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Implementation of the Case Method with Blooket Media to Enhance Student Learning Outcomes in Radiochemical Material

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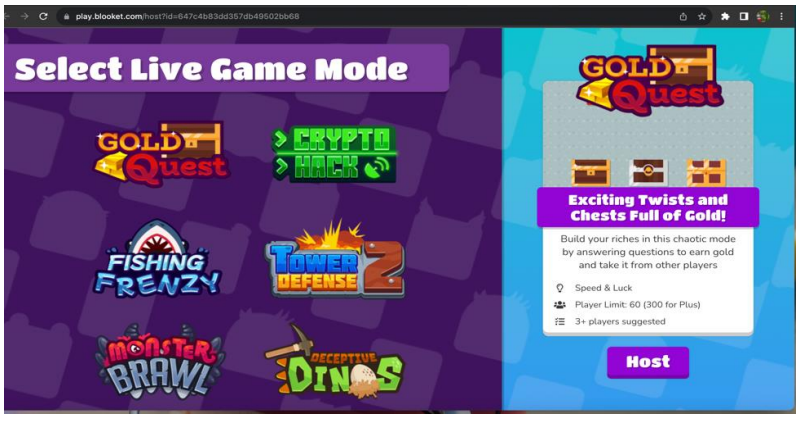
Research related to the implementation of learning models to improve the quality of learning continues to be carried out in line with changes in the applicable curriculum. The selection of the right learning model with the help of fun game media is the basis for this research, so that learning becomes more meaningful and not boring. This is a quasi-experimental study using a "nonrandomized pretest-posttest control group design." Before the t-test, a prerequisite test was carried out in the form of a normality test (using the Liliefors test) and a homogeneity test (using the Levene test). In addition to hypothesis testing, this study also calculated the score increase (N-Gain) from the pretest and posttest data. The t count value is 2.88, while the t table value at = 0.05 with dk = 51 is 1.67. The hypothesis is supported because the t count value is greater than the t table value (2.88 > 1.67). In addition to the t count and t table values, the r^2 = 0.1403 value was examined. This coefficient value of 14.03% indicates the level of effect of employing the case method with blooket media on increasing student learning outcomes in the Radiochemistry subject.

Graphical abstract



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1. Introduction

Learning must be a process of adding new information and abilities. When a teacher thinks about what skills a student should have, then at that moment the teacher must think about what to do so that all of them can be achieved [22]. It could be the basis for solving the problems of education in Indonesia today. With regard to the issue of education that is happening in Indonesia in practice, education is experiencing many challenges and problems, so there should have been educational reforms to ensure that education in Indonesia is not oppressed by its inertia to such rapid technological development. Therefore, the government must guarantee an improvement in the quality of Indonesian education [28].

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Faced with the issue of education in Indonesia today, the government should not only improve the quality of education but also revise the existing quality of education [27], while that is what is determining quality education, which is to have a SDM that is focused on interrelated with the existence of the Indonesian interrelationship in the future. According to the Global Human Capital Report, Indonesia's position is very worrying, as it ranks 65th out of 130 countries in the field of education. It is because of the lack of interest in studying in Indonesia as well as the lack of literacy interest in reading books that the quality of education in Indonesia lags far behind that of neighboring countries [27]. This lack of interest in learning and literacy generally occurs due to 2 main problem areas: macro problems and micro problems. Educational problems in macroscope, i.e., curriculum is confusing and too complex; education is uneven; the problem of teacher placement; inadequate teacher training; the cost of education is expensive. On the scale of micro, the monotonous learning methods, the insufficient means and resources, and the poor student performance [21]. Especially in today's time, where the learning process runs online, this has become a problem in the world of uneven education. Like a networking problem that makes education more and more difficult to access in the slums. Teachers need to improve their competence in the use of technology in learning because not a few teachers only use WhatsApp groups for online learning processes where the learning process is carried out on the basis of the delivery of materials and tasks [29]. Internet constraints are indeed the main factor that hampers online learning activities [6]. Online learning requires adequate tools and facilities, such as laptops, computers, smartphones, and Internet networks [17]. This can be an obstacle for students, especially for those who are less capable in areas where the majority of economies are still low, because not all students have the means to support this online learning path. Another effort that can be made in the face of the digital age is to change the model or method of learning and adapt it to technological developments.

