Enhancıng Students Learnıng Outcomes And Motıvatıon In Analytical Chemistry: A Problem-Based Learnıng Usıng Tıktok and Instagram With Multi-Representation Approach

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Abstract. This research investigates the effect of integrated traditional media on using TikTok and Instagram; to increase students 'motivation and learning outcomes in qualitative analysis in the 2015-6 qualitative analysis for groups (I) and (II)) multi-representation approach and problem-based learning model (IB) level 2, 2023. In a quasi-experimental design with pretest-posttest control groups, we found a significant difference between the experimental class (mean post-test value = 82.00) and the control class (mean post-test value = 61.73, Man-Whitney U test ($p < 0.05$)). The experimental class had an average N-Gain score of 0.7369 compared to 0.4753 for the control class. Additionally, the use of these social media platforms positively influenced students' interest (25% to 30%), understanding (14% to 21%), achievement motivation (42% to 48%), and activeness and learning independence (17% to 20%). Thus, integrating TikTok and Instagram significantly improves students' motivation and learning outcomes in qualitative analysis.

Keywords: Cation Qualitative Analysis, Learning Motivation, Learning Outcomes, Multi Representation PBL, Social Media.

1 Introduction

Analytical chemistry is a branch of chemistry that includes the study of qualitative analysis. Qualitative analysis identifies the type of substance or component within a material. This analysis relies on examining the material's physical and chemical properties. For instance, to identify a liquid sample in a beaker, we perform qualitative analysis by assessing its physical properties such as color, odor, refractive index, boiling point, density, and solubility. Similarly, we examine a solid sample's color, odor, flame color, melting point, crystal form, and solubility. Qualitative analysis is divided

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into two categories: analysis based on physical characteristics and chemical properties, including reactions with H_2S, which involves cation and anion analysis [1].

Understanding qualitative analysis is very important because it reflects the nature of chemistry that answers the questions 'what', 'why', and 'how' related to natural events. This discipline focuses on analyzing the composition, structure, and properties of substances, as well as the changes that occur, the dynamics, and the energy involved [2]. As stated by Kurniasih and Rahayu (2017), understanding analytical chemistry (qualitative and quantitative analysis) is needed to think critically, logically, creatively, and innovatively [3]. Nevertheless, in practice, it indicates that students struggle to understand it. This aligns with Fathonah et al., (2015) based on interviews with teachers, qualitative analysis material is considered difficult to teach, with only 69% of students achieving the Minimum Mastery Criteria (MMC) score. This is supported by A survey conducted on 30 students at SMK Bhakti Mulia Wonogiri which is shown that 53.33% of the student consider qualita-tive analysis material as the difficult material [4]. The reason behind this is that the subject has concepts and procedures such as chemical reaction equations, which are based on a lot of facts, and it requires a lot of structural learning. Furthermore, the way of teaching that teachers do is more focused on the teacher (teacher centered), so that the messages conveyed can not be well understood by students [4].

To address the problem of students struggling to understand qualitative analysis, a solution is proposed that involves implementing a problem-based learning (PBL) approach. This method is student-centered, allowing learners to actively engage in their education [5]. Additionally, incorporating social media platforms such as TikTok and Instagram can enhance the delivery of material through audio-visual learning media [6], [7]. By utilizing these platforms, teachers can present complex concepts in a more accessible and relatable manner, thereby improving students' comprehension and motivation in qualitative analysis.

High motivation among students is crucial for increasing their overall learning outcomes [8]. When students are motivated, they tend to participate more fully in classroom activities, complete assignments diligently, and seek additional resources outside of regular lessons [9]. Studies have shown that incorporating social media platforms like TikTok and Instagram into the study can considerably increase student motivation. An example is a research [10] finding that the use of Instagram-based learning media can enhance students' motivation and understanding of reaction rates, with an N-gain value of 0.71 higher than a control class with an N-gain value of 0.55. In line with this, a study [11] has also briefly shown that the use of integrated learning media using TikTok & Insta-gram (badance in science) can enhance students 'learning motivation in the chemical qualitative analysis material. These findings suggest that incorporating PBL with social media not only makes learning more engaging but also effectively boosts student motivation, thereby improving their overall academic performance.

To further deepen students' understanding, employing a multi-representation approach in TikTok and Instagram videos can be highly effective. This approach incorporates macroscopic, submicroscopic, and symbolic representations, allowing students to visualize concepts from different perspectives. For instance, videos can illustrate chemical reactions visually (macroscopic), depict molecular interactions (submicroscopic), and present chemical equations (symbolic). The purpose of this study was to

examine the impact of using TikTok and Instagram as integrated learning media to enhance student motivation and learning outcomes in qualitative analysis for groups I and II, employing a multi-representation approach and a problem-based learning model.

