, D.N., & Falah, T.N., 2023).

Learning media can be digital or non-digital media. Currently, learning media is very minimal, especially digital media and most teachers only use platforms that have been used daily (Ngazizah, N., Fadhillah Z.M., 2023). Even though it has utilized technology, the learning is still not balanced with skills that support the character of students. Even though this is important so that children avoid consumptive attitudes and become objects of the digital world. Therefore, the problem and project-based learning method of coding that intersects with other fields of science such as the STEAM method (Science, Technology, Engineering, Art and Mathematics) is needed to train and equip students' competencies to help solve real-world problems and even develop the potential of humans in the future

(Annam, S., Supriyono, Pangestika, R.R., 2021). The learning model can be used to develop students' abilities in planning, creativity, communication, collaboration, problem solving, and problem decision making (Ingtiyasningsih, P., Nurhidayati, & Ngazizah, N., 2022).

UNESCO states that there are at least 4 (four) fundamental skills that students need to have since the 21st century known as 4C consisting of critical thinking, communication, collaboration, and creativity (Official Educourse, 2023). However, the lack of variety in the use of learning media is one of the obstacles to learning (Mubarakah, U., Khaq, M., Pangestika, R.R., 2022). More modern digital learning media began to be developed such as games, animations, and others as learning media that present the concept of sound, images, or interactive videos. (Ngazizah, N., Saputri, D.R., Prahastiwi F.A., Maulannisa, D., & Safitri, D., 2021). One of the containers that can be utilized to overcome these learning variations is by using interactive digital coding media with STEAM methods that can hone students' 4C skills with the scratch platform. Research from Janne Fagerlund (2021) who conducted a literature study on the use of Scratch coding programming in the learning process in elementary school classes also supports that overall programming through the Scratch web can explore Computational Thinking (CT) and language as applied in several countries such as Finland, England, and Estonia which can develop and encourage student abilities in accordance with STEAM learning methods including 4C skills.

Scratch is a visual programming or coding language platform that can be accessed through the web or applications and was developed by the Lifelong Kindergarten Group at the MIT Media Lab. Scratch is designed specifically for children or technology beginners who have an attractive appearance and have complete features. It allows Scratch to make it easy for beginners to create visual interaction projects by combining coding blocks, such as puzzles to create stories, animations, and games that can be shared around the world.

Animation is a moving image of a set of objects that are specially arranged to follow a storyline that describes systematic events. The use of animation in learning can explain complex concepts in a clearer and more understandable way. Through animation, events or concepts that require detailed explanation can be conveyed more effectively. Animation also has visual appeal that can motivate students to be more active in the learning process (Sae, H.L., & Radia, E.H., 2023). Games have the same benefits as animation, but games can also be used to attract attention, train focus, overcome boredom, improve problem solving, and even student creativity. The opinion

that animation and games are more interesting than using audio or visual media, because they have two sensory sensors, namely the eyes and ears (Ginting, F.B., Wesnina, & Soeprijanto, 2022) supports this research to be more useful when combined with learning.

Sangkhom Islam Wittaya School in Phrathom (elementary) school has implemented computer learning, such as the use of Microsoft Word, Microsoft Paint, and coding. In learning computer coding, Sangkhom Islam Wittaya School has a curriculum through web scratch. However, the curriculum is still only used a few times in Phrathom computer learning grade VI in 2023/2024 and has not been linked to the STEAM method and 4C skills. The computer coding material used in grade VI is still only animation and games. Therefore, the author wants to measure the effectiveness of the application of STEAM coding (animation and games) designed through web scratch with a link to the 4C skills of Phrathom (elementary) Sangkhom Islam Wittaya School through the experimental method with the material that the author developed for sustainability and recommendations for better types of coding learning applied in the future.

There are studies that are almost the same as previous research. First, "The Effectiveness of Animated Video Media in Learning Dental Health Education for Tunagrahita Children" written by Constantika, L., Dewi, R.K., and Wardani, I.K. (2022). Second, "The Effectiveness of Animated Video Media in Sociology Learning on Increasing Students' Understanding of Material at SMAN 12 Merangin" where Ayuliandari, F. and Sylvia, I. (2023) were the authors. (2023) as the authors. Third, "Improving Learning Effectiveness Through Android-Based Educational Game Applications" written by Annisa, N.A., Rusdiyani, I., Nulhakim, L. (2022). Fourth, "The Effectiveness of Educational Games as a Cultural Learning Media for Traditional Games for Elementary School Students in Indonesia" with Marcheta, N., and Kareem, R.A. (2023) as the authors. The equation of the first and second studies with this study, namely both examining the effectiveness of animation media. While the third and fourth studies both examine the effectiveness of games. It's just that all of his research still refers to simple methods and facilities and has not been associated with STEAM-based digital coding scratch media learning nor has it had the aim of forming or improving 4C learner skills. Therefore, researchers want to examine both by combining the objectives of the existing problems as a novelty so that the title can be "EFFECTIVENESS OF STEAM CODING APPLICATION (ANIMATION AND GAME) THROUGH WEB SCRATCH ON 4C SKILLS" as its novelty.

