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# Digital Game Development As A Computer Science Learning Tool For Vocational High School Students

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**Abstract:** Indonesia has a shortage of professionals in Information and Communications Technology (ICT). Therefore, to increase the pool of electrical experts who are also qualified in the field of computer science, it is necessary to boost interest in computer science at an early year of upper secondary level. The Game Based Learning (GBL) approach increased investment in computer science for vocational high school learners. The two-dimensional (2D) game named Jack into Woods (JIW) was developed to teach fundamental concepts of C++ programming and influence the view in the computer science fields of electrical engineering of vocational high school students. The research involved the instructional design procedure, particularly the ADDIE model, to build and observe the computer game prototype and whether the product contextually fulfills the feasible and practical standard. The quantitative research method study was used to analyze the measurement. A total of 4 experts, 32 students from the pilot study group and 64 students from the control and experiment groups, participated in the research. The data was collected from research participants through pre-test–post-test, and pre-survey–post-survey responses. The quantitative data was collected, and feasibility was analyzed using descriptive statistics. Although participants scored significantly different between experiment and control groups' post-survey responses, the focus and control groups' post-test performances were not significantly different.

***Keywords***—Digital Game,Game Based Learning, Computer Science, Vocational High School

Indonesia presently is a progressive country signalised by vast opportunity. Indonesia is the 16th biggest economy in the world and the country that have stable growth rates in global economies. (Razdan, R., Das, M., & Sohoni, A., 2014). It is predicted that Indonesia will be one of the five countries with the most robust economy in the world by 2050 (PWC, 2017). This is in tune with the emerging challenge of the AEC (Asean Economic Community). In 2018 Indonesia demands 113 million workers with sufficient skills, including 3.122.800 ICT human resources. However, according to the ICT Development Index (IDI) concern in skills and capabilities, Indonesia reached the 109th rank of the 176 countries in 2017 (Peña-López, 2017).

Moreover, the government want to evolve ten industries which is one of them is the Information and Communications Technology (ICT) industry. The development of the ICT industry from 0.5% in 2010 until achieving 8% in 2014 shows broadband business multiplying.

Unfortunately, the Central Bureau of Statistics (2017) data show that the labour force in Indonesia is still dominated by 95.6 million less skilled workers, 17.2 million skilled workers and 11.5 million are experts in the field. Based on the 2030 Agenda for Sustainable Development set by United Nations Statistical Commission (UNSC) (ITU, 2017) by 2030, the youth and adults who have technical and vocational skills for occupation and entrepreneurship will increase significantly.

A memorandum of understanding (MoU) on vocational education development was signed on November 29, 2016, among relevant five ministries. Moreover, one of the ministries, the Ministry of Industry is working on Industrial 4.0 roadmap focusing on four technologies: IoT, E-smart SMEs, start-up incubation, and the use of digital technology for industries (big data, AR, Cloud, cybersecurity).

According to a study, an educational strategy based on proficient workouts can assist students to tie-up the perception of mathematics, statistics, science and professional practices (Dierdorp, Bakker, van Maanen, & Eijkelhof, 2014). Early exposure and an idea of a particular career field may specify the student's interest level and the probability of success in their career. (Maltese & Tai, 2010). By enhancing knowledge and desire of enthusiasm of the student in this level, the student may interest and want to extend a keen in STEM to be successful in the fields like in computer science (CS). The number of students that take courses of STEM and their possibility enters the STEM correlate. (Lee, 2015).

Coding is an essential technical skill for electrical engineers, especially for the first-year school-aged students. Game-Based Learning (GBL) is a sort of interactivity that has assigned learning results and was picked as a strategy for substance conveyance for a few reasons (Prensky & Thiagarajan, 2007). GBL is valuable since it joined three learning theory: the situated learning theory, the active learning theory, and mastery learning theory (Why does GBL work? 2012). The first is the theory of implementing the material being seen in the correct conditions. The second theory is the ideas that bolster hands-on learning exercises over different techniques. The third theory requires the overcoming the materials at one level before proceeding onward to the following. The three techniques apply to GBL, making it empowering in ability and learning improvement. GBL generates potent outcomes since it remotes casualness, commitment, precious substance, mission-based learning, adaptability, and apprehend student enthusiasm (Ten Reasons why Game-Based Learning Works in Education, 2012).

