Using Instagram as Rate of Reaction Learning Media Based on PjBL to Increase Students' Motivation and Creative Thinking Ability

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***Abstract*—This study aims to determine the impact of learning with the Project-Based Learning (PjBL) integrated with Instagram social media in increasing learning motivation and students' creative thinking abilities in chemical material reaction rate. The research was carried out using a quasi-experimental method. Sampling was taken using a random sampling technique involving two XI classes at State High School 1 Singosari, namely 29 students for the class of control and 33 students for the class of experiment. Data analysis used qualitative and quantitative descriptive tests with independent sample t-tests and N-Gain. Results of the qualitative analysis conducted, the increase in learning motivation in the experimental class (71%) was greater when compared to the control class (64%). The results of H_A can be accepted refers on the independent t-test with a value of <0.05. The results of the study show, that the PjBL integrated with social media Instagram can improve students' creative thinking skills and learning motivation in the matter of reaction rate. Percentage value of the N-gain test is 66.6% and is in the sufficient category to increase students' creative thinking ability.**

***Index Terms*—Project-Based Learning (PjBL), social media, creative thinking, motivation, rate of reaction**

I. Introduction

The 21st century is known as the age of knowledge; in this era, efforts to fulfil life's needs in various contexts are based on knowledge and progress. This era also raises new problems and challenges for human life to adapt to future developments, including the education sector [1]. One of the skills of the 21st century today is increasing student competence in emphasizing Higher-Order Thinking (HOTS) [2]. According to Law No. 20 of 2003, education is a form of effort made by educators to equip students with knowledge, understanding, skills and competencies for education, including creating a creative and competent generation so that students can develop their thinking skills creatively and innovatively in the current era [1]. Education consists of many fields of knowledge including science, namely chemistry. Among the branches of science that underlie technological developments are chemistry. Chemistry is a branch of science which discusses composition, structure, properties, and changes in matter and the energy that accompanies it [3]. In studying chemistry, student motivation is necessary when learning is carried out.

Motivation is a person's internal and external encouragement to make a change. According to Keller [4], motivation consists of four aspects: attention, relevance, confidence, and satisfaction. Learning motivation is very important because it can be a driving force in influencing student learning activities and habits and doing assignments at school. In addition, motivation is also an important factor in supporting student achievement because, with high learning motivation, students will always study diligently and fully concentrate on the learning process [5]. That is, motivation can encourage students to continue learning so they can know the direction of their learning.

Chemistry is very closely related to concepts that exist in everyday life, while one of the chemicals closely related to everyday life is the rate of reaction. Reaction rate material can be analyzed quantitatively and explicitly designed to study it skillfully [6]. Skills enable students to generate creative ideas that they can apply daily. However, the current problem and obstacle is the lack of interest of students in studying chemistry which is considered difficult and complicated to understand, so researchers provide a solution to overcome this problem, namely by implementing a learning model that can increase student creativity in learning, including in the chemistry-based learning project (PjBL) [7].

PjBL is considered an alternative to traditional teacher-led education. The PjBL model is a learning model that can increase student creativity in integrated learning with real-life problems. The completion of the project shows the creativity of the students. Project-based learning encourages collaboration between students, and the teacher only acts as a guide during the project [8]. The PjBL learning show emphasizes relevant learning through complex exercises, giving understudies flexibility to investigate the plan of learning exercises or tests, carry out ventures collaboratively, and eventually create an item.

PjBL's learning model and creative thinking are closely related. Creativity is the result obtained from the ability to think creatively trained. Creative thinking can evoke the process of finding new ideas and ideas in solving a problem [9]. Creative thinking skill built from the creative process; it is a problem-solving activity in cognitive abilities such as analysis, generation, evaluation, and implementation [10–13], so that to know creative thinking skills someone, it is know

Manuscript received February 13, 2023; revised April 17, 2023; accepted May 4, 2023.

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how he solves problems using analysis, generation, evaluation, and implementation. Creative thinking skills have indicators involving fluency, flexibility, elaboration, and originality [14–16]. If the idea is complicated, then someone who can think creatively must decipher it into simple things that can be explained [17].

This results in someone involved in creative endeavors doing two basic things. The first is an attempt to find ideas, plans, or answers, while the second is to create an implementation plan, evidence, and confirmation that the idea can be implemented. According to previous researchers, there are four aspects of creative thinking: fluency, *flexibility*, *originality*, and *elaboration* [18].

