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Enhancing student motivation in reaction rate topics through the integration of Instagram-based learning media and the Student Teams-Achievement Divisions cooperative model

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Abstract

Instagram-based learning media can be applied in chemistry learning because it can be accessed at any time, it is not limited by distance or time if you have an internet network and adequate hardware and can increase student learning motivation. This study aimed to ascertain whether applying the Instagram-integrated Student Team-Achievement Divisions learning model and multi-representation strategies enhances student motivation on reaction rate topics. The Nonequivalent Control Group Design with the Quasi-Experimental technique is the research design. Using a random sampling technique, students from Malang Senior High School's class XI-Science were selected as the research sample. Student learning motivation data was descriptively and quantitatively examined, and statistical tests, such as prerequisite analysis tests and hypothesis testing, were used to analyze data on learning outcomes. The results of this experimental research found that in the extremely high category, the percentage of students who were motivated to learn rose from 56 to 85%. These findings show the experimental class's improvement in learning motivation outperformed that of the control class.

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1. Instagram;
2. learning motivation;
3. reaction rate;
4. Student Teams-Achievement Divisions;
5. cooperative learning.

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Highlights

- Instagram-based learning can be effectively applied to chemistry education.
- STAD model integrated with Instagram enhances collaborative student learning.
- Multi-representation strategies boost motivation in learning reaction rates.
- Student motivation increased significantly, from 56% to 85% after the treatment.

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1. Introduction

Education stands as a cornerstone in the development of individuals, crucial for fostering intelligence, honing skills, nurturing character, fortifying personality, and fostering a sense of communal unity, thereby contributing to the nation's advancement (Saptono, 2017). This field gets more attention because the country's quality of education is used as a benchmark for the country's progress. In the era of digitalization, it brings many positive impacts on people in various sectors of life, especially in education. According to Fadlillah (2016), the field of education has experienced significant developments in its direction, which is now not only limited to "education" but has led to "edutainment". These two approaches essentially do not change the nature of the teaching and learning process in the classroom, but there are differences in planning, strategies, techniques, and teaching methods (Afif, 2019). Furthermore, the contemporary landscape offers an array of diverse learning outlets, with the advent of numerous mass media platforms, notably the Internet and electronic media, emerging as vital reservoirs of knowledge and educational hubs. This will impact on teachers who are no longer the only primary source of knowledge in teaching and learning activities. This change will also create a new paradigm for educators regarding the use of time that must be as efficient as possible to facilitate students' maximum learning outcomes. This can be achieved if educators can make a teaching innovation, i.e., balanced with the increasing quality of teachers (Harsanto, 2014).

Apart from the educators, this all-digital era will also impact students who are born as "digital native generations", a term for the generation who was born, grew up, grew up and interacted with various kinds of digital media. This condition may impact the psychological aspect, which affects the cognitive map. According to Widianingsih (2019), students' needs, changes and habits tend to follow what they see through the media they see and use the most. The students also have broad opportunities to operate in the digital world anywhere and anytime if there is an internet network and adequate hardware. With this opportunity, from now until the future, education can be implemented without being limited by space and time. This transformation will change the strategy in teaching from conventional media to digital-based so that educators will find it easier to manage classes in learning. Thus, student learning activities in the digital era will find a structured and sustainable pattern with a predetermined curriculum flow.