In this study, the game is depicted as an intuitive type of stimulation with objectives, principles, and difficulties joined with critical thinking exercises with the motivations behind educating a topic (Novak, 2012; Schell, 2008). Educational games are any diversions intended for the specific use in accomplishing a study plan point in school courses (Gee, 2003). Computer games provide a fun and entertaining practice and keep players focused on long-term concourses. Thus, games with educational aims, i.e., Serious Game (SG) are becoming more recognised recently (Mortara et al., 2014). The learning aspect executes an instructive procedure by composing the educational subject matter and organising its delivering; while the entertaining part of a Serious Games offers engagement and can be dictated by several factors like a storyboard, designs, ease of use, collaboration/competition mechanisms and interaction tools (Capdevila Ibáñez, Marne, & Labat, 2011). The purpose of the research is to find the effectiveness of JIW to students' perceiving CS and knowledge of CS.

## METHODOLOGY

Develop and validate educational products is a process as known as educational research and development (R & D) (Borg and Gall, 1983). The primary purpose of development research is to inform the decision-making process during product/program development to improve the products/programs being developed and the developer's ability to create these things in future situations (Walker & Bresler, 1993). This development research uses the ADDIE model, consisting of five stages: Analyze, Design, Develop, Implement, Evaluation (Branch, 2009). ADDIE is a model of instructional system design (ISD).

To evaluating the game developed, an experimental research design will be used in this research. This study involves the collection of quantitative data. This research uses experimental procedures and tends exploratory. The study involved three steps. First, the researcher selected a sample. Second, the researcher randomly assigned participants to experimental and control groups. Third, the researcher applied the treatment to the experimental group only (Joyner et al., 2013).

### 2.1 Instructional Procedure

The development of the educational game done using an instructional systems design model, and it includes the designing of any content for educational purposes. Furthermore, designing a system that commonly used is the ADDIE model, or the Analysis, Design, Develop, Implement, Evaluate model (Kadlec, 2013).

The games with actual planning are involved in the design stage of the ADDIE model. Developing of the idea for the proposed game is the main focus in this stage. In the completed game design document, the goals, rules, and challenges within the game were portrayed.

In the developing phase, several software and instruments available to game developers were used to create the actual playable game. Furthermore, the targeted demographic playing the game was involved in the implementation and evaluation phase. Therefore, for these phases, a computer science (CS) learning workshop was held. In its application, where other students played the game while another group learned C++ language via direct course delivery.

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Figure 1. ADDIE Model

**2.2 Product Testing Subject**

Pilot test participants of the study are 10th graders 32 students majoring in of Software Programming at State Vocational High School 2 Surabaya. The participants of the implementation phase trial are two classes of 10th graders' 33 students majoring in Power Electrical Engineering at State Vocational High School 2 Surabaya for the experiment and control group.

**2.3 Data Collection**

The first phase of this study involved collecting and analysing quantitative data. The meaning of such analysis implies measurement includes notes the numbers, and analysis requires the results' interpreting (Vogt, 2007). Data collection is conducted simultaneously during the learning process.

The type of data obtained in this developmental study consists of quantitative data obtained from the questionnaire. Experts will validate the questionnaire instruments to provide an assessment of the C++ educational digital game development. At the end of the experiment, the post-game survey questions were offered exclusively. Along these lines, participants were only asked some information about their change of perception the post-game study.

Students assigned to the control group participated in a class where the same concepts presented in the computer video game were taught. The topics were presented using a PowerPoint Presentation trying to imitate a traditional lecture environment. The speeches were content focused; the PowerPoint presentation included text and visual representations.

Students assigned to the experimental group played with the computer video game at their own pace. The students were involved in an active multimedia learning environment with no interaction about the content with the researcher during the gameplay intervention. Questions and answers were related to gameplay and C++ concepts. Two instruments (Likert scale surveys, and open-ended content surveys) were used mainly for quantitative data collection.

**2.4 Data Analysis**

The Likert scale questions were used for the survey of post-game in the game assessments. Participants rated their effectiveness perceiving and ease of use tutorial. Besides, the students rated the ability of the game to teach theory and materials.