Creativity is already well-designed through experience. Formal learning will pay off meaningful improvement in performance creativity [19]. However, another thing that influences and becomes a challenge for 21st-century students is technological advances, namely digital technology. Social media is no stranger to today's society. In this 4.0 era, many social media have emerged that can be used by high school and college students to learn [20]. In line with Nenohai *et al.'s* research [21], learning using the Wordwall game media received a positive response marked by media validation results of 90% from the validator, and implementation to students scored 81.75%. With this development, Various social media continues to grow in terms of service and quantity of media so that they can open up opportunities to be used as a medium for learning. Social media is a channel where people build communication between themselves, share their content, and choose what to show or not themselves, either only to a few people (limited) or many people (public) [22, 23]. Social media can make learning more accessible and efficient, especially when the Covid-19 outbreak hit Indonesia, requiring students to study at home. Social media helps teachers carry out the learning process and can be a learning medium. Based on the study's results, it was shown that 60% of teacher respondents had implemented literacy-based science learning using various learning media [24].

Facebook, Twitter, blogs, Youtube, Instagram, google docs, and others have become favorite social media [25]. Ease of access to social media is also considered because most students must have social media. Supported by research from Widiarti *et al.* [26], social media can be straightforward and flexible in communicating without being limited by space, it can enable students to study chemistry at any time, and social media can be used as an exciting learning medium. The social media chosen in this study is *Instagram. This Instagram account* contains content about chemical reaction rates in the form of videos, pictures, and memes so they can more easily know the concept of reaction rate material. Based on that, problem identification exists. Based on this, this study aims to determine how applying the PjBL learning model affects students' critical thinking skills through integrated learning media, Instagram social media.

II. Method

This is quasi-experimental research, and its design is a pretest-posttest control group design. The research was conducted at one State High School, Malang Regency, State High School 1 Singosari. The population in this research is all students of class XI MIPA of State High School 1 Singosari of the 2022/2023 academic year. Sampling with a simple technique, random sampling, and finally, two samples of classes were chosen. The research involved 62 students in class XI, namely 29 students in XI IPA A and 33 in XI IPA C.

Class XI IPA A is a control class, and class XI IPA C is an experimental class. Each control and experimental class applied project-based learning. The project for both classes is the same: making a video about simple experiments related to material factors that affect reaction rates. The difference in treatment for these two classes is using media for learning. The control class used PowerPoint learning media, while the experimental class used social media-based learning media, Instagram. The learning media used is based on *Instagram social media*, which is suitable because experts have validated it. The Instagram account used is @chemsquad.kimia. Content from the account regarding reaction rate material related to everyday life. Instagram accounts used as learning media, as shown in Fig. 1.

Fig. 1. Instagram account @chemsquad.kimia.

Instagram media is used when learning takes place. For the experimental class, the material link on Instagram is linked in the Student Work Sheet (LKPD). During learning, the teacher instructs students to access the Instagram content with their respective groups, and then the teacher asks if there is anything they want to ask or discuss further. Whereas in the control class, the teacher instructed them to listen to the material in the PowerPoint and then asked students to work on the LKPD in groups. LKPD in control and experimental classes can be seen in Fig. 2.

This research was done in five face-to-face meetings in class in November of the 2022/2023 school year. The instruments used were a student learning motivation questionnaire and pretest and posttest essay questions. The material being taught is Reaction Rate. The first meeting was carried out with pretest work. The second to the fourth meeting is carried out face-to-face learning in class. In the fifth meeting, the posttest was carried out. Filling in the

questionnaire by students is done at the end of the first and last meeting hours. Data collection techniques include the preparation level, the implementation level, and the final level. Questions in the motivational questionnaire can be seen in Table II.

Fig. 2. LKPD display in the control and experimental classes.