METHOD

This study uses a type of experimental quantitative research that is comparative and descriptive statistics (Sugiyono, 2024). The research approach used a quasi-experimental posttest only design (Asni, Wildan, & Hadisaputra, S., (2020). This study did not use a control class, because it aimed to see the effectiveness of the two learning models in the experimental class. The experimental learning research design also does not provide an initial value (pre-test) before receiving treatment, but after receiving treatment is given a final value (post-test). This research was conducted at Phrathom (Elementary) Sangkhom Islam Wittaya School, Sadao, Songkhla, Thailand which was held in January 2024 in the 2023/2024 school year with a total of 32 students using the total sample technique.

Table 1:
Posttest Only Design

GROUP	TREATMENT	AFTER TREATMENT
Experiment 1	*coding STEAM animation*	*Posttest (4C)*
Experiment 2	*coding STEAM game*	*Posttest (4C)*

Data collection techniques using observation, interviews, and Data collection techniques using observation, interviews, and documentation techniques. Observation uses participant observation techniques where researchers are involved with the daily activities of the person or data source being observed and participate in the activities carried out by the data source as well as using structured observation techniques that are designed and require systematic preparation, about the place and things to be observed. Meanwhile, for interviews using semi-structured interview techniques (semi structured interviews) which include indepth with free implementation and open issues where respondents are asked for ideas and opinions. The documentation technique used is in the form of student autobiographies and official documents such as internal documents (memos, announcements, instructions, community rules) and external documents (statements, news). In addition, the documentation used is data on student names, STEAM learning, STEAM coding scores concerning 4C skills and photos during research time learning.

The value data obtained in this study is ordinal data, so the hypothesis data analysis technique is a parametric inferential design using a paired sample t test from the application of animated coding and STEAM games and descriptive statistical tests to determine the

effectiveness of each learner's 4C skills. In addition, researchers also conducted prerequisite tests in the form of normality and homogeneity tests. Normality test is used to determine whether the research data is normally distributed or not. Meanwhile, the homogeneity test is used to test the data variance between two or more groups has the same or different variance as a condition for the paired sample t test.

FINDINGS AND DISCUSSION

Before testing the hypothesis, researchers conducted normality and homogeneity tests using SPSS. The sample that the researchers used amounted to 32 which was less than 50 students (although the sample technique used was total, but the number was classified as a small sample), so the normality and homogeneity test used was shapiro-wilk. The basis for decision making is done if the significance data> 0.05 then the research data is normally distributed. However, if the significance <0.05 then the normality test research data is not normally distributed.

Table 2:
Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Unstandardized Residual	.112	32	.200*	.936	32	.058

Table 3:
Tests of Normality

		Levene Statistic	df1	df2	Sig.
Computer1	Based on Mean	.810	3	28	.499
	Based on Median	.540	3	28	.659
	Based on Median and with adjusted df	.540	3	26.053	.659
	Based on trimmed mean	.732	3	28	.542

The results of the normality test above show that the significance is 0.058. Meanwhile, the results of the homogeneity test of the average significance are also obtained 0.499 where all of them are greater than 0.05, so the data significance of normality and homogeneity research data shows that the overall distribution is normal.

The research hypothesis test used 2 techniques, namely paired sample t test and descriptive statistical test. The paired sample t test uses experimental research data to determine the effectiveness of 2 models of implementing animation and game coding learning (Hartono, 2014).

Table 4:
Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Animation	91.7188	32	7.36265	1.30155
	Game	84.0625	32	10.19468	1.80218

Table 5:
Paired Samples Correlations

		N	Correlation	Significance	
				One-Sided p	Two-Sided p
Pair 1	Animation & Game	32	.774	<.001	<.001

Tabel 6:
Paired Samples Test

		Paired Differences					t	df	Significance	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			One-Sided p	Two-Sided p
Pair 1	Animation - Game	7.65625	6.47382	1.14442	5.32219	9.99031	6.690	31	<.001	<.001

The results of the paired samples statistics output display the mean application of STEAM animation coding 91.71 and the mean application of STEAM game coding 84.06. N for each cell is 32. Standard Deviation for the application of STEAM animation coding is 7.36, and Standard Deviation for the application of STEAM game coding is 10.19. Mean standard error for the application of STEAM animation coding 1.30, while for the application of STEAM game coding 1.80.

The results of the paired samples correlation output display the magnitude of the correlation between the two samples, where the

correlation figure is 0.77 and the significance figure is 0.00. Decision making is based on the probability results obtained, ie:

1. If the probability > 0.05 then the null hypothesis is accepted.
2. If the probability <0.05 then the null hypothesis is rejected.

The significance number 0.00 is much smaller than 0.05. This means that the hypothesis stating that there is no relationship between the application of animated STEAM coding and the application of STEAM game coding (Ho) is rejected, in other words, the application of animated STEAM coding and the application of STEAM game coding have a significant relationship (Ha) is accepted.

The paired sample test output displays the results of the comparison analysis using the test. The output displays the mean of the application of animated STEAM coding and the application of game STEAM coding is 7.65. The standard deviation is 6.47. The mean standard error is 1.14. The lowest difference between the two is 5.32 while the highest difference is 9.99. The t-test result = 6.69 with df = 31 and significance of 0.00.