## RESULTS AND DISCUSSION

**3.1 Validity and Reliability of Data Collection Instruments**

In order to ensure the validities and reliabilities of questions the researcher has undertaken some validated survey instruments with similar purposes and slightly revise some question items. The validity assessment was carried out through a pretesting strategy. The questionnaire is distributed to at least 30 participants of the same population of participants not included in this study (Delice, 2010). Therefore, the data is not biased (Spooner & Flaherty, 1993). In this study, the pilot study was involved 32 participants, who were chosen from the student from the department of software engineering. Instrument validity testing was using Product Moment correlation formula. The following Product Moment formulas:

$$r_{xy} = \frac{N\sum xy - (\sum x)(\sum y)}{\sqrt{N\sum x^2 - (\sum x)^2\left(N\sum y^2 - (\sum y)^2\right)}}$$

$r_{xy}$ = Correlation coefficient between x and y variables
$\sum xy$ = Number of multiplications between x and y variables
$\sum x^2$ = Number of squares of value x
$\sum y^2$ = Number of squares of value y
$(\sum x)^2$ = Number of x values is then squared
$(\sum y)^2$ = Number of y values is then squared

Table 3. Performance Assessment Instrument Validity

| | No Item | $R_{count}$ | $R_{table}$ | Suggestion |
|---|---|---|---|---|
| Likert | 1 | 0.814 | 0.349 | Valid |
| | 3 | 0.640 | | Valid |
| | 4 | 0.733 | | Valid |
| | 5 | 0.554 | | Valid |
| | 6 | 0.761 | | Valid |
| Multiple choice | 2 | 0.846 | 0.349 | Valid |
| | 7 | 0.836 | | Valid |
| | 8 | 0.562 | | Valid |
| | 9 | 0.829 | | Valid |

Based on the data in Table 3, all items are valid. The validity test was separated into two methods due to questions type, 5 Likert based questions and four multiple choices. That is indicated by the result of the correlation (Rcount) between each item score, and the total score was ranged between 0.496 – 0.713 greater than ≥ 0.349 (Rtable N=32). Then, this study was used nine items to measure the students' knowledge or performance of computer science.

Table 4. Perceiving Assessment Instrument Validity

| No Item | $R_{count}$ | $R_{table}$ | Suggestion |
|---|---|---|---|
| 1 | 0.456 | 0.349 | Valid |
| 2 | 0.407 | | Valid |
| 3 | 0.483 | | Valid |
| 4 | 0.451 | | Valid |
| 5 | 0.567 | | Valid |
| 6 | 0.472 | | Valid |
| 7 | 0.585 | | Valid |
| 8 | 0.376 | | Valid |
| 9 | 0.611 | | Valid |
| 10 | 0.397 | | Valid |
| 11 | 0.604 | | Valid |
| 12 | 0.542 | | Valid |
| 13 | 0.482 | | Valid |

Based on the data in Table 4, all items are valid. That is indicated by the result of the correlation (Rcount) between each item score, and the total score was ranged between 0.376 – 0.611 greater than ≥ 0.349 (Rtable N=32). Then, this study was used 13 items to measure the students' respond or perceiving toward computer science.

Reliability pointed to the measurement or design's consistency (Vogt, 2007). The survey and test questions are based on prior instruments, and the previous curriculum is considered reliable. Reliability also refers to the expectation that the same results are gained by one person or by another when doing the same research at different times. In each class meeting, surveys and tests are given at the beginning and end, and differences in answers before and after deciding the effectiveness of the learning model. This method of test-retest is easily duplicated and can be remade by other academics at any time using the

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available instrumentation. Instrument reliability testing was using Cronbach Alpha formula. The following Cronbach Alpha formulas:

$$R_{xx} = \left(\frac{n}{n-1}\right)\left(1 - \frac{\sum \sigma_t^2}{\sigma_t^2}\right)$$

$R_{xx}$ = Number of reliability (Alpha)
$n$ = Number of tested question items
$\sum \sigma_t^2$ = Total number of each item's variance
$\sigma_t^2$ = Total variance