2 Literature Review

2.1 Separation of Group I and II Cations

Qualitative analysis often involves memorizing numerous procedures, observations, and chemical reactions, which can overwhelm students and hinder their ability to connect theoretical knowledge with practical applications. A study examining learners' issues in the preparation and qualitative analysis of salts found that students reported negative perceptions of the topic, describing it as complex and challenging [12].

Social media can be utilized to present qualitative analysis materials for Group I and II cations through infographics and learning videos. Infographics contain information in the form of text and images related to learning materials and are uploaded to the Instagram feed. The learning videos can consist of demonstration videos showcasing laboratory experiments on the separation of group I and II cations, with the content creator providing detailed explanations of the processes and aspects of multi-representation. A comprehensive understanding of chemistry concepts can be achieved through the three representations (macro, sub-micro, and symbolic) to foster student motivation and elevate learning results [13].

2.2 Multi-Representation

According to Widarti et al. (2023), utilizing integrated learning media such as TikTok and Instagram with a multi-representational approach enhances students' comprehension of qualitative analysis materials by providing diverse ways to engage with the content. By utilizing these platforms creatively, educators can cater to various learning styles, ultimately improving students' grasp of qualitative analysis material [11]. This multi-representation approach can be presented as an explanation of the reactions in the separation of cations group I and II using the H_2S method in social media-based learning videos. For more details, the application of 3 levels of representation in the qualitative analysis material group I and II using the H_2S method is presented in Table 1.

Table 1. Table captions should be placed above the tables.

Representation	Example
Macroscopic	Formation of yellow PbCrO4 precipitate. The aspect that can be observed with the five senses is that the solution containing Pb2+ cations when added with yellow K2CrO4 solution forms a yellow precipitate.
Sub-Microscopic	Contains an explanation of particles related to ionic interactions between Pb2+ cations and CrO42- anions to form PbCrO4 precipitates.
Symbolic	*The reaction equation for the formation of PbCrO4 precipitate.* *Pb2+(aq) + CrO42-(aq) PbCrO4(s)*

2.3 Problem-Based Learning

Numerous studies indicate that the efficient implementation of PBL significantly improves the learning process. Research by Sumiati (2018) indicates that the implementation of PBL models can enhance student motivation and improve learning results in chemistry [14]. Islamiati et al., (2020) indicated that the implementation of a problem-based learning paradigm positively affected students' learning results in chemistry, specifically for redox reactions [15]. Therefore, the problem-based learning (PBL) model is applied, especially since there is no research that applies PBL to the material of qualitative analysis of cations. This research is needed because PBL is very suitable to support students' understanding of the material. Qualitative analysis material of cations of groups I and II can be applied using problem-based learning models because there are contextual problems that can be raised from the material. The contextual problems concerning qualitative analysis material of cations of groups I and II that can be raised are presented in Table 2.

Table 2. Contextual Problems in Separation of Group I and II Cations

Representation	Example
Group I	The discovery of heavy metals lead and mercury in catfish has the potential to harm the public if consumed.
Group IIA	The Minahasa people experienced symptoms of Minamata-like disease due to consuming river water that was suspected of being contaminated with mercury and arsenic metals.
Group IIB	Water sources in Batam are contaminated with tin metal because they are close to mining sites, which has the potential to harm local residents.

Through these contextual problems, students can be instructed to design an analysis method to detect the presence of metals that pollute the environment using qualitative analysis of cations group I and II using the H2S method so that the community can avoid the potential for heavy metal poisoning because they already know that fish, river, water, or surrounding water sources are contaminated with metals.

2.4 Social Media

The use of social media in chemistry learning is considered effective for increasing high school students learning [16]. Therefore, social media such as TikTok and Instagram can be used as learning media. The use of TikTok and Instagram applications as learning media has been proven effective in improving learning outcomes and student motivation. In their research, Dini et al., (2019) said that TikTok creator content for learning is very enjoyable, especially if the material presented is appropriate, the video illustrations and sound background are also interesting [17]. In addition, utilizing Instagram in conjunction with infographics is very efficacious and can enhance students' engagement in understanding hydrocarbons, a subject they frequently see as difficult to grasp [18].

