Kahoot quiz: interactive media in knowing the increase in understanding of the numerical method of oceanographic physics based on matlab programming

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## ABSTRACT

This study aims to improve the practical understanding of the numerical method of oceanographic physics based on Mathlab software to calculate the roots of the Airy wave equation through the Kahoot application as an interactive media. This study used a population of 3 classes totaling 105 people. The determination of the increase in quiz scores with and without the Kahoot application was analyzed using the primary statistical comparison method, Independent T-Test Comparison (Intecomp) testing, and the distribution of the increase in quiz scores per class and per mean predicate with a weighted scale of 4. The average score of the quiz scores without Kahoot 76.28; with Kahoot 84.96; the Intecomp P-Value test results 6,1.10-6 (α = 0.05), a significant increase in quiz scores from the use of the Kahoot application. The distribution of data for increasing the quiz's value with weighted scores is 9.63%; the distribution of the increase in the average quiz score per class was 5.42%. Based on the statistical analysis test, it can be concluded that the use of the Kahoot application as an interactive media can increase the practitioner's understanding of the mathematical physics numerical method

INTRODUCTION

Oceanography is a pure field of analysis of physical, biological, chemical, and geological phenomena related to the oceans and their surrounding environment, specifically in physical oceanography, which describes physical processes or phenomena in the sea such as waves, ocean currents, and tides. Especially in the calculation of Airy waves, the physical oceanographic parameters can't get the exact value, so an approximation is needed. This approach uses numerical methods that are facilitated by the use of the Mathlab programming language. This authentic learning tends to be rigid and
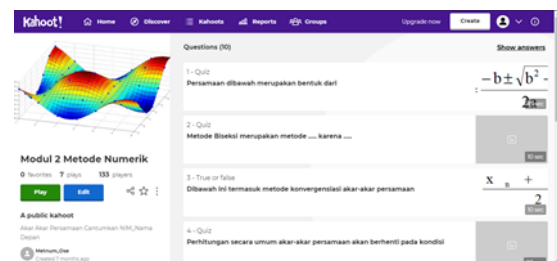
Figure 1. Display questions on Kahoot

not dynamic, so it requires media with dynamic and eye-catching properties such as Kahoot as interactive media in authentic education (Wang & Tahir, 2020).

Kahoot is an interactive media in game-

based educational quizzes that can be accessed via the Android platform or the web. It can support the practitioner in understanding the material presented during the practical work. Kahoot has a feature to make a series of multiple-choice and true-to-false questions with a relatively short answer time (5-30 seconds) from the lecture and practicum materials to be delivered. Kahoot is also open-source, meaning that anyone can access and change each quiz's appearance that will be held and is free to design questions and answers before the time the quiz or exam starts (see Figure 1). Thus this media can support teaching and learning activities creatively. Interactive without losing the essence of the material presented makes it easier for teachers to control the quiz course and avoids cheating because the time to answer each question is limited. The questions are only displayed on the projector screen so that the practitioner can focus on the problems in front and reduces the opportunity to cheat. Kahoot also provides a positive stimulus to reduce clumsiness, support dynamic learning, and increase learning effectiveness (Graham, 2015; Göksün & Gürsoy, 2020; Ismail et al., 2018 .; Lin, Ganapathy & Kaur, 2018; Wang & Tahir, 2020). As for Kahoot's attractiveness in motivating to learn, it is interesting to implement the new interactive learning method based on the material based on numerical-oceanographic physics methods in changing the learning mechanism, which is rigid and monotonous.

This application makes it easy to calculate the final score of a quiz or exam because every question that is entered will be automatically recorded in the .csv (Excel) file at the end of the quiz session, as shown in Figure 2 so that the teacher does not need to check the answer of the practitioner thoroughly. Studies related to the use of Kahoot in learning are usually "only" used as a support platform for interactive and qualitative learning, such as in research (Göksün & Gürsoy, 2020; Wang & Tahir, 2020). Therefore, this study uses Kahoot as the leading platform for assessing a practitioner's understanding of the material provided quantitatively.

Figure 2. Example of a quiz score report sheet at the end of the Kahoot session.

RESEARCH METHODS

This study uses a comparative method that compares condition one, namely the final quiz score, without using Kahoot compared to condition two, namely the quiz's final score using the Kahoot application (Sugiyono, 2015).

