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# THE IMPACT OF ONLINE LEARNING IN CHEMISTRY ON STUDENT INTEREST, MOTIVATION AND LEARNING OUTCOMES

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**ABSTRACT**

Unstable network connections, including chemistry learning, often hamper the implementation of online learning during a pandemic. The study aims to investigate the effects of online learning on chemistry students' interest, motivation, learning outcomes, and the challenges faced during the implementation. The method used is a quantitative method with descriptive research. Using the proportional stratified random technique, this study determined 72 high school students (33 boys and 39 girls). In online learning, data is collected using student and teacher response questionnaires. In addition, student reactions to teacher efforts in online learning. Then, interviews with teachers and students were conducted. Questionnaires and interview guidelines were used as research instruments. Data analysis techniques were used to determine respondents' level of achievement using the percentage formula (TCR). The study's findings revealed that the average response value for learning interest was 76%, motivation was 79%, and learning outcomes were 75%. Students achieve a minimum completeness criterion score of 81% for eleventh-grade students in the science program and 89% based on the results of the chemistry test scores in online learning. The study concludes that while online learning positively impacts students' interest, motivation, and learning outcomes, there are significant barriers identified by respondents, such as a less stable internet network, for further research is expected to be able to update the data taken by researchers.

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## INTRODUCTION

The Minister of Education and Culture in Indonesia initiated a policy of remote learning, specifically tailored for educational institutions, to respond to the pandemic. This strategy utilizes a distance learning model that enables students to study from their homes. This approach integrates remote work and electronic collaboration, which gained prominence during the coronavirus outbreak [1]. Consequently, transitioning from traditional classroom settings to virtual classes becam,e the predominant solution to address the challenges posed by the pandemic [2]. However, assessing how online learning impacts students' comprehension of chemistry subjects is imperative. Online education is conducted online as a platform for delivering educational content. This mode of learning involves modern-person interactions between

educators and students, relying instead on various virtual applications [3]. Learning, in this context, can be defined as the process of assimilating knowledge within the online environment, involving educators and learners, facilitated by instructional materials, techniques, and content that are aligned with the standards of Indonesian education, the curriculum 2013 framework, as well as the independent curriculum [4].

Online learning makes teaching and learning more student-centered, innovative, and flexible. It provides a learning experience using various internet-enabled devices in a synchronous or asynchronous environment [31]. Within this context, students can learn and interact with teachers from anywhere [5]. Teachers must also be able to create online media and materials in the teaching and learning process, such as using multiple platforms, social media, and other online sources to increase student motivation, interest, and learning outcomes [6]. Online learning is not just material transferred via Internet media and questions sent through social media applications. However, it must be planned, implemented, evaluated, and learned in class. Based on the findings [7], learning through the network has potential capabilities, including the meaning of learning, ease of access, and improving learning outcomes. Online learning provides effective methods, such as practicing with feedback regarding incorporating collaborative self-learning activities [8].

Utilizing the internet network in the learning process gives students the flexibility of study time. Students can interact with teachers using applications such as classroom, video conferencing, telephone or live chat, Zoom, or WhatsApp group [32]. According to [9], educator considers that online learning can help students build learning autonomy and help them meet their learning needs. In chemistry learning, students have difficulty understanding terms and chemical concepts and with formulas or mathematical operations in chemistry lessons. One way to boost teacher motivation, interest, and learning outcomes is to use a variety of pleasant learning environments so that students are not bored while learning and their learning outcomes improve [10,39]. Students' interest in learning a material is another important factor that can influence their level of understanding [11]. Students must learn independently to complete a task. Students must be responsible for constructing cognitive, psychomotor, and affective knowledge [12,37].

The concept of online learning is relatively novel. Adequate preparation of diverse tools and infrastructure, including smartphones, computers, laptops, and most crucially, a reliable internet connection or data plan, along with other supportive amenities to ensure seamless learning continuity. However, integrating technology into education encounters challenges, such as limited technological proficiency, insufficient infrastructure and resources, and occasional connectivity issues. Adopting Online Learning applications has become nearly ubiquitous across various educational institutions in Indonesia, spanning all academic levels. This transition has influenced every subject taught in schools,

including chemistry. Furthermore, within chemistry education, instructors are tasked with fortifying foundational concepts, enabling an enhanced grasp of intricate chemistry principles and consequently fostering improved academic achievements among students [32,36].

According to the research findings [13], online learning has the potential to develop capabilities such as increasing learning motivation, learning interest, and learning outcomes. The teacher's feedback encourages students to be more active and independent in their online learning. According to the implementation of online learning, as many as 81% of teachers provide teaching with video/YouTube type to make the material easier to understand and to attract students' learning interest. Online learning can positively impact participation in core courses, especially by reducing anxiety about the radiation of chemicals used and keeping the distance between students so that they are not exposed [33,40]. In general, students have a very strong interest and motivation to learn to take part in learning during a pandemic [14]. Furthermore, during the COVID-19 pandemic, students' response and interest in online chemistry learning in most research showed a positive relationship, especially when there was a fast and significant ase in applying learning and information technology [15].