TABLE II: STUDENT MOTIVATION QUESTIONNAIRE

Number	Statement
1	I like chemistry lessons
2	I am happy when studying chemistry
3	I like the media used in learning chemistry
4	The teacher makes a fun atmosphere while teaching chemistry
5	I like the way the teacher teaches chemistry
6	I am always active in learning chemistry in class
7	I paid attention to the explanation given by the teacher during the teaching and learning process.
8	I ask my teacher or friends if there is material I need help understanding.
9	If there is a difficult task, I will ask a friend about how to do the task correctly and adequately.
10	I am passionate about learning chemistry.
11	I always try to answer questions from the teacher
12	I always do the assignments given by the teacher
13	I recorded the important points conveyed by the teacher when delivering the subject matter.
14	I feel chemistry is very beneficial for me
15	I know the purpose and benefits of the material I study
16	I feel that studying chemistry is essential and needed in everyday life
17	I feel chemistry is significantly related to everyday life
18	I can relate chemical material to contexts that I have seen, done, or thought about in my daily life
19	I am confident that I can understand chemistry well
20	I do the work myself without seeing and asking other people
21	I am confident that I can complete any given task
22	I am sure that every task I do is correct
23	I am confident that I can complete assignments on time
24	I am sure I can face all the difficulties in learning chemistry
25	I am sure I can solve complex chemistry problems
26	I feel satisfied because I can understand the material well
27	I feel satisfied with what I get from learning chemistry
28	I feel satisfied because I can gain new knowledge from learning chemistry
29	I feel satisfied because I can solve the problem independently
30	I feel satisfied because I can solve the problem correctly

This motivational questionnaire was filled out by students when they finished using Instagram social media-based learning media. The questionnaire contains several questions regarding students' motivation when studying before and after using Instagram learning media. Students can respond by giving a tick mark on each statement with their opinion. Students can respond to numbers 1 to 4; number 1 means strongly disagree, number 2 means disagree, number 3 means agree, and number 4 means strongly agree.

In the preparatory stage, research instruments were prepared and validated, licensing documents for research, and distribution of questionnaires before operational testing. The data collection stage includes the implementation of PjBL in schools using *Instagram* social media learning media for the class of experiment and for the class of control using PowerPoint learning media.

This study put forward two hypotheses, namely H0 and HA. The proposed H0 is that there is no difference between the learning outcomes of the experimental and control classes. At the same time, HA, namely that there is a difference between the learning outcomes of the experimental and control classes.

Finally, research data analysis is carried out, drawing conclusions and preparing reports or articles. Data processing techniques include qualitative descriptive tests on learning motivation questionnaires and statistical tests on students' creative thinking instruments. They then proceeded to test the hypothesis with the independent sample-t-test and the N-gain test to determine the increased creative thinking skills with the SPSS Statistics 26 program.

III. RESULTS AND DISCUSSION

So that this research can be carried out maximally and focused, this research is limited by the following things. The scope of material used is only reaction rate material. The learning model used is the PjBL-STEM learning model. The media used is Instagram social media. The results of the

post-test determine students' creative thinking ability. Student motivation is determined from the results of the student learning motivation questionnaire.

This study hypothesizes that using integrated learning media, the PjBL-STEM Instagram model has a positive effect on increasing creative thinking skills and student learning motivation in the material on reaction rate. Qualitative descriptive analysis for student learning motivation was obtained from questionnaire data. The number of questionnaire statement items regarding students' learning motivation after having been tested for validity was 30 statement items. Questionnaires were given to the class of experiments and the class of control. The grouping of student studying motivation scores from the results of distributing questionnaires to the two classes was given different treatments shown in Fig. 2.

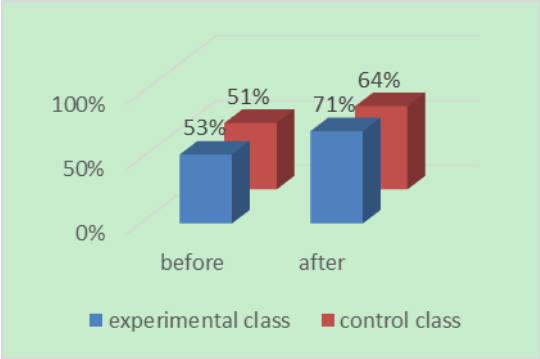

Fig. 3. Diagram of increasing student motivation.