The material research design discussed the Airy wave equation, namely the theory of linear ocean waves, which measures (mainly) the water level elevation η (x, t) as shown in **Figure 3**, which is derived from the Laplace and Bernoulli equations (Hutahaean, 2019) :

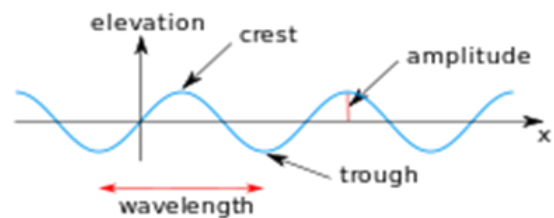$$\eta(x,t) = (H_0 / 2)\cos[2\pi x / L_0 - 2\pi t / T_w] \quad (1)$$

Figure 3. Wave Characteristics

Based on equation (1), it can be derived again to calculate the general celerity c_p (which will then be classified by the relative depth d / l described in **Figure 4**), namely:

$$c = \sqrt{\frac{g}{k}\tanh(kh)} \quad (2)$$

After obtaining the wave propagation velocity

cp, equation (2) can be differentiated and interpolated with the value of the deep sea wave height obtained from the measured wave period (see Figure 4). The results of equation (2) are used to measure the actual wave height;

$$H_w = H_0 \{A \exp[(H_0 / L_0)B]\} \qquad (3)$$

Where

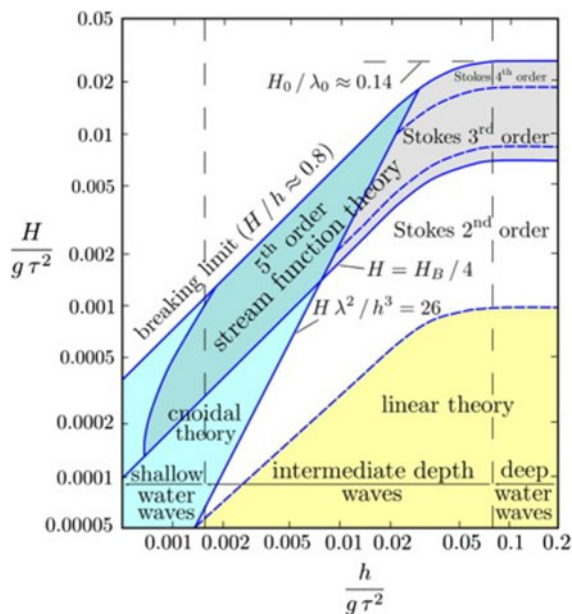$$A = 0.5875(d / L_0)^{-0,18} \qquad (4)$$

When $\quad d / L_0 \leq 0.0844$

$$A = 0.9672(d / L_0)^2 - 0.5013(d / L_0) \\ +0.9521 \qquad (5)$$

When $\quad 0.0844 \leq (d / L_0) \leq 0.6$

$$A = 1 \qquad (6)$$

When $(d / L_0) > 0.6; B = 0.0042(d / L_0)^{-2.3211}$ (Martínez-Ferrer *et al.*, 2008).

Figure 4. The scope of the theory of linear waves (Airy) with others split H as wavelength per period and has wave height per period and relative depth.

Equation (3) until (6) requires several approaches to perform calculations, such as iteration (repetition) of steps using the Fourier series function, which is impossible to do manually. Hence, it takes the Mathlab program to solve it. Mathlab is a supporting tool in calculating a complex, complicated and repetitive equation. However, the explanation of physics oceanography material using numerical methods still can be difficult for the practitioner to understand. Therefore, interactive media is needed to help improve the practitioner's understanding of this learning to increase the final grade of the course in the future.

The research was conducted on Monday, 2, and 9 March 2020 for class A; Tuesday, 3 and 10 March 2020 for Class B as well as; Wednesday, March 4 and 11, 2020 for class C. All activities are held at the Computing Laboratory Building J, 5th Floor, Faculty of Fisheries and Marine Sciences, Diponegoro University, Semarang, Central Java.

The data used came from 3 classes with a total of 105 people in the form of the population (N), so that the degrees of freedom used was 0.05 (Winter, 2013) to determine the distribution of the pure value and after weighting the final score with two independent variables (DK and TK).

The research was carried out using the Kahoot device as a medium for testing the interactivity of the learning material presented, some software such as Ms. Powerpoint, Ms. Excel 2020 (Collective Data), and Mathlab 27a (Operations on Digital Numerical Methods), as well as Minitab 2018 for t-test statistical data processing.