The "digital native" generation has a great opportunity to utilize the digital world in education. With the digital world that can be accessed anytime and anywhere and the trend of internet and mobile phone developments, this generation has great potential to learn to explore their potential independently anywhere and anytime. Although students learn independently, educators remain responsible for guiding and facilitating students. Learning that is carried out independently needs to be directed to stimulate a sense of responsibility and creativity and build logical and critical thinking skills. According to Wibowo (2018), independent learning autonomy is rooted in regulated learning, which emphasizes the individual's capacity to autonomously regulate their learning journey through various modalities, to achieve peak academic achievement. In addition, educators need to develop independent learning by choosing the right and creative learning model that emphasizes the activities of students as actors in learning tasks. This creative learning activity is expected to foster new creativity in students' thinking, feelings, and attitudes. In the digital era, choosing a diverse and creative learning model is about acquiring skills and fostering social cohesion and national unity with a spirit of inclusivity (Anwar, 2004). These models serve as a foundation for educational practice, derived from theories in educational psychology and learning, which are carefully crafted to guide curriculum implementation and its practical implications in the classroom environment. Thus, to encourage a spectrum of learning experiences, creativity in designing various learning models becomes a must (Warsono, 2013). This is supported by the current state of the education world, which is changing the traditional paradigm to include classroom-based learning, especially the lecture method. As a result, there is a need for alternative methodologies, among which the cooperative learning model stands out as a promising path.

Cooperative learning emerges as a pedagogical approach wherein students collaborate towards shared objectives. This structured method aims to enhance student engagement, foster leadership qualities, encourage decision-making within groups, and promote cross-cultural interaction and learning (Afandi *et al.*, 2013). Extensive research underscores the manifold benefits of cooperative learning, transcending mere academic achievement. It cultivates self-assurance, nurtures interpersonal skills, and fosters mutual trust among peers, both individually and collectively. Moreover, it nurtures a culture of assistance and collaboration among classmates, eschewing individual competition and fostering a collaborative ethos within the classroom. There are several techniques in the cooperative learning method, including jigsaw, Student Teams-Achievement Divisions (STAD), NHT (Numbered Heads Together), and others. This cooperative learning is suitable for use in all subjects. One of the subjects taught in this era was chemistry. Chemistry is one of the science subjects that is usually taught in high school.

Chemistry is a science discipline that studies matter's structure, properties, and transformation (Artini and Wijaya, 2020). Chemistry subjects in high school provide a comprehensive understanding of substances, covering aspects such as composition, structure, properties, changes, dynamics, and energetics, all explored at the molecular level (Astuti, 2020). Teaching chemistry lessons in schools can improve thinking skills and stimulate the creative thinking patterns of students (Rachman and Ahsannunisa, 2017). The large scope of material studied in chemistry makes it a complex and not simple subject, making students' views of it negative. Many students often complain and consider this subject difficult to learn. Students' difficulty in understanding chemistry learning is because it is abstract and complex concepts that require a deep understanding to study it (Sariati *et al.*, 2020). In addition, chemistry is also often considered a difficult and boring subject by most students (Muderawan *et al.*, 2019). Some of the difficulties experienced by students in studying chemistry tend to be caused by students not knowing how to learn, having difficulty connecting between concepts, and requiring the ability to utilize logic, mathematics, and language skills (Zakiyah *et al.*, 2017). In learning chemistry, students may have difficulty learning complex chemistry materials and use a lot of mathematical calculations to solve problems. One of the chemistry materials often considered difficult to understand is the reaction rate material. Based on research conducted by Marthafera *et al.* (2018), it is stated that the low understanding of students' concepts on the reaction rate material is caused by several factors, one of which is the media and teaching materials that are not by the conditions of students in the classroom so that it affects students' conceptual understanding. In learning chemistry, students have difficulty learning complex chemistry materials and use a lot of mathematical calculations to solve problems. The concept of reaction rates poses a significant challenge for students studying chemistry. Research conducted by Marthafera *et al.* (2018)

highlights that students' difficulties in grasping the intricacies of reaction rate material stem from various factors, including inadequacies in instructional media and teaching materials that fail to align with classroom dynamics, thus hindering conceptual understanding. Furthermore, students encounter hurdles when tackling complex chemistry topics, particularly those involving extensive mathematical calculations. This underscores the need for tailored instructional strategies and supportive learning environments to enhance students' comprehension and mastery of chemistry concepts, particularly those related to reaction rates.