Table 5. Assessment Instrument Reliability

| Instruments | $R_{xx}$ | Reliability Coeff. | Suggestion |
|---|---|---|---|
| Performance (Likert) | 0.747 | 0.7 – 0.9 | Valid |
| Performance (Multiple choices) | 0.771 | 0.7 – 0.9 | Valid |
| Perceiving | 0.745 | 0.7 – 0.9 | Valid |

The criteria of instrument reliability are: if alpha is > 0.90, then reliability is excellent; if the alpha is > 0.80, then the reliability is good; if alpha is > 0.07, then reliability is acceptable; if alpha is > 0.60, then reliability is questionable; and if alpha is < 0.50, then reliability is poor (George & Mallery, 2003; Kimberlin & Winterstein, 2008). Based on the Excel analysis the reliability for these instruments was ranged from 0.723 to 0.771, which is indicated the instruments have sufficient reliability.

After translated into the Indonesian language, content validity of the questionnaire and question-wording checks was assessed by experts from universities and vocational high school teachers (The list of experts' members was shown in Table 6). The name of experts' members used initials because all of them did not want to expose their name in this study.

Table 6. The Experts List Members

| Name Initials | Education Degree | Affiliation |
|---|---|---|
| WS | Doctor | State University of Malang |
| LA | Doctor | State University of Surabaya |
| TW | Master | Private University of Surabaya |
| NM | Bachelor | Vocational High School 2 of Surabaya |

Furthermore, to meet this study purposes and participants' reading preference, before the pilot study and distributing the questionnaire, the researcher checked the question wording of the survey to three participants to find out whether the questions translated from English into Indonesian were easy to understand. The result from this process can be concluded that the questions are easy to understand and answer.

**3.2 Product Effectiveness**

To determine the effectiveness of the JIW software, the implementation carried in the control class with 32 students and experimental class with 32 students. Both groups of students were recruited from the same grader, and they were enrolled in the same department. To examine the learning gains after gameplay interventions, an assessment of the understanding of C++ concepts after the intervention was required. It was imperative to collect data with open-ended content surveys. In the open-

ended content surveys, the questions related to the C++ programming concepts presented in the intervention. The survey questions included four basic concepts; variables, operators, if-statement, and array. Figure 4.15 presents the performance results in a survey taken by all participants.

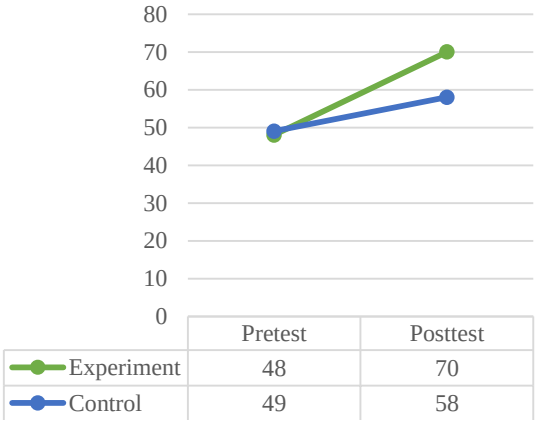


Figure 12. Response Results of Experiment and Control Group

The response result of experiment and control group based on Figure 12 shows that there is improvement score between pre-test and post-test of computer science perceiving. The experiment class has average pre-test score of 48 and post-test average score 70, while the control group has pre-test average score of 49 and post-test average score 58. Furthermore, to provide an overview of the increase in treatment outcomes scores between pre-test and post-test the PPG method is applied. For the detailed data.

Two comparison calculations were used to evaluate the perception gains in the pre-test and post-test: average gain (the difference between post and pre-mean scores) and the percent of possible gain (PPG). Percent of possible gain is used in the study (Menlo, 1976) for group comparisons to examine the intervention effect.