Data were collected through respondents, the value of Airy's linear wave theory discussion using the Matlab numerical method with 3 class sessions. In each session, an assessment was carried out in the form of a written test with answers written on LJU in Ms. Document (.docx). The next session of the exam in the form of a quiz presented in the Kahoot application for 20 minutes (with variations per question to answer 30 seconds - 5 minutes depending on the difficulty of the problem), all sessions have 20 multiple choice questions with a maximum value of 100. LJU non -Kahoots will be collected and sorted using Excel, while LJU Kahoot will be downloaded instantly via .csv format.

The collection of final quiz scores with and without using Kahoot will be compared using the analytical, statistical method Independent t-

test comparison (Intecomp) or the comparison of the independent t-test variables with two different variables (Vetter & Mascha, 2018):

$$t = \frac{(\bar{x}_1 - \bar{x}_2)(\mu_1 - \mu_2)}{\sqrt{\dfrac{s_1^2}{n_1} + \dfrac{s_2^2}{n_2}}} \qquad (7)$$

Where

$$df = n\text{-}1 \qquad (8)$$

In addition to using the Intecomp method, this study uses a comparative method between mean, median, mode, maximum, minimum, standard deviation, beta coefficients, variance, range of values, and variance values per class per variable without the use and with the use of Kahoot. The final quiz score data is also illustrated through a scatter plot diagram to find the margin (difference) from the value of the R2 relationship between the frequency of the final quiz score and the number of quiz score winners to see the distribution between the 2 predetermined variables per class with the trend equation or the data centerline which is linear to assist in the analysis of the distribution data presented (Vong et al., 2013).

RESULTS AND DISCUSSION

Based on the results of statistical analysis that has been carried out, it was found that the Intecomp assessment components were tested first using the normality test, the significance of the values classified based on the control and experimental variables per class A, B, and C; the results are used to calculate the P-Value and the difference in the mean value of independent t for two variables because it uses condition 1 (TK: Without Kahoot) & condition 2 (DK: With Kahoot). The results are presented as follows:

The variable significance value for classes A, B, and C for the control group using Kahoot was 0.811; 0.769; and 0.765; while for the experiment, it is 0.832; 0.733; and 0.718, which allows the data to have normality according to the normality test criteria before being included in the t-test, namely df = 104 with a value almost close to number 1 which means standard data.

Table 1. The results of the normality test and the significance of the Intecomp 2 variables.

Independent T-Test Comparison	
P-Value	6.1.E-06
Siginificant	Significant
Mean Without Kahoot	76.1714
Mean With Kahoot	84.9571
Differences	-8.7857
Trend	Increase

Table 2. Results of fundamental statistical analysis per class

Variable	A		B		C	
	TK	DK	TK	DK	TK	DK
Total value	2780.50	3215.50	2475.00	2765.00	2742.50	2940.00
Sum (N)	38.00	38.00	33.00	33.00	34.00	34.00
Mean	73.17	84.62	75.00	83.79	80.66	86.47
Median	42.50	82.50	80.00	85.00	80.00	87.50
Modus	80.00	87.50	80.00	87.50	80.00	87.50
Max	90.00	93.00	87.50	95.00	90.00	100.00
Min	0.00	70.00	2.50	60.00	32.50	80.00
Standard Deviation (P)	22.65	4.70	17.92	6.52	8.74	4.25
Koef β	-0.03	0.61	0.42	-0.20	-0.08	0.83
Variance	512.98	22.10	321.21	42.47	76.34	18.06
Range	90.00	23.00	85.00	35.00	57.50	20.00
Varian	512.98	22.10	321.21	42.47	117.76	18.06

It compared data from condition one to condition two results in a P-Value data of 6.1 x 10-6 with a value of degrees of freedom <0.05 so that it is in a significant category according to Table 1. Further determination uses a comparison of the mean value that has been evaluated or calculated between the mean without Kahoot and with Kahoot are 76.1714 and 84.9571 respectively, which has a margin of 8.7857, which leads to an increase in the mean

value of the quiz score data using Kahoot. These results reject Ho's premise to state a decrease in the quiz score in condition one, or H1 is accepted on condition two.