In tandem with technological advancements, the landscape of learning media is undergoing exponential growth and diversification. A notable innovation in the digital era is the emergence of internet-based learning platforms. This surge is propelled by the prevalence of internet usage among teenagers, as evidenced by research conducted jointly by the National High School of Passwords (STSN) Indonesia and Yahoo, revealing that adolescents aged 15-19 constitute a significant portion, accounting for 64% of internet users in Indonesia. Consequently, there has been a notable shift towards using social media platforms as engaging online learning tools, particularly accentuated during the pandemic due to heightened social media usage among students (Annur, 2021). Besides, video and image-based learning innovations are interactive and interesting learning media solutions that ask students to learn during the COVID-19 pandemic (Adawiyah *et al.*, 2021). The existence of these innovations can encourage educators and students who become teachers and content creators to learn chemistry that creates interesting and easy-to-understand content for students (Maeskina and Hidayat, 2022). Media creations can be in the form of images, videos, or writing that will become complete content and be distributed through platforms, one of them being social media (Sundawa and Trigartanti, 2018).

Instagram emerges as a promising platform for educational advancement, offering a range of features conducive to learning. This application was first launched in October 2010 and experienced significant user growth after it was officially launched. As of April 2015, the number of users has reached 300 million active users (Costill, 2014). The popularity of Instagram has reached Indonesia, it was recorded that in 2019, Indonesia had the most active Instagram users (Riyanto, 2019). With a total number of active users of as many as 56 million or 20.97% of the total population of the entire Indonesian community. Instagram facilitates various features that can be developed for students to learn critically and reflect on the meaningful learning process (Chun et al., 2016). These include live streaming and facilitating direct teacher-student interaction to comprehensively monitor learning needs. Post feeds provide a convenient avenue for students to gather and submit assignments and work, fostering collaboration and engagement within the learning community. Moreover, the platform's video reels offer a creative outlet for presenting educational content in engaging video formats, enhancing comprehension and retention.

Additionally, Instagram TV is a valuable resource for students to access longer-form educational content. It enables them to explore assignments and works in video or animation formats, thus enriching the learning experience with diverse multimedia resources. This application is suitable for keeping teachers or educators connected so they can always relate to students.

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Instagram's diverse features and its great potential for integration into learning follow the opinion of Mandja (2016), who discovered a statistically significant difference between classrooms that used traditional learning methods and classes that used Instagram media. Instagram media could enhance learning outcomes suggesting motivation. The study by Widarti (2024) echoed similar outcomes, revealing a substantial improvement with a standard gain of 0.82 in the higher performance bracket. It showed a notable surge in students' learning motivation after incorporating Instagram as an integrated learning tool for independent study. These findings underscore the imperative for further investigation to elucidate the potential efficacy of implementing the Instagram-integrated STAD learning model alongside a multi-representation approach. This forthcoming research explores whether such pedagogical strategies will bolster student motivation and augment learning outcomes, particularly in chemistry, focusing on reaction rate material.

2. Experimental

2.1. Research design

The study conducted falls under the category of Quasi-Experimental research. It was carried out during the odd semester of the 2022/2023 academic year at Senior High School (SMA/Sekolah Menengah Atas) Negeri 8 Malang. Employing a random sampling technique, subjects were selected from all six XI (second year of a three-year study period) mayor Mathematics and Natural Sciences (MIPA/Matematika dan Ilmu Pengetahuan Alam) classes at SMA Negeri 8 Malang, with the control group comprised of XI MIPA 1 (consisting of 13 male and 20 female students) and the experimental group comprised of XI MIPA 2 (comprising 13 male and 18 female students). The research design adopted is a control group design, specifically a Non-equivalent Control Group Design, allowing for the inference of causal relationships. The experimental class implemented the STAD learning model supplemented with Instagram media. The same learning model is used in the control class without additional treatment, utilizing PowerPoint as the learning medium.