In Fig. 3, it is understandable when students' learning motivation has increased. In the experimental class, students' learning motivation was initially 53%, increasing 18% to 71%, while in the class of control, students' studying motivation was initially 51%, increasing 13% to 64%. That is, increasing student motivation in the experiment class is higher than in the control class. The class experiment that applied the PjBL model with Instagram learning media had a higher percentage of learning motivation than the class that applied the PjBL model with PowerPoint learning media. Inside difference percentage increase in student motivation between the experiment and control classes is 5%. Many factors, including the learning model and media applied, influenced this increase. In line with research from Widiarti *et al.* [26] regarding using virtual laboratory learning media as an alternative to online practicum, this research shows that this learning media is beneficial in supporting practicum activities with a validity percentage value of 91.1 & and 92.3%.

This can happen because students who take part in learning in the experimental class are given treatment with the help of Instagram media. Hence, the students are over-enthusiastic and motivated to participate in learning and are actively involved in it. Instagram media supports the learning process because material content is presented in the form of interesting photos and videos related to everyday life, so students' boredom is minimized by using Instagram. As a result, students follow the learning well.

The study's results are similar to the research conducted by Azzarkasyi *et al.* [27] on learning Instagram can increase learning motivation. The same thing was also expressed by Amiruddin *et al.* [28], who revealed that Instagram media has a positive influence on increasing student learning motivation, where Instagram media is in great demand among students and can trigger student enthusiasm for learning. That's because, on Instagram, students get material presented in the form of animated videos and infographics; for the outcome, the process of learning that occurs is felt to be more enjoyable.

A. Students' Creative Thinking Ability on Reaction Rate Material

There are four aspects of creative thinking, as shown in Table III. These four aspects guide the instruments used to assess creative thinking skills. Following the context of this study, it is necessary to have a prior understanding of reaction rates, which students' creative thinking abilities can then identify through questions developed to measure their creative thinking abilities.

Refers to the results of the test used to measure the creative thinking skills in the class of experiment and control, the data is as shown in Table IV; the experimental class gets the mean pretest score of 43.65 and the standard deviation of 4.45 with a minimum score of 37.5 and a maximal score of 53.13. For a mean posttest value *of* 81.34 and a standard deviation of 8.17 with a minimum score of 65.63 and a maximal score of 93.75. In the control class, the mean pretest score is 37.9, and the standard deviation is 4.92, with a minimum value of 28.13 and a maximal value of 46.88. The average posttest score is 76.18, and the standard deviation is 7.48, with a minimum score of 62.5 and a maximal score of 90.63.

Based on these results, it can be seen that there has been an increase in students' creative thinking, which is higher in classes that use the PjBL learning model with Instagram social media integrated learning media (experimental class) presupposed by the class that uses the PjBL learning model with PowerPoint media. This is due to the effect of Instagram social media on learning, where students will try more to develop their creative thinking patterns and encourage students to master chemistry subjects. Content on Instagram accounts for learning media motivates students to think outside the box.

They can solve problems well through their thinking. Likewise, the results of research by Kawser and Hamid *et al.* [29] also state that creativity in solving a problem can improve students' ability to solve problems.

TABLE III: ASPECTS AND PARAMETERS OF CREATIVE THINKING [30]

Aspect	Indicator
Fluency	Sparking answers by solving problems or questions smoothly Ability to think of alternative answers
Flexibility	produce ideas, answers, or statements that vary, are able to see problems from different perspectives skills in the way of approach or thinking
Originality	the ability to create new and unique expressions the ability to combine parts or elements
Elaboration	adding or detailing the details of an object or idea so that it develops

TABLE IV: PRETEST AND POSTTEST DATA ON CREATIVE THINKING ABILITY

Class	Score	Pretest	Posttest
Experiment	Min	37.5	65.63
	max	53.13	93.75
	x̄	43.65	81.34
	std. Deviation	4.45	8.17
Control	Min	28.13	62.5
	max	46.88	90.63
	x̄	37.93	76.18
	std. Deviation	4.92	7.48

Furthermore, before carrying out the *independent sample-t test*, normality and homogeneity tests were carried out as precondition tests. The normality test uses *the One-Sample Kolmogorov-Smirnov test* provided that the significance is > 0.05, then the data is normally distributed, and the data is as shown in Table V.