The government has made efforts through the Ministry of Education and Culture's 2020-2024 strategic plan. which aims to improve the quality of learning and relevance of higher education in the environment of colleges, so that colleges are required to be able to design and implement innovative learning so that students can access learning that includes attitudes, knowledge, and skills optimally. Followed by the Ministry of Education and Culture's policy on ‘’Merdeka Belajar Kampus Merdeka” (MBKM) with the program "the right to study three semesters outside of the curriculum" for students is a real step to improve the competence of graduates so that soft skills as well as hard skills are more prepared and relevant to the needs of the 21st century. The requirement to prepare graduates as future leaders of superiority and personality who accommodate a variety of experiential learning programs on a flexible path is expected to facilitate students development of their potential in accordance with their passion and talent. It's a tough task, well, in the learning process that has to be supported, as well as the management strategy that has to be quality. Learning that is still centered on the hard skill pattern and ignores evaluations related to soft skills, especially those that include the evaluation of the 4Cs (creativity, critical thinking, communication, and collaboration), is less realizable and also becomes one of the indicators of the low absorption of graduates in the world of work. [5]. 4C capabilities applied to higher education refer to the Main Performance Indicators of State Universities (IKU-PTN). IKU-PTN aims to measure the success and achievement of the teaching and learning process [14]. Indicator 7 in the IKU-PTN requires a collaborative and participatory classroom. The suggested learning method in fulfilling this IKU-PTN is a case study.

Case method teaching is an active form of instruction that focuses on a case and involves students learning by doing [10,13]. Cases are real or invented stories that include “an educational message” or recount events, problems, dilemmas, theoretical or conceptual issue that requires analysis and/or decision-making [7]. Case-based teaching simulates real world situations and asks students to actively grapple with complex problems [4,16]. Problem solving through discussion activities based on observations and students' perspectives triggers learning not only to memorize material but to understand the meaning of the connection between the material taught and the real world situation [1]. Case method teaching has been found to improve student learning, to increase students’ perception of learning gains, and to meet learning objectives [3,15]. Faculty have noted the instructional benefits of cases including greater student engagement in their learning [25], deeper student understanding of concepts, stronger critical thinking skills, and an ability to make connections across content areas and view an issue from multiple perspectives [31].

Through case-based learning, students are the ones asking questions about the case, doing the problem-solving, interacting with and learning from their peers, “unpacking” the case, analyzing the case, and summarizing the case. They learn how to work with limited information and ambiguity, think in professional or disciplinary ways, and ask themselves “what would I do if I were in this specific situation?” The case method bridges theory to practice, and promotes the development of skills including: communication, active listening, critical thinking, decision-making, and metacognitive skills [21], as students apply course content knowledge, reflect on what they know and their approach to analyzing, and make sense of a case.

Cases are often used as “vehicles for classroom discussion” [16]. Students should be encouraged to take ownership of their learning from a case. Discussion-based approaches engage students in thinking and communicating about a case. Instructors can set up a case activity in which students are the ones doing the work of “asking questions, summarizing content, generating hypotheses, proposing theories, or offering critical analyses” [30].

The case study method can be applied to all courses including radiochemistry.. Radiochemistry is the chemistry of radioactive materials; it involves study of chemical transformations of radioactive substances, dealing with actinides and **transuranium elements**, development of physicochemical principles of handling **radioactive waste** from nuclear power engineering, solving radioecology problems, developing methods for manufacturing sources of radioactive emissions, and separation of **radioactive isotopes** [19]. The scope of radiochemistry showed abstract concepts but closely related to its application in life. This Lesson cannot be practiced and becomes one of the factors that make it difficult for students to learn. So a learning media is needed that can attract students' interest in learning this material. One of them is through game media such as blooket.

Blooket is an engaging gaming platform that is fun and effective for learning purposes. Teachers can use it to interact with learners in class, and learners can practice independently on the questions in the Blooket media game. Blooket also records answers instantly to display on the student's screen, which makes them answer the quiz at their own pace. Blooket helps students recognize their achievements and efforts in the

learning process [26]. Blooket can be used for online learning [18]. The site of this platform is https://www.blooket.com/, and students can embroider the https://play.blooket.com/play page and then enter the game code. The advantage of Blooket is that it can enter questions in the bank about the quiz or just take questions that already exist. Blooket has the advantage that users can copy the template directly to the quiz clipboard, can set the duration of the topic view, and can comment directly when the student is working on the quiz [4]. Blooket is included in virtual-based learning. Research results by Rahmadani stated that the Virtual STEM Laboratory's effectiveness in enhancing high school students' STEM literacy and creativity [20]. Not only that, the same research related to virtual learning can create a pleasant learning atmosphere that is not monotonous, making it easier for students to find concepts in hydrolysis materials [11]. Combining case method strategies with blooket media is one of the alternatives to creating fun learning so that it can influence the learning outcomes of students.