2.2. Research instruments and procedures

The research comprised three sessions, each lasting 2 JP or 2 x 45 minutes for both classes. Various instruments were utilized, including a questionnaire to assess learning motivation before and after the study. Additionally, learning materials such as lesson plans and student worksheets (LKPD/Lembar Kerja Peserta Didik) were employed, having undergone validation by chemistry experts from SMA Negeri 8 Malang and chemistry lecturers. Data collection encompassed both test and non-test instruments. The test instrument comprised *pre-* and *post-test questions* featuring 10 multiple-choice items with 5 response options, whereas the non-test instrument consisted of a student learning motivation questionnaire utilizing a 4-point Likert scale. The scale utilized in the learning motivation questionnaire presented statements followed by four response choices. The research measurement scale was adapted from Riduan's framework. The values given are one to four for responses that are very less agreeable, less, good, and very good, which describes a very negative position to a very positive position. The level of scale measurement in this study uses intervals.

At the outset of the learning sessions, a non-test instrument in the form of a learning motivation questionnaire was administered to both classes utilizing Instagram and PowerPoint media. This initial step aimed to gauge the level of student motivation towards learning reaction rate material at the onset of the session. Subsequently, a pre-test was administered before the commencement of the learning process to assess students' baseline understanding of the reaction rate material. While the experimental class received Instagram media as a form of treatment, the control class utilized PowerPoint media without any additional treatment. Following the learning sessions, a post-test was administered, and a learning motivation questionnaire was distributed to both the experimental and control classes. This post-test and questionnaire aimed to evaluate the increase in motivation and learning outcomes in the experimental class, which received treatment through Instagram social media, compared to the control class. The data processing methodology for the student learning motivation questionnaire involved descriptive quantitative analysis.

3. Results and discussion

3.1. Learning implementation data

Information regarding the execution of the learning process was gathered through observations conducted throughout the instructional sessions. Two observers, observer I and observer II, were tasked with this observation process, and the resulting data is presented in **Fig. 1** (results in percentage).

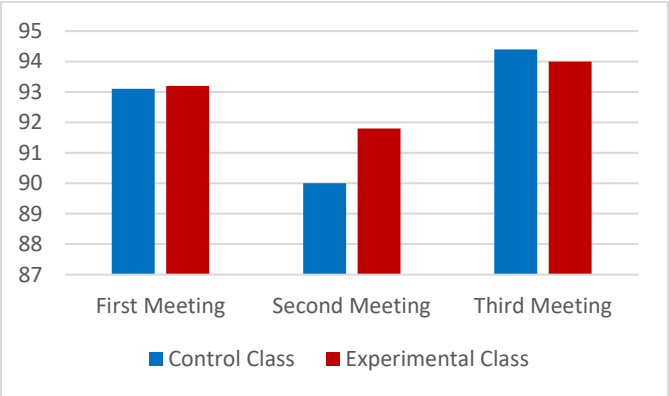

Figure 1. Histogram of Learning Implementation.
Source: Elaborated by the authors.

The assessment of learning implementation indicated that the control and experimental classes exhibited implementation rates of 92.5 and 93%, respectively. These findings suggest a minimal disparity in the execution of learning activities between the two classes. The learning implementation deficit occurred in the control class due to students' tardiness in participating in learning both during learning and discipline which was slightly less than in the experimental class, so it affected the enthusiasm for learning in the control class in contrast to the experimental class.

3.2. Implementing an Instagram-integrated STAD learning model

The integration of Instagram social media into the STAD learning model was implemented in class XI MIPA 2 at SMA Negeri 8 Malang, comprising 31 students of both genders. STAD is a cooperative learning model emphasizing student interaction to help and motivate each other. Instructions on reaction rate material occurred during three sessions per meeting, each lasting 45 minutes, throughout September 2022. The experimental and control classes utilized the STAD learning model; however, the experimental class employed Instagram media, while the control class used PowerPoint. The Instagram learning media, integrated into the @chemsquad.kimia account, offered accessibility across various devices such as laptops, smartphones, and tablets. Content included infographics and videos covering reaction rate material, with each sub-material featuring real-life examples, explanations, sample problems, and discussions. The appearance of the @chemsquad.kimia Instagram account utilized in the instructional process is depicted in **Fig. 2**.