TABLE V: THE RESULTS OF NORMALITY TEST FOR *PRETEST - POSTTEST SCORES* FOR CREATIVE THINKING SKILLS

Class	N	Data	*Kolmogorov-Smirnov Sig.*	Information
Experiment	33	*Pretest*	0.052	Normal
		Posttest	0.136	Normal
Control	29	*Pretest*	0.070	Normal
		Posttest	0.200	Normal

Refers to Table V, the result of the *pretest-posttest normality test for the* ability to think creatively in the experimental and control class obtained a meaningful value of >0.05. It can be seen that the data has been normally distributed, and then a statistical test will be carried out. Namely, a homogeneity test to determine whether the population's variance is the same or different from the criteria. If the significance is >0.05, then the sample is a homogeneous population, and the data obtained in Table VI.

TABLE VI: RESULTS OF PRETEST - POSTTEST VALUE HOMOGENEITY TEST FOR CREATIVE THINKING ABILITIES

Levene Statistics	*Df1*	*Df2*	*Sig.*
0.147	1	60	0.703

Refers to Table VI, the homogeneity test results obtained a meaningful value of>0.05, which is 0.703. The sample is a homogeneous population. Next, test the hypothesis with the independent sample-t test. The results of the hypothesis test for students' creative thinking abilities in the class of experimental and the class of control are shown in Table VI. The results of the *independent sample-t-test* data can be seen in the following Table VII.

TABLE VII: *INDEPENDENT SAMPLE T-TEST* RESULTS

T-test for Equality of Means	Equal variances assumed XI IPA A	Equal variances assumed XI IPA C
Q	−2.579	−2.593
Df	60	59.9
sig. (2-tailed)	0.012	0.012

Refers to the results obtained in Table VII, the sign can be seen. (2-tailed) belonging to both classes is 0.012<0.05. Based on this statement, it is stated that H0 is rejected and HA is accepted; this means that there are meaningful differences in student learning outcomes between the experiment and the control class. Thus, it is suspected that there are differences in students' creative skill abilities between the experimental class, which studied *Instagram social media-based learning media*, and the control class, which studied PowerPoint learning media—supported by processed research data at a significance value of <0.05.

The N-gain test was carried out to determine the increase in creative thinking skills. Gain is the difference between the pretest-postest scores. Gain shows an increase in student learning outcomes after learning is done. The test results are presented in Table VIII.

TABLE VIII: THE N-GAIN TEST RESULTS

	Control Class	Experiment Class
N-Gain Score (%)	61.2	66.6
Minimum	35.3	26.7
Maximum	85	87.5

Refers to the results of the N-gain score test, showing that the N-gain score for the experimental class is 66.6%. It means the learning model is project-based learning with social media-integrated learning media and Instagram effective enough to improve student learning outcomes. In other words, improve students' creative thinking abilities as well. When compared, the increase in scores from the pretest to the post-test for both classes was greater for the experimental class. The difference in treatment for the experimental class provides an increase in student grades. The percentage increase indicates that students' creative thinking skills have also increased because the aspects required for creative thinking have been considered in the post-test instrument.

IV. CONCLUSION

This study used a quasi-experimental method with a pretest-posttest control group design. Sampling was carried out using a simple random sampling technique, and finally, two sample classes were selected, namely the experimental and control classes. From the results of this study obtained sig. (2-tailed) owned by both classes is 0.012<0.05. Referring to the statement that H0 is rejected and HA is accepted, this means that there are significant differences in student learning outcomes between the experimental class and the control class. Then the proportion of the N-gain score is 66.6%, which means it effectively improves student learning outcomes; In other words, it also improves students' creative thinking skills. Therefore, similar learning media can be developed for chemical materials for reaction rates and other chemical materials for further research. The researcher suggests that in future research, using a different learning model or other social media learning media can improve students' creative thinking abilities and motivation in learning chemistry.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

The contribution of Hayuni Retno Widiarti as the first

author is to provide direction regarding the limitations of the cited journals to be used as literature to use as basis. Sri Yamtinah, as the second author's contributed is writing articles and providing new interpretations of every reference in the article to use as a research basis. Mawardi, as The third author's contribution, is correcting the article's contents, making improvements to the format, and making publications. Deni Ainur Rokhim and Afis Baghiz Syafruddin, The fourth and fifth authors' contribution is controlling the writing of articles to comply with the guidelines for writing excellent and correct papers. Zsa Zsa Salsabila Firdaus is the last author's contribution as an editor in writing articles and is involved in helping other writers' assignments.

FUNDING

This research was supported by Malang State University. Their support and consideration are highly appreciated.

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