2.5 Learning Motivation and Outcomes

Learning motivation according to Uno (2016:23) is Internal and external motivation for students leads to behavioral changes, typically accompanied by several indicators or contributing factors. It has a crucial role in an individual's success in learning. Uno (2016:23) posits that learning motivation is evidenced by: (1) a desire for success, (2) encouragement and necessity in education, (3) aspirations for the future, (4) acknowledgment in learning, (5) stimulating activities in the educational process, and (6) a conducive learning environment. Learning motivation is an internal factor that affects learning outcomes, enhancing both understanding and the desire to learn. Therefore, learning models such as problem-based learning can be effectively implemented [8].

As stated by Sudjana (1991:22), "Learning outcomes are the abilities possessed by students after receiving their learning experiences" [19]. Learning outcomes are the results of an individual's learning process and are associated with changes in students or learners. These changes manifest in various forms, including knowledge, understanding, attitudes and behaviors, as well as skills and abilities [20]. Student learning outcomes show student competencies as a result of the learning process that the student has gone through. Melton indicated that learning outcomes encompass behaviors and results that reflect students' abilities to effectively apply existing information in their learning. Thus, learning outcomes can be understood as the skills and competencies that students acquire after progressing through the learning stages [21].

Students' learning outcomes are affected by two factors. The first factor is intrinsic factors which include: (1) student characteristics, (2) student attitudes during the learning process, (3) student learning motivation, (4) student focus in learning, (5) student ability to utilize learning material information, (6) student ability to explore previous learning outcomes, (7) self-confidence, and (8) habits when learning. Extrinsic variables are external influences on the learner, including: (1) teachers as educators, (2) students' social environment and friendships, (3) school curriculum, and (4) facilities and infrastructure [22]. Therefore, learning motivation is an intrinsic factor that significantly impacts learning outcomes, demonstrating its crucial role in the student learning process.

In this research, we aim to explore how the integration of problem-based learning (PBL) with social media platforms like TikTok and Instagram can influence students' learning motivation and outcomes in qualitative analysis. By leveraging these modern tools within an established motivational framework, we anticipate that students will experience enhanced engagement and improved academic performance. This study will contribute to the existing body of knowledge by demonstrating how innovative teaching methods can effectively address motivational challenges in chemistry education.

3 Methodology

In this study, a quasi-experimental method was used to compare the motivation and learning outcomes of students in both experimental and control classes after implementing social media-based learning media. The experimental class used Instagram and TikTok applications as learning media. The control class uses PPT as a learning

medium. The research took place at a vocational high school in Malang during the odd semester of the 2022/2023 academic year, involving three sessions. The sample consisted of 30 students from class XII Chemistry Analysis 2, designated as the control class, and 29 students from class XII Chemistry Analysis 1, serving as the experimental class. Due to the limited number of vocational schools offering analytical chemistry majors in Malang, convenience sampling was utilized to select participants for the study.

This research was started by distributing a learning motivation questionnaire and conducting a pre-test to determine initial students' motivation and ability in the cation qualitative analysis of group I and II material. After the treatment, students were given the same motivational questionnaire and a post-test to assess the differences in motivation and student learning outcomes in the experimental and control classes.

The pretest and posttest instruments had 7 multiple-choice questions and 2 descriptive questions pertaining to the qualitative analysis material for Groups I and II. The pre-test and post-test questions differ yet maintain comparable content.The motivational questionnaire's aspects are (1) the interest in cation analysis material, (2) the desire to get a good cation analysis value, (3) the understanding of the cation analysis material, and (4) the activeness and independence. The questionnaire instrument, 4 Likert scales, was used to measure student motivation in each statement given with a rating scale presented in Table 3.

Table 3. Likert Scale

1	not good / not right / not easy / not clear / not appropriate.
2	not enough good / not quite right / not enough easy / less clear / not enough appropriate.
3	good enough/ fairly right/ fairly easy/ fairly clear/ fairly appropriate.
4	good / right / easy / clear / appropriate.
5	very good/very precise/very easy/very clear/very appropriate

The instruments have been confirmed for both validity and reliability through validation by three experts: two lecturers in chemistry education and one teacher of analytical chemistry. The instrument has also been revised according to the validator's suggestions.

4 Results and Discussion

The research was conducted from 12-29 September 2022 in 3 meetings for 3 x 45 minutes in the experimental class and the control class. The procedure for collecting data in experimental and control classes is the same, only different in using learning media. The Instagram account @kimiafun2022 and TikTok @kimiafun is the media used in this research. The presented content includes cation analysis of group I and II in infographics and videos. Views of the Instagram account @kimiafun2022 and TikTok @kimiafun are shown in Figure 1 and Figure 2.