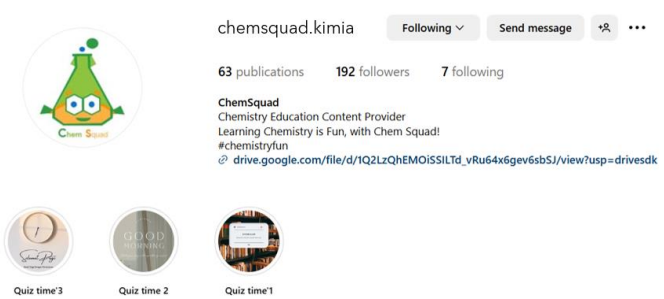

Figure 2. Depicts the front view of @chemsquad.kimia *Instagram* account.
Source: Elaborated by the authors.

The utilization of Instagram-integrated learning media in education involves several features. One such feature is the presentation of teaching media for reaction rate material in the feeds feature, illustrated in **Fig. 3**.

Figure 3. The presentation of material on *Instagram Feeds* Feature.
Source: Elaborated by the authors.

Users can upload infographics as images within the Instagram Feeds feature, with each post accommodating up to 10 images. Additionally, the content or material presented can include supplementary information in the form of a concise narrative, provided through a feature known as caption. Furthermore, each post includes a comment feature, enabling students to contribute comments about the material presented or pose questions to the teacher regarding any unclear concepts. This

allows for collaborative interactions among students, fostering courage in expressing opinions in public forums and promoting independent learning during and outside formal educational settings. Figure 4 illustrates these aspects.

Figure 4. Depicts of comment columns across various Posts.
Source: Elaborated by the authors.

The material was provided through the Instagram Reels feature, as illustrated in Fig. 5. This feature presents short videos with a maximum duration of 2 minutes each. The video uploading system in the reels feature differs from the feeds, allowing for a maximum of one video per upload. Despite this distinction, student interaction with teachers remains feasible, as students can comment or pose questions through the comment column.

Figure 5. Depicts the presentation of materials on the Instagram reels feature.
Source: Elaborated by the authors.

Two primary considerations in implementing learning through social media on Instagram are the potential improvements in student learning motivation, particularly regarding reaction rate material. Learning motivation is crucial in achieving student learning objectives, which originate from within each student. The level of learning motivation varies among students, influenced by numerous internal and external factors, driving students to learn for diverse reasons. Students with heightened learning motivation are more inclined to exert greater effort towards achieving their learning objectives. Conversely, the effort required to attain these goals decreases when learning motivation is low.

3.3. The impact of Instagram media on enhancing learning motivation in the experimental group

The study was centered on leveraging Instagram media to bolster learning motivation. A motivation questionnaire was administered to 31 students in the experimental class, who were exposed to Instagram as a learning medium. The questionnaire aimed to assess learning motivation before and after utilizing Instagram-based media. The effectiveness of Instagram media was evaluated based on the increased motivation levels pre- and post-exposure to the media in learning reaction rates. The learning motivation data, which comprises quantitative information, was subjected to descriptive analysis to elucidate its implications.

3.3.1. The average analysis of the student learning motivation questionnaire

Figure 6 graphically depicts the findings, showcasing the average student learning motivation results (results in percentage).

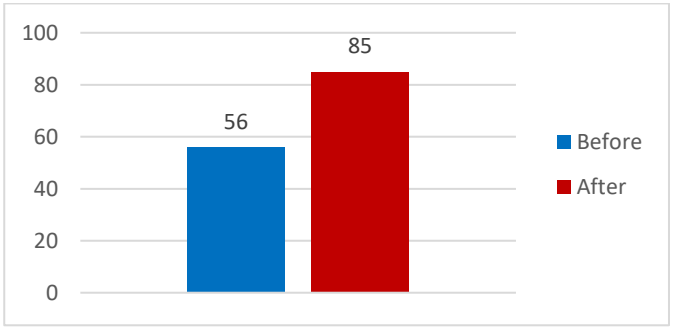

Figure 6. Illustrates the average outcomes of student learning motivation.
Source: Elaborated by the authors.