The interpretation of t is done in two ways:

1. Guided by the value of the t test by comparing to (t observation) with tt, (t table), where with df = 31 obtained numbers: 2.04 for 5% significant level and 2.74 for 1% significant level. With to = 6.69, it is greater than t, at a significant level of 5% or at a significant level of 1% (2.04 < 6.69 > 2.74), which means that the null hypothesis is rejected.
2. Guided by the magnitude of the significance number. In this case the decision is taken with the provisions, If the probability> 0.05 then the null hypothesis is accepted If the probability <0.05 then the null hypothesis is rejected. With a significance number of 0.00, which is smaller than 0.05, it means that the null hypothesis stating that there is no difference in the application of animated STEAM coding and the application of game STEAM coding is rejected.

The conclusion of the paired t test results means that there is a significant difference between the application of STEAM coding using the animation method and the game method. The difference in the mean application of STEAM animation coding of 91.71 and the mean application of STEAM game coding of 84.06 shows that the use of the animation method is better than the game method, so the animation in this study is more effective.

Descriptive statistical tests are used to determine the description of the data by knowing the basic description. The descriptive statistical test of this study researchers used to determine the parts of the 4C skills in the application of animation and games by looking at the average.

Tabel 7:
Animation Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Critical_Thinking	32	15.00	25.00	22.0313	3.32619
Creative	32	15.00	25.00	23.2812	2.72662
Communication	32	15.00	25.00	22.9688	2.79959
Collaboration	32	15.00	25.00	23.4375	2.96145
Valid N (listwise)	32				

Tabel 8:
Game Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Critical_Thinking	32	15.00	25.00	20.6250	3.96558
Creative	32	15.00	25.00	21.8750	3.53553
Communication	32	15.00	25.00	20.3125	3.79675
Collaboration	32	15.00	25.00	21.2500	3.59211
Valid N (listwise)	32				

4C skills in the application of animation have an average Critical thinking of 22.03. Creative is 23.28. Communication is 22.96. Collaboration is 23.43. Meanwhile, 4C skills in the application of games have an average Critical thinking of 20.62. Creative is 21.87. Communication of 20.31. Collaboration of 21.25. Therefore, this study shows that on average, the application of animated STEAM coding through web scratch in honing 4C skills is more effective than the application of games in line with the paired t test. However, if the effectiveness of the application of 4C is sorted from the more honed, then animation can more effectively improve collaboration, creativity, communication, and critical thinking, while games from creativity, collaboration, critical thinking, and communication.

Figure 1:
Application of Animation STEAM Coding

Figure 2:
Application of Game STEAM Coding

CONCLUSION

In field research, researchers combine animation with stories and games with STEAM methods using the scratch platform. Animation is a series of several images that get a simple coding treatment, so that they can move and be concrete, more illustrative, imaginative, easy to understand, and not quickly damaged. Meanwhile, educational game media research is a little more complicated in its making, but it can be entertaining, can increase concentration, practice problem solving, and educate both in terms of material and information. In this study, researchers combined the two media whose application combines animation with stories and games have their own concepts with their respective projects still referring to interactive STEAM coding to find out the EFFECTIVENESS OF APPLICATION OF STEAM CODING (ANIMATION AND GAME) THROUGH WEB SCRATCH ON 4C SKILLS.

Judging from 1. The magnitude of the significance number 0.00 which is smaller than 0.05 and the interpretation of t which is guided by the value of the t test in comparing to (t observation) with tt, (t table) where it is known that to = 6.69 is greater than t. This means that the hypothesis stating that there is no relationship between the application of animated STEAM coding and the application of STEAM game coding (Ho) is rejected, in other words, between the application of animated STEAM coding and the application of STEAM game coding has a significant relationship (Ha) is accepted. The mean difference in the application of coding STEAM animation 91.71 and the mean application of coding STEAM game 84.06 shows that the use of the animation method is better than the game method, so the animation in this study is more effective.

To find out the parts of the 4C skills that are honed in the application of animations and games, this research uses a way to see the average value of the components. 2. 4C skills in the application of animation have an average Critical thinking of 22.03. Creative is 23.28. Communication is 22.96. Collaboration of 23.43. Meanwhile, 4C skills in the application of games have an average Critical thinking of 20.62. Creative is 21.87. Communication of 20.31. Collaboration of 21.25. Therefore, this study shows that on average, the application of animated STEAM coding through web scratch in honing 4C skills is more effective than the application of games in line with the paired t test. However, if the effectiveness of the application of 4C is sorted from the more honed, then animation can more effectively improve collaboration, creativity, communication, and critical thinking, while

games from creativity, collaboration, critical thinking, and communication.

The application of STEAM coding between animation and games that researchers carried out at Sangkhom Islam Wittaya Thailand school through web scratch proved effective in applying the animation method compared to the application of the game method. However, in the application in the field to improve 4C skills as a whole, it is possible that all STEAM coding methods can be utilized and created according to field conditions. In the 4C skills research above all categories are declared very feasible to use, because the value of each category has an average of more than 20.00.

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