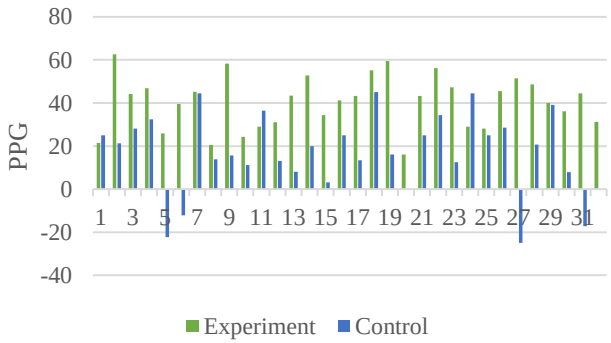


Figure 13. Comparison of percentage of possible gains (PPG) for the experiment and control groups on CS perceiving

The percentage of possible gain was used because it provides a better overall comparison between the groups. A comparison of response between the experiments versus control group is presented in Figure 13. In this graph, the PPG for each treatment group was compared by using an independent t-test statistical analysis. Overall, the PPG for the experiment group (40%) which categorised as “Fair gain” was larger than the control group (17%) which categorised as “Low gain”. The zero number of scores with negative PPG suggests that the computer video game was effective in boosting students’ perception of CS concepts. For the detailed data.

Due to the difference between post-test results of experiment and control group, the independent t-test statistical analysis was used. Before executing the independent samples t-test, there are several requirements that must be fulfilled. As with other parametric statistical tests, independent sample t-test tests using the data used must be normally distributed. Data variance between groups also should be similar or homogeneous.

Table 7. Homogeneity and Shapiro-Wilk normality test on CS perceiving pre-test score

| Group | Homogeneity score | Normality score |
|---|---|---|

| | | |
|---|---|---|
| Experiment | .199 | .578 |
| Control | | .604 |

Based on the SPSS output in Table 7 it is known that the significance value of the CS variable perceiving the experimental class and the control class is .199 (p > .05), meaning that the data variants of the two classes are homogeneous. For the test of normality, the significance value for the experiment group is .578 (p > .05), while the significance value for the control group is .604 (p > .05), meaning the pre-test data of CS perceiving for two groups have a normal distribution.

Table 8. Normality test on CS perceiving post-test score

| Group | Statistic | df | Sig. |
|---|---|---|---|
| Experiment | .976 | 32 | .683 |
| Control | .959 | 32 | .265 |

Based on the output test of normality, the significance value for the experiment group is .683 (p> .05), while the significance value for the control group is .265 (p > .05), meaning the post-test data of CS perceiving for two groups have a normal distribution.

Table 9. Independent t-test result of CS perceiving post-test score

| | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | F | Sig. | f | g. | Si (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference | |
| | | | | | | | | Lower | Upper |
| Equal variances assumed | 6.474 | .013 | .787 | 62 | .000 | 11.50000 | 1.69432 | 8.11319 | 14.88681 |
| Equal variances not assumed | | | .787 | 3.333 | .000 | 11.50000 | 1.69432 | 8.10218 | 14.89782 |

After the data to be tested fulfil the requirements of a normal distribution and has a homogeneous variant, then the independent t-test statistical test can be run. An independent t-test assisted analyse the post-test mean of the control group versus experiment group. From the 13 questions asked regarding attitude on computer science, the percentage of students' response was compared (n = 32). The significance value of the two groups, p = .000 with p < .05, shows that there were significant differences between the two groups. We can reject the null hypothesis, and based on the results we can state there was a significant difference between the experimental group and the control group on CS perceiving.

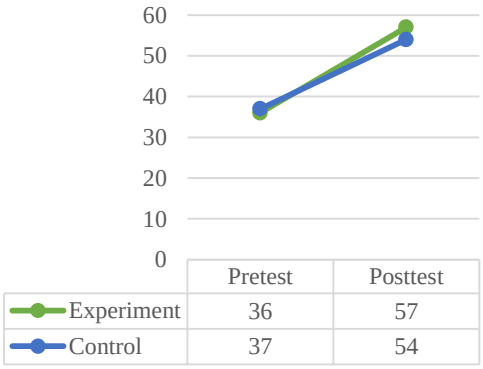

Figure 14. Performance Results of Experiment and Control Group

The performance result of experiment and control group based on Figure 14 shows that there is improvement score between pre-test and post-test of computer science perceiving. The experiment class has average pre-test score of 36 and post-test average score 57, while the control group has pre-test average score of 37 and post-test average score 54. Furthermore, to provide an overview of the increase in treatment outcomes scores between pre-test and post-test the PPG method is applied. A comparison of response between the experiments versus control group is presented in Figure 4.18. For the detailed data.