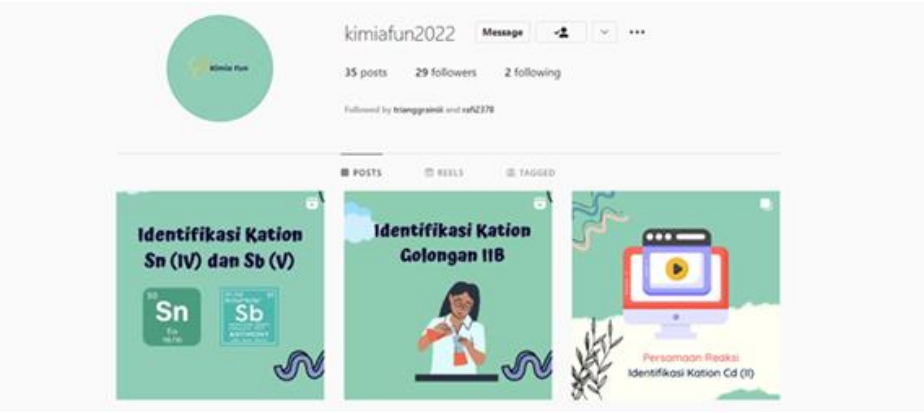

Fig. 1. Instagram Account of @kimiafun2022

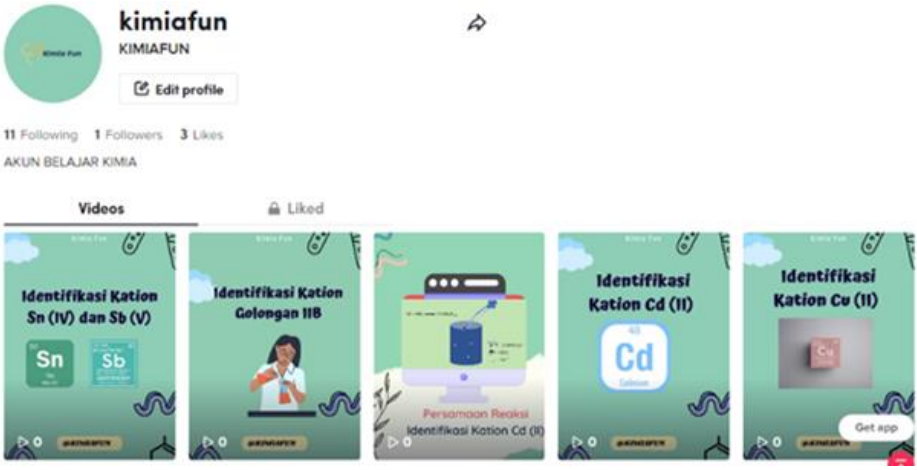

Fig. 2. TikTokAccount of @kimiafun2022

A preliminary test using previous final test values was conducted before data analysis. The experimental and control classes gave significant value in the normality test <0.05, these results indicated that the data were not normally distributed. The significance value in the homogeneity test is 0.808 where the value is > 0.05 so the data is homogeneous. Upon conducting the necessary tests for normality and homogeneity, proceed with the Mann-Whitney U non-parametric test due to the non-normal distribution of the data. The Mann-Whitney U test shows a significant value of 1,000 which is > 0.05, so the decision is made that H_0 is accepted. Thus, students in both the control and experimental classes have the same initial abilities.

4.1 Results

The results of the motivation questionnaire indicated a substantial rise in students' learning motivation following instruction implemented using Instagram and TikTok social media with the PBL model. The analysis of data on learning motivation and interest in the material of separation of groups I and II is presented in Table 4.

Table 4. Aspects of Interest in Cation Analysis Materials for Groups I and II

Statements:

1. I am interested in learning the qualitative analysis of group I and II cations.
2. I am always happy when I succeed in learning and understanding a topic of qualitative analysis of group I and II cations.
3. Learning the qualitative analysis of group I and II cations is fun.
4. The material for qualitative analysis of group I and II cations is interesting to study.
5. I am eager to learn qualitative analysis of group I and II cations.
6. I enjoy learning the qualitative analysis of group I and II cations with the help of pictures and videos.

Class	Experiment					Control				
Scale	1	2	3	4	5	1	2	3	4	5
Average Percentage (Before)	1%	3%	34%	30%	25%	1%	7%	29%	35%	31%
Average Percentage (After)	4%	12%	23%	30%	30%	11%	10%	27%	30%	25%

The analysis of learning motivation data on aspects of achievement motivation is presented in Table 5.

Table 5. Aspects of Achievement Motivation

Statements:

1. I am worried that other students have better achievements in the qualitative analysis of cations groups I and II.
2. I am confident that I will do well in the qualitative analysis exam of cations of groups I and II.
3. I always improve myself when I don't succeed in an exam.
4. I want to get the best qualitative analysis score for group I and II cations in the class.