Before utilizing media, the average learning motivation stood at 56%, surging by 29% to 85% post-implementation. These results suggest a significant improvement in student learning motivation, attributed to the integration of Instagram media. This observation aligns with prior research conducted by Widyastuti and Puspitasari (2020), which reported a similar increase in student learning motivation upon utilizing Instagram as an independent learning resource. The study yielded a Z value of -3.300 with an asymp.sig (2-tailed) value of 0.001, further corroborating the efficacy of Instagram media in fostering enhanced learning motivation. Other social media, such as TikTok, which has been studied by Caballero (2024), got positive results. However, the research conducted is still limited to microlearning and small samples. In addition, there are more posts on Instagram than on TikTok, according to Dubin's (2024) research. With this comparison, Instagram is superior in social media development, and the number of posts and views is expected to increase interaction between users more effectively. With its diverse features, Instagram emerges as a promising alternative learning medium, offering meaningful engagement opportunities for students in chemistry education.

3.3.2. Analysis of factors affecting the improvement of student learning motivation

Students' motivation to learn can come from internal and external factors. This study used three indicators of learning motivation to show the increase in students' learning motivation.

3.3.2.1. Indicator of encouragement of student morale in learning

In this indicator, the results of the learning motivation questionnaire on four supporting aspects consisting of aspects of student interest, activeness, and curiosity about the reaction rate material are presented in **Table 1**.

Based on **Table 1**, in the aspect of interest in the reaction rate material, there was a significant increase in students who felt very interested in the reaction rate material after being given Instagram media, where initially only 8.57% of students then increased to 50.72%. The learning motivation of students who use Instagram media as learning media is greater in terms of student interest in learning and the reaction rate. This was also shown during teaching and learning activities, where the experimental class actively discussed the reaction rate material. Using Instagram as a learning media increases students' enthusiasm, activeness and motivation (Fidian, 2017). In the aspect of student activeness during the learning process, there is an increase in students who have very high activeness when learning the reaction rate, with an initial percentage of 27.59% rising to 48.28%. Based on this description, the learning motivation of students who use Instagram media as learning media has increased in student activeness in the learning process. This was also shown during teaching and learning activities, where the experimental class showed increased activeness by asking more questions when they did not understand and asking many questions during discussions to make learning more meaningful. Regarding student curiosity in learning, before being given Instagram-integrated learning media, students who were very curious had a percentage of 5.71%. Giving Instagram afterwards can significantly increase the percentage to 28.57%. Using Instagram media to display images and videos on the reel and feed features can increase student curiosity about the exposure of reaction rate material. In addition, the comment column can provide a wide platform for students who want to ask questions about material they do not understand. Furthermore, other students who understand better can answer these questions, thus creating an open discussion space between one student and another.

3.3.2.2. Indicator of desire to succeed in learning

In this indicator, the results of the learning motivation questionnaire are obtained in two supporting aspects, namely, there are aspects of student confidence in mastering the material and student confidence in completing the exam presented in **Table 2**.

3.3.2.3. Indicators of student interest in using learning media

In addition to internal factors, external factors can increase learning motivation, in this case, the use of learning media. Students' interest in the learning media is presented in **Table 3**.

Based on **Table 3**, students feel very interested in the learning media provided in the reaction rate material, which has a percentage of 57.23%. Providing learning media significantly increases students who feel interested in Instagram media up to 47.33%. Instagram-integrated learning media can attract attention and help students understand reaction rate material. There is a caption feature that contains a written explanation of the material presented in addition to the presentation of material in the form of images and videos contained in the *feeds* and *reels* feature. The combination of explanation in the form of writing and interpretation in the form of images makes the presentation of material more varied and attracts students' attention. The fact that they do not use paper is unrelated to the possibility of using other media. This distinguishes Instagram learning media from traditional learning media such as lectures that use notebooks continuously. Instagram learning media can be an alternative to creative and environmentally friendly learning innovation because it minimizes paper use.