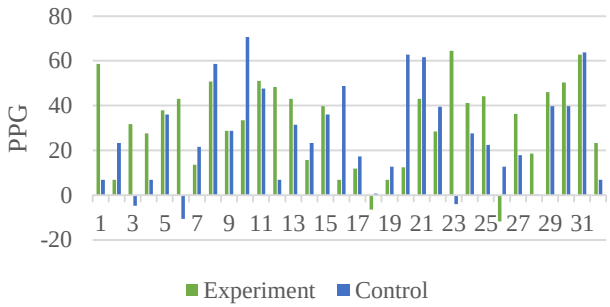


Figure 15. Comparison of percentage of possible gains (PPG) for the experiment and control groups on CS knowledge

A percentage of possible gain comparison of performance between the experiments versus control group is presented in Figure 4.18. In this graph, the PPG for each treatment group was compared by using an independent t-test statistical analysis. Overall, the PPG for the experiment group (32%) which categorised as "Fair gain" was somewhat larger than the control group (27%) which categorised as "Low gain". The balanced number of scores with negative PPG suggests that the computer video game was not effective enough in boosting students' knowledge of CS concepts. The further explanation will be discussed in t-test statistical analysis. For the detailed data.

Table 10. Homogeneity and Shapiro-Wilk Normality Test on CS Knowledge Pre-Test Score

| Group | Homogeneity score | Normality score |
|---|---|---|
| Experiment | .079 | .248 |
| Control | | .095 |

Based on the SPSS output in Table 10 it is known that the significance value of the CS variable knowledge the experimental class and the control class is .079 ($p > .05$), meaning that the data variants of the two classes are homogeneous. For the test of normality, the significance value for the experiment group is .248 ($p > .05$), while the significance value for the control group is .095 ($p > .05$), meaning the pre-test data of CS knowledge for two groups have a normal distribution.

Table 11. Normality Test on CS Knowledge Post-Test Score

| Group | Statistic | df | Sig. |
|---|---|---|---|
| Experiment | .937 | 28 | .094 |
| Control | .956 | 32 | .211 |

Based on the output test of normality, the significance value for the experiment group is .094 ($p > .05$), while the significance value for the control group is .211 ($p > .05$), meaning the post-test data of CS knowledge for two groups have a normal distribution.

Table 12. Independent T-Test Result of CS Knowledge Post-Test Score

| | Levene's Test for Equality of Variances | t-test for Equality of Means |
|---|---|---|

| | F | Sig. | f | g. | Si (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Lower | Upper |
| Equal variances assumed | .097 | .756 | .001 | 2 | .320 | 2.9375 | 2.93541 | -2.93030 | 8.8053 |
| Equal variances not assumed | | | .001 | 1.633 | .320 | 2.9375 | 2.93541 | -2.93099 | 8.8059 |

An independent t-test helped analyse the average of post-survey between the experiment group and control group. The positive gain of 64 students CS understanding from nine questions item was compared. The significance scoring of the two groups, $p = .321$ with $p > .05$, indicates that there was no significant difference between the two groups. We can accept the null hypothesis, and based on the results we can state there was no significant difference between the experimental group and the control group on CS understanding.

This step would like to analyse how much effect of the treatment that produced from developed digital games by the effect size test. The most common step that was used to measure the scale of treatment effectiveness from independent t-test is the Cohen method (Cohen, 1988). Cohen's d is dictated by computing the mean difference between two groups and then dividing the scores' outcome by the pooled standard deviation. The formula of the Cohen method as follows:

$$\text{Cohen's } d = (M_{exp} - M_{ctrl}) / \text{Std Dev}_{pooled}$$

Furthermore, the result of effect size based on perceiving and knowledge is shown in Table 13.

Table 13. Effect Size Result of CS Perceiving and Knowledge Score

| Data Entry | | | | | | Standardised Effect Size | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Outcome measure | Experiment group | | Control group | | | Pooled Standard Deviation | Effect Size | E.S. estimate Standard Error | Effect Size Confidence Interval for | | Effect Size based on control group SD |
| | Mean | SD | Mean | SD | | | | | lower | upper | |
| Perceiving | 0 | 2 | .26 | 8 | 2 | .01 | .78 | .77 | .29 | 1.17 | 2.33 | .50 |
| Knowledge | 7 | 2 | 1.30 | 4 | 2 | 2.20 | 1.76 | .26 | .25 | -0.24 | 0.74 | .25 |

Based on table 14 the results show that the effects of developed digital games for the CS perceiving section had a score of 1.77 and the CS knowledge section had a score of 0.26.