Class	Experiment					Control				
Scale	1	2	3	4	5	1	2	3	4	5
Average Percentage (Before)	1%	12%	22%	22%	42%	8%	18%	22%	25%	31%
Average Percentage (After)	4%	13%	19%	18%	48%	11%	9%	28%	26%	30%

As for the analysis of learning motivation data on the aspect of understanding of the material for group I and II analysis cations are presented in Table 6.

Table 6. Aspects of Understanding of Cation Analysis Material Groups I and II

Statements: 1. I am confident I can master the knowledge and skills in qualitative analysis cations groups I and II. 2. I can learn the difficult qualitative analysis material of cations groups I and II. 3. I can easily understand the material for the qualitative analysis of group I and II cations										
Class	Experiment					Control				
Scale	1	2	3	4	5	1	2	3	4	5
Average Percentage (Before)	6%	7%	46%	28%	14%	3%	18%	47%	20%	15%
Average Percentage (After)	2%	10%	36%	31%	21%	7%	17%	39%	30%	10%

As for the analysis of student motivation in the aspect of learning activeness and independence, it is presented in Table 7.

Table 7. Aspects of Learning Activeness and Independence

Statements: 1. I always prepare learning equipment before the teacher enters the classroom. 2. I always pay attention to every material. 3. I take notes on the learning materials. 4. I am always active in the self-study process through learning media. 5. I think about the relationship between the qualitative analysis of group I and II cations with everyday life. 6. I always ask if there is material that I don't understand. 7. I like to observe natural events in my daily life.										
Class	Experiment					Control				
Scale	1	2	3	4	5	1	2	3	4	5
Average Percentage (Before)	4%	15%	31%	33%	17%	6%	16%	36%	23%	22%
Average Percentage (After)	7%	13%	33%	26%	20%	3%	14%	37%	31%	18%

Data on learning outcomes were obtained from the pre-test and post-test. The analysis of student learning outcomes used the SPSS application for Windows version 26.0. The normality and homogeneity tests were performed using the pre-test and post-test data collected from both the control and experimental classes.

Table 8. Results of the Kolmogorov-Smirnov Normality Test Data

Class	N Total	Significancy	Conclusion
PreTest Experiment	59	.000	Not Normally distributed
PreTest Control		.001	
PostTest Experiment		.000	
PostTest Control		.002	

Table 9. Homogeneity Test Results of Control and Experiment Class Learning Outcomes

Class	Levene Statistic	Significancy	Conclusion
PostTest Control	.717	.401	Homogeneous

Table 10. Results of the Mann-Whitney U Test Data

	Students' Learning Outcomes	Conclusion
Mann-Whitney U	137.500	
Wilcoxon W	602.500	
Z	-4.524	
Asymp. Sig. (2-tailed)	.000	Ha accepted

The enhancement of student learning outcomes is assessed by calculating the average pre-test and post-test scores using the N-Gain Score. The N-Gain Score test results for both control and experimental classes are displayed in Table 11.

Table 11. N-Gain Score Test Results Data on Control Class and Experiment Class Learning Outcomes

Class	Score	N-Gain
Experiment	Minimum	0.36
	Maximum	1.00
	Mean	0.74
	Std. Deviation	0.19
Control	Minimum	0.14
	Maximum	0.83
	Mean	0.48
	Std. Deviation	0.19

4.2 Discussion

Learning Motivation

The findings from the motivation questionnaire revealed a notable increase in students' learning motivation after utilizing Instagram as a learning medium with the PBL

model. Table 6 indicates that TikTok and Instagram positively affect students' learning motivation, especially with their interest in content connected to the separation of groups I and II. This is evidenced by an increase from 25% to 30% of pupils selecting a rating of 5. This rise is also seen in students' conduct, as they exhibit enthusiasm and enjoyment in studying the information about groups I and II, finding it engaging and intriguing. Meaning, examining difficult group I and II material become interesting to study once one uses TikTok and Instagram. The usage of Tik tok is on line with the research of Arianti and Hadi (2023) that Tik Tok can be accessed anywhere and anytime so that it is expected to be an alternative for students to understand learning material in school and at outside of school. a substitute for learners in comprehending the studying substances each in school and out of school [23].