The purpose of this research is to find out the effectiveness of the implementation of case methods using blooket media against the improvement of student learning outcomes on radiochemistry materials in the Chemistry Education study program of at FKIP Undana and to know the great impact of the implementation of the case method using blooket media on the improvement of students' learning outcomes on the materials of radiochemists

2. Material and Methods

2.1 Type of Research

The type of this research is a quasi-experimental study using a "nonrandomized pretest-posttest control group design". The use of this design in research makes it easy for researchers to construct fake settings that will be evaluated for their impacts. The following table shows the nonrandomized pretest-posttest control group design [9].

Table 1. Nonrandomized pretest-posttest control group design.

Group	Pretest	Treatment	Posttest
Experimen	O_1	X	O_2
Control	O_3	-	O_4

Description:

O1 = Experimental class pretest results

O2 = Experimental class posttest results

O3 = Control class pretest results

O4 = Control class posttest results

X = Treatment (application of the case method using the media booklet)

- = No treatment (application of case method without media booklet)

This research was conducted on 6th semester students in the Radiochemistry course from May to April 2023 in the even semester of the 2022/2023 academic year totaling three classes. The three classes that took this radiochemistry course were the population in this study. So, the withdrawal of samples is done by purposive sampling technique. The way three classes were given questions to test the equality of initial abilities. The experimental and control classes are then determined, with essentially identical average values. The initial ability test results indicate class A has 26 students with an average score of 62.523, class B has 26 students with an average score of 56.346, and class C has 27 students with an average score of 53.148. In this study, classes B and C have almost comparable talents since their average values are not significantly different. Based on the initial ability equality test, the average score of class B is higher than class C, so class B becomes the control class and class C becomes the experimental class.

2.2 Data Type

The types of data in this research are quantitatif data from pretest and posttest.

2.3 Data Collection Instrument

Data collection instrument in this research was multiple choice test. The test used as pretest and posttest. After class selection, a pretest was conducted, then the learning process was carried out and ended with a posttest.

2.4 Data Analysis Techniques

Data from pretest and posttest results were processed using inferential analysis using independent t-tests for hypothesis testing. Before the t-test, a prerequisite test was carried out in the form of a normality test (using the Liliefors test) and a homogeneity test (using the Levene test). In addition to hypothesis testing, this study also calculated the score increase (N-Gain) from the pretest and posttest data. This score improvement was estimated using the Hake algorithm and criteria [11], as shown in Figure 1 and Table 2.

$$< g > = \frac{(posttest\ score - pretest\ score)}{(maximum\ score - pretest\ score)}$$

Fig. 1. The N-Gain Formula.

The N-Gain value (<g>) has three criteria as follows [11]:

Table 2. N-Gain Score Criteria (<g>).

N-Gain score scale	N-Gain Score criteria
(<g>) ≥ 0,700	High
0,300 ≤ *(<g>)* < 0,700	Medium
(<g>) < 0,300	Low

3. Results and Discussion

The results of the data analysis described are the results of the analysis of normality test, the analysis of homogeneity test, and the results of the data analysis of hypothetical test. Before hypothesis testing, data from pretest and posttest findings were evaluated using precursor tests. Prerequisite tests include the Liliefors Test for normality and the Levene Test for homogeneity. Table 3 shows the results of the normality and homogeneity tests on the pretest and posttest data for both sample classes.

If the significance value is more than 0.050, the data is said to be regularly distributed and homogenous. According to Table 1, the significant value for both the normality and homogeneity tests is more than 0.050, indicating that the pretest and posttest data match the analysis's necessary

requirements and may be proceeded for hypothesis testing using the independent t test. The N-Gain formula was used to calculate score improvement prior to the t-test. The results of the N-Gain calculation are listed in Table 4 and presented in Figure 2.

Table 3. Normality and Homogeneity Test Results of Student Learning Outcomes.