The data analysis of the questionnaire results of student learning motivation above, which increasingly shows changes in the good direction, can be interpreted as increasing student motivation in the learning process. The fulfilment of each aspect of the learning motivation indicator is directly proportional to the appearance of several student attitudes shown during learning such as the emergence of a sense of comfort, helping each other in understanding lessons, not feeling alone so that self-confidence grows, growing attitudes willing to work together, responsibility and a healthy competitive spirit. Students motivated during learning will feel encouraged to actively participate in every learning process, such as asking questions, discussing, and expressing opinions during the question-and-answer process at the presentation stage. Students' focus on following the teacher's instructions during learning will also be maintained by showing it at the stage of presenting material through Instagram learning media, where students listen carefully to the presentation of the material in it, and students can make good use of the provided media.

According to Andrew *et al.* (2005), two factors influence motivation: attitudes and needs. If students have a positive attitude towards learning, learning motivation will increase, and vice versa. Likewise, with students' needs, if lessons are considered meaningful in students' lives, then students' learning motivation will increase, and vice versa. Based on the observation results in the initial condition before implementing the STAD-type cooperative learning model, students' learning motivation was still lacking, as indicated by students' activities during learning tended to be low where most students were still passive, did not dare to ask questions, were not confident in answering questions asked by the teacher, and still lacked cooperation in completing tasks. Changes from these conditions began to appear after implementing the STAD learning model integrated with Instagram learning media, where student motivation to learn began to appear from the initial stage of presenting the material to the final stage of learning by giving awards and quizzes.

At the material presentation stage, student activity began to appear as shown by students who actively asked questions about the reaction rate material that was not understood. This attitude appeared in both classes, but the aspect of curiosity about the reaction rate material was more prominent in the experimental class, which was shown by most of the group representatives asking questions, compared to the control class, which needed to be given an additional question stimulus from the teacher first before they arose curiosity. The attitude of daring to ask questions was also shown in the experimental class, which was very prominent during the discussion when answering the exercise questions in the LKPD. Students in this class were not afraid to raise their hands to ask questions or ask for directions in working on problems. This is slightly different from the control class where the class tends to be passive in asking questions, so the teacher must check each group to ensure students understanding and the course of discussion in working on exercise questions. Regarding cooperation between group members, the experimental class was more organized and organized regarding the division of tasks for each group member. A slight difference was shown in the control

class, where several group members did not work on the division of tasks and were only charged to several members. Based on this, the control class is still dominated by several passive students and does not show any motivation to learn during the learning process.

At the publication stage, one group representative presented their group discussion results, followed by a question-and-answer process. At this stage, student activeness in the experimental class was seen with all representatives of groups that did not present asking questions to the presenter group. When clarifying the answers, students did not hesitate to enthusiastically express their opinions. Student activeness at this stage in the control class was also visible. Still, those who dared to ask questions and express opinions were only dominated by a few students, and it seemed that other students began to be distracted by other things, so they did not focus on paying attention to the question-and-answer process during the presentation. However, those who dared to ask questions and express opinions were only dominated by a few students, and it seemed that other students began to be distracted by other things, so they did not focus on paying attention to the question-and-answer process during the presentation. Followed by the awarding stage, where the accumulation of award stickers obtained from the *Reward Chart* of the two classes was different, where in the experimental class the most active group was successfully fulfilled by the award sticker in the table given, while in the control class, the most active group was not fully fulfilled by the sticker in it. From these results, students' motivation during the discussion session to ask and answer questions in the experimental class increased in terms of learning activities.