Based on the se data in Table 7, it can be seen that the social media has a positive impact on a student 's learn ing motivation board especially achievement motiva-tion, as evidenced by the 5th scale achievement value for students who choose from 42 % to 48 %. This improvement can also be seen from the students' attitude who want to get the best grades in class and will always improve themselves if they fail the exam. This could mean that, social media as learning media make students more motivated to study in the classroom. This attitude of achievement motivates motivation in learning in line with the indicators of learning motivation according to Uno, namely the desire to succeed along with the hopes and ambitions of the future [8]. In contrast to the control class, PPT does not motivate students to achieve. Based on this, it was concluded that social media can enhance student motivation in achievement motivation.

Table 8 illustrates an increase from 14% to 21% of students selecting a scale of 5, and from 28% to 31% for those selecting a scale of 4. This indicates that, following engagement with social media, students' comprehension of the topic improved. This is in line with the study conducted by Widarti et al. (2022), teachers, acting as content creators, aim to enhance their teaching methods and practices to improve students' understanding of social media usage. Social media has the potential to help address some of the challenges faced by educators [13].

Drawing from the data in Table 9, after utilizing social media in the learning process, activeness in class and independence in learning experience positive changes. Where the increase occurred from 17% to 20% of students choosing a scale of 5. This increase indicates a drive and need for learning, in this case an awareness of the importance of learning arises. Based on this, students are more motivated to study independently through TikTok and Instagram media. In addition, TikTok and Instagram media create a conducive learning environment. This is following the indicators sparked by Uno (2016:23) [8]. However, this increase is insignificant, highlighting a drawback of using social media as a learning tool. It can distract students from focusing on the separation of groups I and II. This aligns with Mekler's (2021) study that spending too much time on TikTok can distract them while learning [24].

Learning Outcomes

A normality test was conducted to evaluate the data distribution, resulting in a significance value below 0.05, indicating a non-normal distribution of the data. A homogeneity test employing the Levene test was performed, revealing that the data appeared homogeneous with a significance value of 0.401. Due to the failure to meet normal

assumptions, a Mann-Whitney U non-parametric test was utilized for hypothesis testing. The results revealed a significant value of 0.000, resulting in the approval of the alternative hypothesis, which demonstrated differences in learning outcomes between students utilizing social media and those employing PPT. The improvement in student learning outcomes is evaluated by calculating the average scores of the pre-test and post-test using the N-Gain Score test.

Have a data such in the table as shown in Table of 13. The whole N-Gain score of the mean in the control group is 0,4753 with medium category. A greater improvement in student learning outcomes in the experimental class. Auditing the results of the preliminary test, the first two classes have the same initial conditions. However, the two classes which had employed social media in the learning process produced different results. The abilities of students in the experimental class were more qualified. Moreover, according to the results of the study, the higher the student morale to learn, the greater the learning outcome. So, TikTok and Instagram with a multi-representational approach can help students to get better learning motivation and learning outcomes.

The features on TikTok and Instagram enhance students' comprehension of learning materials. For instance, Instagram's Reels feature allows students to engage with learning content through uploaded videos, often re-shared from TikTok. These videos utilize TikTok's editing tools, making them more engaging by incorporating text and sound. Additionally, TikTok's save feature enables students to download videos for offline viewing. The infographics shared on Instagram further aid understanding, as they provide relevant information on separation of groups I and II cations. With these features, the learning experience becomes much more enjoyable. These results match with the research done by Kusumadyahdewi and Kusumarasdyati (2021). Audio-visual features provide different learning styles to students, and they consider it useful and can maximize learning [25]. In addition, Audie (2019) explained that learning media is one of the most important supporting components in improving student learning outcomes and motivating students in learning, because the existence of learning media can significantly support the development of their intellect, especially in the learning process. The results of this study showed that learning media with an audio-visual type tended to be more effective than an audio or visual type [26].

The results presented show that integrating social media learning tools such as TikTok and Instagram with a multi-representational ing approach resulted in improved student motivation and improved learning outcomes. The students revealed the qualitative analysis of group I and II cations were of more interest to them, after the use of the media. This motivates the students to gain knowledge and with the better understanding of the material, they will have a great learning outcome. In contrast to the control class which showed lower learning outcomes, because the use of PPT media was considered boring and made the material uninteresting to learn. This corresponds with the findings of Nugroho et al. (2022), which indicate that the utilization of PowerPoint presentations as a pedagogical tool does not enhance student learning outcomes, primarily due to students' disengagement with the material presented by the teacher, as they perceive PPT-based learning to be monotonous [27].