Learning Outcomes	Class Grade Average		Prerequisite Analysis Test			
	Experiment	Control	Normality (Sig.)	Conclusion	Homogeneity (Sig.)	Conclusion
Pretest	36,297	31,410	0,085	Normal	0,122	Homogeneous
Posttest	82,593	68,848	0,099	Normal	0,115	Homogeneous

Table 4. N-Gain calculation results and criteria

Class	Data				Kriteria
	Pretest	Posttest	Gain (Y-X)	N-Gain	
Experiment	36,297	82,593	46,296	0,727	High
Control	31,410	68,848	37,438	0,546	Medium

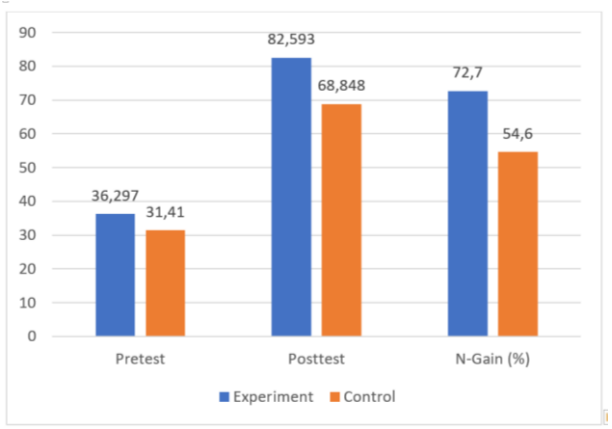


Fig. 2. Improvement of student learning outcomes graph

According to the data in Table 4 and Figure 2 above, there is an improvement in learning outcomes in both classes. However, the experimental class outperforms the control class in terms of learning outcomes. According to the N-Gain value (Table 4), the experimental class improvement requirements are high, whereas the control class improvement criteria are medium. It implies that treatment in the experimental class improves learning results. In addition, the pretest, posttest, and pretest and posttest difference values (gain) were tested using an independent t-test. Table 5 shows the results of the hypothesis test.

Table 5. Hypothesis Test Results.

Learning Outcomes	Class Grade Average		t-test *(Sig.)*	Conclusion
	Experiment	Control		
Pretest (X)	36,297	31,410	0,580	Not different
Posttest (Y)	82,593	68,848	0,000	Different
Gain (Y-X)	46,296	37,438	0,000	Different

The results of hypothesis testing using the t-test in the table above reveal that there are differences in learning outcomes after the treatment. The significant value on the posttest and the difference in value (gain) are both less than 0.050. Furthermore, the t value and t table from the pretest and posttest difference data (gain) shown in Table 6 are used to examine the calculation for hypothesis testing. If the hypothesis fulfills the t count> t table criteria with dk = n1 + n2 - 2, probability criteria 1 -, it is accepted. The t count value is 2.88, while the t table value at = 0.05 with dk = 51 is 1.67. The hypothesis is supported because the t count value is greater than the t table value (2.88 > 1.67). In addition to the t count and t table values, the r^2 = 0.1403 value was examined. This coefficient value of 14.03% indicates the level of effect of employing the case method with blooket media on increasing student learning outcomes in the Radiochemistry subject.