The increase in student motivation to learn is due to the application of STAD learning. This follows the results of research conducted by Yudiasa et al. (2016) which states that using the STAD model can increase student learning motivation. Increased motivation occurs during learning following the stages of the STAD learning process. Students focus when the teacher explains the material, cooperate in doing group assignments, actively ask questions during group discussions and presentations, and utilize learning resources during the learning process. The following research by Supriyo (2008) shows that the STAD cooperative learning model can increase students' motivation. Previous research conducted by Widarti (2022) showed that the increase in student learning motivation after using the *Chem Squad Instagram* account learning media as an independent learning resource for chemistry learning on Acid and Base material showed an increase in the standard gain value of 0.40 in moderate criteria.

Banerjee *et al.* (2014) argue that when students learn with a self-learning approach, it will create an environment where they can learn. A supportive learning atmosphere, as well as innovations in learning that involve the active role of students, will further increase student learning motivation. Learning requires creative strategies when using technology, especially for novice students. The most important feature that is directly influenced by engagement is self-concept. Instagram social media encourages creative learning. The use of Instagram social media in education as an innovative, interactive and creative learning media shows that this application can increase students' learning motivation which is also very important in achieving maximum learning outcomes.

Table 1. Indicators of encouraging student enthusiasm in learning.

Aspects	Average percentage of each score (%)							
	Before				After			
	1	2	3	4	1	2	3	4
Interest in the Material Rate Reaction	2.86	8.57	68.57	8.57	0	3.57	45.71	50.72
Student Activity in Learning Reaction Rate	6.90	20.69	31.03	27.59	6.90	13.79	27.59	48.28
Students' Curiosity in Learning Reaction Rate	2.86	28.57	51.43	5.71	0	17.14	42.86	28.57

Source: Elaborated by the authors.

Table 2. Indicator of desire to succeed in learning an average percentage of each score.

Aspects	Average percentage of each score (%)							
	Before				After			
	1	2	3	4	1	2	3	4
Student Self-Confidence in Mastering the Material of the Rate Reaction	17.24	37.93	27.59	6.90	2.86	11.43	20	54.23
Student Self-Confidence in Completing an Exam	5.71	22.86	48.57	14.29	0	22.86	51.43	17.14

Source: Elaborated by the authors.

Table 3. Indicators of student interest in using learning media average percentage of each score (%).

Aspects	Percentage of each score (%)							
	Before				After			
	1	2	3	4	1	2	3	4
Student interest in using learning media	17.24	37.93	27.59	6.90%	2.86	11.43	20	54.23

Source: Elaborated by the authors.

4. Conclusions

Considering the findings and subsequent discussion, it is evident that integrating Instagram applications positively affects student motivation and learning outcomes. The research outcomes revealed a notable increase in learning motivation, with students utilizing the Instagram-integrated STAD learning model registering a remarkable 85% motivation level in the very high category. These findings collectively affirm the efficacy of the Instagram-integrated STAD learning model in enhancing chemistry learning, particularly regarding reaction rate material, and in augmenting student motivation and learning outcomes. Future research efforts are encouraged to explore the application of Instagram application in chemistry education across various materials and to investigate further to identify which Instagram features are most conducive to the chemistry learning process or other social media that may be able to develop better than Instagram.

Authors' contribution

Conceptualization: Hayuni Retno Widarti; **Data curation**: Elvira Risva Firda Amalia; **Formal Analysis**: Elvira Risva Firda Amalia; **Funding acquisition**: Hayuni Retno Widarti; **Investigation**: Elvira Risva Firda Amalia; Hayuni Retno Widarti; **Methodology**: Elvira Risva Firda Amalia; **Project administration**: Hayuni Retno Widarti; Elvira Risva Firda Amalia; Deni Ainur Rokhim; **Resources**: Elvira Risva Firda Amalia; **Software**: Deni Ainur Rokhim; **Supervision**: Hayuni Retno Widarti; **Validation**: Hayuni Retno Widarti; **Visualization**: Elvira Risva Firda Amalia; **Writing – original draft**: Elvira Risva Firda Amalia; **Writing – review & editing**: Deni Ainur Rokhim

Data availability statement

All data were acquired and analyzed in the present investigation.

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Not applicable.

Conflict of interest

The authors declare that there is no conflict of interest.

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