5 Conclusion

The results showed that the application of the multi-representational based problem based learning model integrating tik tok and Instagram could significantly improve student learning outcomes (Mann Whitney U test, p = 0.000; Ha accepted) (mean post test experimental class = 82.00, control class = 61.73). The experimental class had a mean N-Gain score of 0.7369 (high category) and the control class had a mean of 0.4753 (medium category). This study also demonstrates an increase in students' interest in separation of group I and II cations with an increase from 25% to 30%, students understanding of separation of group I and II cations from 14% to 21%, achievement motivation from 42% to 48%, and activeness and student learning independence by 17% to 20%. Yet, using social media as media for learning could lead to student distraction when learning. Therefore, it is suggested to teachers and researchers who will conduct similar research to further maximize classroom conditioning so that the learning atmosphere is more conducive. Furthermore, analogous educational media may be created for the qualitative examination of cation groups III, IV, and V, along with additional chemistry topics necessitating audio-visual visualization with a multi-representational approach for further research.

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References

[1] S. Sahirman, *Analisis Kimia Dasar Kelas X Semester 2*. Jakarta: Direktorat Jenderal Pendidikan Dasar dan Menengah, 2013.

[2] R. T. Astuti, "Relevansi Kegiatan Praktikum Dengan Teori Dan Pemahaman Mahasiswa Pada Mata Kuliah Kimia Dasar Lanjut," *Orbital: Jurnal Pendidikan Kimia*, vol. 4, no. 1, pp. 16–30, 2020, doi: 10.19109/ojpk.v4i1.4336.

[3] D. Kurniasih and H. M. Rahayu, "Pengembangan Perangkat Pembelajaran Kimia Analitik Materi Kromatografi Berorientasi Inkuiri Terbimbing," *Jurnal Pendidikan Matematika dan IPA*, vol. 8, no. 2, p. 31, 2017, doi: 10.26418/jpmipa.v8i2.21173.

[4] R. Fathonah, M. Masykuri, and S. Saputro, "Pengembangan Multimedia Simulatif Kimia Berbasis Inkuiri Terbimbing pada Materi Analisis Kualitatif Kation Golongan 1," *Jurnal Inkuiri*, vol. 4, no. 3, pp. 2252–7893, 2015.

[5] S. S. Ali, "Problem Based Learning: A Student-Centered Approach," *English Language Teaching*, vol. 12, no. 5, p. 73, 2019, doi: 10.5539/elt.v12n5p73.

[6] J. Ferstephanie and T. Lady Pratiwi, "the Effect of Tiktok Platform To Develop Students' Motivation in Speaking Ability: a Classroom Action Research," *Wiralodra English Journal*, vol. 6, no. 1, pp. 1–12, 2022, doi: 10.31943/wej.v6i1.147.

[7] A. M. Rohim and D. Yulianti, “Pembelajaran Fisika Berbantuan Aplikasi Instagram untuk Meningkatkan Motivasi dan Hasil Belajar Siswa,” *Unnes Physics Education Journal Terakreditasi SINTA*, vol. 9, no. 2, pp. 149–157, 2020.

[8] H. B. Uno, *Teori motivasi dan pengukurannya*, 14th Editi. Jakarta: PT. Bumi Aksara, 2016.

[9] S. Saeed and D. Zyngier, “How Motivation Influences Student Engagement: A Qualitative Case Study,” *Journal of Education and Learning*, vol. 1, no. 2, pp. 252–267, 2012, doi: 10.5539/jel.v1n2p252.

[10] H. R. Widarti, D. A. Rokhmin, S. Yamtinah, A. S. Shidiq, and A. Baharsyah, “Instagram-Based Learning Media: Improving Student Motivation and Learning Outcomes in Reaction Rate,” *Jurnal Ilmiah Peuradeun*, vol. 12, no. 1, pp. 165–182, 2024, doi: 10.26811/peuradeun.v12i1.957.

[11] H. R. Widarti, M. Munzil, N. Zakia, D. A. Rokhim, A. B. Syafruddin, and Z. A. Rachmanita, “The Use of Integrated Learning Media of TikTok and Instagram Social Media on Student Learning Motivation on Cation Qualitative Analysis Materials Groups I and II,” *JCER (Journal of Chemistry Education Research)*, vol. 7, no. 1, pp. 169–177, 2023, doi: 10.26740/jcer.v7n1.p169-177.

[12] M. F. M. Salleh, R. A. A. Rauf, R. M. Saat, and M. H. Ismail, “Learners’ issues in the preparation and qualitative analysis of salts topics in chemistry: Teachers’ perspectives,” *European Journal of Science and Mathematics Education*, vol. 11, no. 3, pp. 392–409, 2023, doi: 10.30935/scimath/12789.

[13] H. R. Widarti, T. Anggraini, D. A. Rokhim, and A. B. Syafruddin, “Learning Innovation Content Creators Social Media-Based Qualitative Analysis to Improve Motivation and Learning Outcomes of Professional Teacher Candidates: A Systematic Literature Review,” *Orbital*, vol. 14, no. 4, pp. 267–275, 2022, doi: 10.17807/orbital.v14i4.16254.