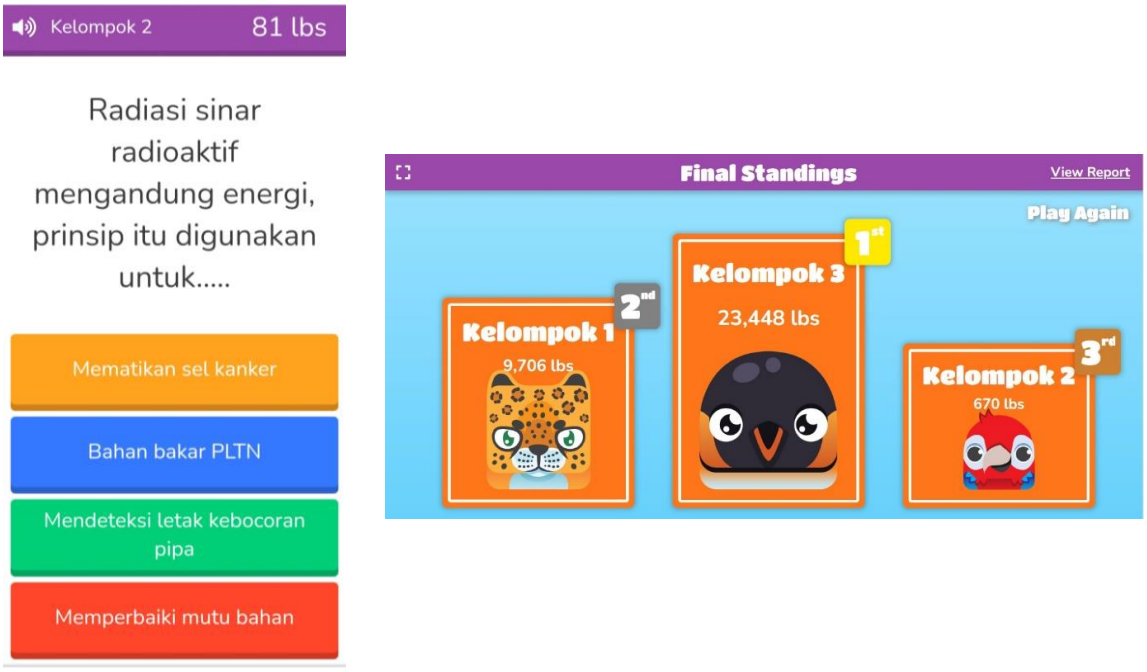
Students have to become actively engaged in the learning process while using the case method with blooket media. The case approach is capable of bridging the gap between theory and practice. In this research, the case raised is related to the Tokaimura nuclear power plant (NPP) nuclear radiation accident on September 30, 1999 in Japan. The case can be accessed by students on the following link: **https://youtu.be/_4TC8CWQZRQ?si=E2tp8MxWClup-geH**. Through the case students must apply course content knowledge, reflect on what they know and their approach to analyzing and interpreting the case. so that students not only memorize content but can also know and understand the meaning of the connection between the material taught and real world situations [1].

Student actions during learning are inextricably linked to lecturer direction. If students find challenges throughout the learning process, the lecturer will give guidance to help them overcome these obstacles. Because students do more work and learn for themselves to seek and obtain this material, the lecturer here functions as a motivator, facilitator, questioner, and director for students rather than just as a source of information. Throughout the learning process, it is clear that all learning activities engage students, implying that students are actively involved in the learning process. It is evident from the students' answers that they can relate the cause of the accident to the uranium decay process and the radiation that occurred and its impact on Hisashi Ouchi and his two other exposed colleagues.

Through cases students are made the center of learning so as to encourage students to become active learners [8]. As students become active participants in the learning process, they can acquire knowledge properly [24]. Students maximally search and find solutions to cases, fostering students' ability to think critically [23]. Indicators of critical thinking can develop conceptual understanding [20].

Learning with this case study is more interesting for students if it is combined with game-based media such as blooket. Blooket is used in this learning to help students grasp the topic matter and to measure students' recall. Blooket can

stimulate interest, enthusiasm, and a sensation of serenity while learning. The feeling of relaxation is consistent with the rationale [4]. The Blooket can lower students' anxiety and tension levels while studying. Blooket's use as a learning medium demonstrates how using learning technology may make it easier for lecturers and students. The convenience in question is when giving questions in the form of games that are done in groups. Through blooket helps students recognize their achievements and efforts in the learning process. Here is an example of a problem and the final result of the game in the blooket.



(a) (b)

Fig. 3. (a) sample question in blooket; (b) end game result in blooket.

The implementation of learning with the case study method combined with the media of the game blooket proved to make students active in learning. Active learning activities have an advantageous impact on student learning outcomes. The evidence can be seen from the difference in N-Gain values between the control group and the experimental group. The experimental class has a higher N-Gain value than the control class

4. Conclusions

The conclusion of this study is that the implementation of case methods using blooket media can be effective in improving student learning outcomes on radiochemistry materials at FKIP Undana Chemical Education Study Program. The great impact of the case method using blooket media on the improvement of student learning outcomes on radiochemistry material was 14.03%.

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Author Contributions

Heru Christianto: Conceptualization, Methodology, Resources, Investigation, writing - Original Draft, Review & Editing. Arvinda C. Lalang: Methodology, Format analysis, Validation, Visualization, Review & Editing. Dorthea M. W. Nay: Investigation, Resources, Visualization, Formal analysis.

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