The subsequent results using basic statistical comparisons (mean, median, mode, maximum, minimum, standard deviation, beta coefficient, variance, range of values, and variance values per class per variable without the use and with the help of Kahoot) are presented as follows:

The TK results in Table 2 are data without the use of Kahoot. DK is the data with the help of Kahoot, indicating that there is an increase in the good value of the mean value per class, which shows a tendency to increase in value, with the difference between classes A, B, and C of 11 , 44; 8.78; and 5.81; or there is an increase in the mean percentage of classes A, B and C, respectively 7.25%; 5.53%; and 3.48% with a total class mean of 5.42%. The comparative results for the TK suggest score were 76.28; while the DK average is 84.96. Thus there is an increase in the value of 10.21%, which indicates the influence of Kahoot in increasing the final score of the quiz. In addition to increasing the value of the practitioner as an indicator of the success of the practitioner in understanding the material of numerical method physics oceanography in the discussion of the roots of the Airy wave equation, it can also affect the psychological and classroom atmosphere to be more positive and interactive (Sabandar, Supit & Suryana, 2018).

The diversity and variability of scores also showed the same results, with condition two (using Kahoot) being superior and quite significant in influencing the practitioner's final score during the quiz. The maximum value achieved (100 for a scale of 100) is also in class C in condition two, which indicates Kahoot indirectly affects the practitioner's confidence in answering questions quickly and accurately.

Table 3. Weighting criteria

Interval	Predi-cate	Weighted
82.5-100	A	4
62.5-80	B	3
42.5-60	C	2
22.5-40	D	1
0-20	E	0

Table 4. The number of practical values

| Total Value of Practitioners	
Without Kahoot	With Kahoot
85	99
6	4
6	1
4	0
3	0

In addition to using class averages, the weighted mean per value described in Table 3 is also used, weighting the scores using a scale of 4 with 5 predicates, the interval shows the range of the final quiz scores for conditions one and two, the green color describes the groups that pass or meet the criteria (letter A and B), while yellow describes the groups that did not give or did not meet the requirements (letters C, D, and E). The weighting of this value is used to determine the increase in the final value based on the predicate achieved by the practitioner: in Table 4 the orange cells state the value of the population N of a condition (1 or without Kahoot and 2 or with Kahoot), the number of practitioners who can achieve an A value reaches 99 14 people or more when using the Kahoot application as a media for interactive quizzes. There was also a decrease in the number of practitioners who did not pass, leaving one person in the C predicate when Kahoot was implemented.

Table 5. practicum value weights

Practicum value weight	
Without Kahoot	With Kahoot
340	396
18	12
12	2
4	0
0	0

The maximum weighted score is 420 from 105 people multiplied on a scale of 4; a significant increase can be seen in Table 5, which shows the movement of the value upward so that the weighted value of condition one increases by 9.63%, which details the percentage of discounts for predicates A, B, C, D, and E are 16.47%; -33.33%; -83.33%; -100; and 0%. This value also supports explaining the significant effect of using Kahoot as an interactive quiz media in increasing the final score of the quiz. This is supported by (Licorish et al., 2018; Chien-Hung et al., 2014; Dellos, 2015), which states that Kahoot can influence teaching dynamics, teacher engagement with students, motivation, and the development of practical learning experiences/learning participants. This game-based Kahoot media can reduce distraction when learning and increase focus when learning occurs because practitioners' perceptions of material discussion become positive due to the use of digital media bases that are not monotonous (Poon, 2013; Wang, 2015; Plump & La Rosa, 2017).

Based on the results of Table 4, a representation of the distribution value of the frequency of score/predicate recipients can be used, as shown in Figure 6. The blue color indicates the distribution of the quiz scores without Kahoot. In contrast, the orange color shows the distribution of quiz scores using Kahoot, each of which has a correlation value of 0, 1378 compared to 0.1024, which means that the Kahoot factor has a significant impact in influencing changes in the final score in class A (see Figure 5), which is interestingly the correlation value is inversely proportional to the hypothesis, there may be practitioners who answer randomly and guess in their answers Kahoot questions because of the limited time per question (Göksün & Gürsoy, 2020). However, the distribution of values using Kahoot is closer to the trend line in the non-passing group (matter <60) so that the main effect of Kahoot in increasing understanding can be partially proven (Graham, 2015).
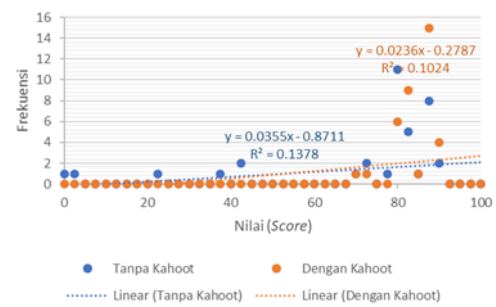
**Figure 5.** Class A quiz score distribution graph
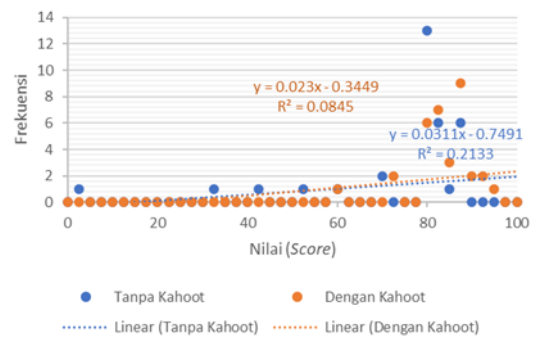
Figure 6. Class B quiz score distribution graph
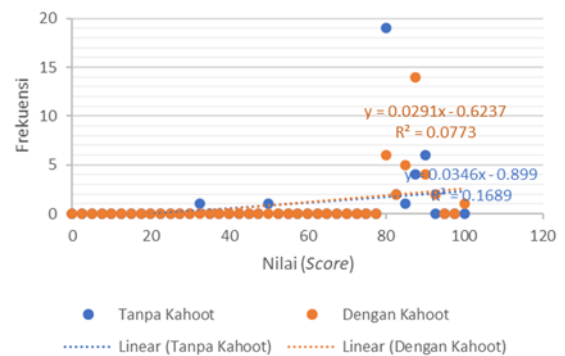
Figure 7. Class C quiz score distribution graph