[14] Sumiati, “PENINGKATAN MOTIVASI DAN HASIL BELAJAR DALAM PEMBELAJARAN KIMIA MELALUI PENERAPAN MODEL PEMBELAJARAN PROBLEM BASED LEARNING (PBL),” *Jurnal Ideguru*, vol. 3, no. 1, pp. 85–92, 2018, doi: 10.28926/riset_konseptual.v4i2.187.

[15] N. Islamiati, R. Rahmawati, and M. Haris, “Pengaruh Model Pembelajaran Berbasis Masalah Terhadap Hasil Belajar Kimia Siswa Kelas X MS SMAN 1 Kediri Pada Materi Reaksi Reduksi Dan Oksidasi,” *Chemistry Education Practice*, vol. 3, no. 2, p. 112, 2020, doi: 10.29303/cep.v3i2.2044.

[16] H. R. Widarti and T. Sriwahyuni, “Social media-based learning in Chemistry learning : A review,” vol. 48, pp. 17–21, 2023, doi: 10.26850/1678-4618eqj.v48.2.2023.p.

[17] C. Dini, E. E. Putri, N. Izzah, and Y. E. Puspitasari, “Penggunaan Video Berbasis Tiktok Pada Pembelajaran Era Masyarakat Digital,” *PROCEEDINGS Seminar Nasional Pembelajaran Bahasa dan Sastra (SELASAR)*, p. 5, 2019.

[18] D. Y. Rokayah, D. A. Rokhim, H. R. Widarti, and A. B. Syafruddin, “IMPLEMENTATION OF INSTAGRAM MEDIA: INFOGRAPHICS AS A POWERFUL FOR STUDENT EXPRESSION OF ART BASED ON HYDROCARBON MATERIALS,” *Jurnal Pembelajaran Sains*, vol. 5, no. 2, pp. 66–71, 2021.

[19] N. Sudjana, *Penilaian hasil proses belajar mengajar*. Bandung: Remaja Rosdakarya, 2006.
[20] I. Lestari, "Pengaruh Waktu Belajar dan Minat Belajar terhadap Hasil Belajar Matematika," *Formatif: Jurnal Ilmiah Pendidikan MIPA*, vol. 3, no. 2, pp. 115–125, 2015, doi: 10.30998/formatif.v3i2.118.
[21] C. Elde Mølstad and B. Karseth, "National curricula in Norway and Finland: The role of learning outcomes," *European Educational Research Journal*, vol. 15, no. 3, pp. 329–344, 2016, doi: 10.1177/1474904116639311.
[22] Sunarti Rahman, "Pentingnya Motivasi Belajar Dalam Meningkatkan Hasil Belajar," *Prosiding Seminar Nasional Pendidikan Dasar*, no. November, pp. 289–302, 2021.
[23] D. R. Arianti and K. Hadi, "Pengembangan Video TikTok Berbasis Stream (Science, Technology, Religiosity, Engineering, Art, And Mathematics) Pada Materi Larutan Penyangga," *Jurnal Pendidikan Kimia dan Terapan*, vol. 7, no. 2, pp. 72–82, 2022.
[24] A. Mekler, "The Effects of TikTok Use on College Student Learning The Effects of TikTok Use on College Student Learning," vol. 16, pp. 145–153, 2021.
[25] Kusumadyahdewi and Kusumarasdyati, "Learners' Perceptions about TikTok Tutorial Videos as Instructional Media in Learning Statistics," *Letters in Information Technology Education (LITE)*, vol. 4, no. 2, pp. 80–85, 2021.
[26] N. Audie, "Peran Media Pembelajaran Meningkatkan Hasil Belajar Peserta Didik," *Prosiding Seminar Nasional Pendidikan FKIP (Vol. 2, No. 1, pp. 586-595).*, vol. 2, no. 1, pp. 589–590, 2019.
[27] A. Nugroho, Marji, and Paryono, "PENERAPAN GAME CAR MECHANIC SIMULATOR BERBASIS ONLINE PADA KOMPETENSI MENERAPKAN CARA PERAWATAN SISTEM SUSPENSI TERHADAP HASIL BELAJAR DAN MOTIVASI BELAJAR SISWA DI SMKS PAWYATAN DAHA 3 KABUPATEN KEDIRI," *JURNAL TEKNIK OTOMOTIF Kajian Keilmuan dan Pengajaran*, vol. 6, no. 2, pp. 35–40, 2022.