Table 14. Interpretation of Effect Size

| **Effect Size** | **Percentage of control group who would be below average person in experimental group** | **Rank of person in a control group of 32 who would be equivalent to the average person in experimental group** |
|---|---|---|
| 0 | 50% | 16th |
| 0.1 | 54% | 15th |
| 0.2 | 58% | 14th |

| Effect Size | Percentage of control group who would be below average person in experimental group | Rank of person in a control group of 32 who would be equivalent to the average person in experimental group |
|---|---|---|
| 0.3 | 62% | 13th |
| 0.4 | 66% | 11th |
| 0.5 | 69% | 10th |
| 0.6 | 73% | 9th |
| 0.7 | 76% | 8th |
| 0.8 | 79% | 7th |
| 0.9 | 82% | 6th |
| 1 | 84% | 6th |
| 1.2 | 88% | 4th |
| 1.4 | 92% | 3rd |
| 1.6 | 95% | 2nd |
| 1.8 | 96% | 2nd |
| 2 | 98% | 1st (or 1st out of 44) |
| 2.5 | 99% | 1st(or 1st out of 160) |
| 3 | 99.90% | 1st(or 1st out of 740) |

The value of d is 1.77 (between 0.8 and 2.0), this can be stated that the intervention of the digital game to students' response and perceiving toward CS indicate a large effect. The average person (i.e., the one who would have been ranked 16th in the group) in the experiment group would have the same perceiving as the 2nd highest person in the control group. The value of d is 0.26 (between 0.2 and 0.5), this can be stated that the intervention of the digital game to students' performance and knowledge toward CS indicates a small effect. The average person (i.e., the one who would have been ranked 16th in the group) in the experiment group would have the same performance as the 13th highest person in the control group.

The early research hypothesis (HA) before done the data analysis was: the experiment group will gain a higher score in the computer science course than the control group. The real results support the null hypothesis (H0) which was: The survey scores of the experiment and the control group's CS performance are not significantly different. This is based on independent t-test results of the post-intervention survey scores, as the significance value of the two groups, $p = .321$ with $p > .05$. The thought at the beginning was that the game would cause the experimental group to comprehend the C++ theory better and have more knowledge gain to programming code. Unluckily, the outcomes comparison did not imply the presumption.

While the null hypothesis (H0) was supported, this does not mean the game failed at what it was developed to do. The results support the point that the game was able to ignite the experiment group's willingness to learn CS. This is based on independent t-test results of the post-intervention survey scores, as the significance value of the two groups, $p = .000$ with $p > .05$ because the result of students' response showed that the students who played the educational game have a higher gain score and better perceiving toward computer science.

## CONCLUSION

The game 'Jack Into the Woods' is an educational game of programming language with adventure genre that at every level the player is asked to solve basic problems of C++ language operation. The four experts and 64 students from the pilot test group and experiment group examine the developed C++ digital game in this research study. There was no contrast gap between two treatment outcomes. However, there were significant differences when carrying the treatment out from the teacher's viewpoint. The experiment group did slightly better than the control group on their post-survey score. One of the primary factors that affected those results is that several of the conventional class participants did not finish wrap the material up from the provided resources before taking the post-quiz. The experiment group participants felt that they had more

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excitement and interest in the hands-on activities. The nuance in the class was different from the experimental group versus the control group. It took much work to teach the non-game group. As the teacher who was teaching the course for four hours including treatment and hands-on exercises. By the time the lecture was finished, the teacher was overwrought. In the non-game group, the teacher was controlling the classroom directly, covering the material and activities in a solitary well-ordered way. In this condition, if a student required help with a specific subject—the teacher holds the class to guide an individual student would be delayed the whole class. The rest students waited for the teacher before proceeding the activity. However, because the teacher controlled the classroom, she could cover the majority of the material inside the four-hour time frame.

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