The conditions are the same as for Class A. The condition of the distribution of grades for classes B and C has a negative correlation or relationship to strengthen the reason for the practice of answering randomly, as seen in Figure 6 and Figure 7. Correlation values for class B (TK; DK) and C (TK; DK) are 0.2133; 0.0845 and 0.1689; 0.0773.
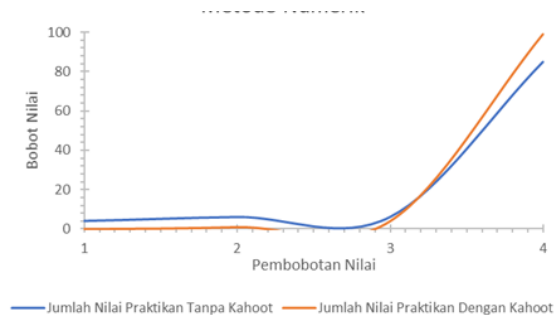
Figure 8. Graph of the increase in the score of the numerical method practicum quiz

Figure 8 states that the significant increase between condition 1 (TK) and condition two (DK), which has an intersect point at 3.65, is the mean value resulting from the two states. This result also represents that Kahoot can boost the achievement of practical importance. To the A and B predicates, to foster self-confidence in further learning (Bicen & Kocakoyun, 2018; Licorish et al., 2018). Most of the practitioners also enjoy learning using Kahoot because they are considered to be able to practice "how to solve problems" and think critically in answering digital game questions. The Kahoot quiz can also be used as an icebreaker or a pause after a serious discussion of the material on the roots of Airy's wave equation.

One condition that is without Kahoot, the practitioner, seems less interested in the material. This is evidenced by the many practitioners who have difficulty running the Mathlab program who do not focus when directing script/coding, which impacts prolonged practicum time efficiency. Whereas in condition two, there is at least a change in the practitioner's attitude, almost the practitioner can run the script that has been given, so it can be said that Kahoot also indirectly affects the efficiency of the practicum time. This opinion is corroborated by (Méndez & Slisko, 2013) which explains that students who learn to use gamified-based software or digital media (games) are quicker to understand coding or programming language, which increases student activity in the classroom as an early indicator in a feasibility study with the teacher. Prospective.

The effectiveness of using Kahoot in learning also has weaknesses in technical implementation because the Kahoot application requires a good wi-fi or signal connection (Lin, Ganapathy & Kaur, 2018). The lack of a stable internet network is a severe problem because questions are asked for only a few seconds, while in weak internet signal conditions allow applications to delay (there is a delay in response), or even fail to answer questions, so this can hurt quiz scores and motivation practice in the future. Kahoot cannot be used for solving case study questions because the characters (letters) in making questions or questions are only in the form of multiple choice and true and false. The answer time is relatively short without an essay answer column.

CONCLUSION

Based on the results and discussion, it can be concluded that Kahoot can improve the final score of the quiz, which is an indicator of an increase in the practitioner's understanding of the discussion of the roots of Airy's wave equation in the practicum of physics oceanographic numerical methods subject Kahoot can be recommended as an interactive learning medium to increase the effectiveness of learning at other universities to support quality learning that is in line with one of the pillars of sustainable development (SDGs), namely quality education.

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