## METHODS

### 1. Research setting and participant

This research was conducted at a public school in Seunagan District, Nagan Raya District, Aceh Province. The public school is one of the schools that has complete science laboratory facilities, so it is the favorite and the best in Nagan Raya Regency, which is geographically located on the West coast of Aceh Province, which is about 236 Km from Banda Aceh City. This research was conducted in December 2022. There were 72 students of tenth and eleventh grade in the science program as participants, consisting of 33 male and 39 female students. There are 2 teachers in chemistry subject studies who are female.

### 2. Research design

The method used in this research is descriptive quantitative. This method is suitable for investigating the impact of online learning on students' chemistry test scores, interest, and motivation. The data collected is based on information on the information provided by the respondents, so the data obtained is processed by researchers based on units of numbers. The quantitative method can be interpreted as a research method based on philosophy positivism [24, 41].

### 3. Sampling technique

The sampling technique in this study is probability sampling. The sample selection was based on consideration of test scores during the online learning period. The number of active students was 240, distributed in 8 science classes consisting of 4 classes in tenth grade and 4 classes in eleventh grade; it was determined that 30% (9 students) from each class as a sample, so 72 students were obtained. The selection of 9 students from each class was carried out randomly, bringing the total to 72 students.

The choice of 2 teachers was made randomly from 4 chemistry teachers.

**4. Data Collection Methods**

The data collection technique used by the instrument consisted of questionnaires and interviews. The questionnaire uses the Google Form instrument, sending a link to each student and teacher. Teacher response questionnaire sheets by students during online learning contain 23 questions divided into several variables. The online learning variable contains 9 questions, the interest variable contains 7 questions, the motivation variable contains 4 questions, and the learning outcome variable contains 3 questions. The teacher's response questionnaire to the learning problems they face contains 20 questions. From each question provided, each student and teacher can give a score of 1-5 with the answer choices strongly disagree, disagree, undecided , agree , and strongly agree.

The interview activity was carried out using the media Zoom meeting. Interviews were conducted to find out the things of the respondents in more depth and to collect data starting from the process, implementation, and planning, as well as being able to reinforce the respondents' answers. Guidelines for interviewing teachers and students each contain five questions.

**Table 1.** Qualification TCR

| No | Respondents achievement (%) | Criteria |
|---|---|---|
| 1 | 85-100 | Very Good |
| 2 | 66-84 | Good |
| 3 | 51-65 | Enough |
| 4 | 36-50 | Not Enough |
| 5 | 0-35 | Not Good |

The data obtained from the study's findings were descriptively analyzed using the respondent achievement level formula (TRC).

$$TCR = \frac{\text{Score average}}{\text{Maximum Score}} \times 100\% \quad \text{.....(1)}$$

where, TCR = Level of achievement of respondents.

**Ethical considerations**

This new research activity was carried out after obtaining permission from the Aceh Provincial Education Office. Questionnaire data and the results of interviews with teachers and students are well-guarded and guaranteed confidentiality, so no party is harmed.

## RESULTS AND DISCUSSION

**1. Student responses to online learning**

The data processing results showed that students responded to online learning in a very good category: an average of 3.90 and a TCR value of 78%. The data provides student responses that they agree with the application of online learning models used in situations and conditions that require them to learn remotely. They are enthusiastic and curious and actively utilize technological media to smoothen learning. Using online learning models in chemistry subjects can increase student independence, enable them to be more active in using ideas and creativity, and take the necessary initiatives [34,35]. According to research [16], 76% of respondents in the study preferred the online learning process, stating that online learning provides convenience and flexibility of access anywhere and at any time through technology. Research [17] During the Covid-19 pandemic, 36% of students and 41% were satisfied with online learning.

The learning interest variable has a TCR of 76% and an average of 3.78. (agree category). Respondents agreed that online

learning in chemistry lessons can increase students' interest. The study's findings demonstrate that online learning can increase students' interest in chemistry. According to the research findings, students have a positive attitude and interest in learning. This is similar to research [15], which found that the frequency of interest in online learning is quite good, with 71.5% of respondents responding positively. Research [18] shows that the average observed interest and motivation is 77.68%. As a result, respondents had a strong interest and motivation to participate in the online learning process during the COVID-19 pandemic.

Students average 3.94 in the learning motivation variable, with a TCR of 79%. (agree category). Students expressed a strong belief that online chemistry learning could boost learning motivation. The study's findings indicate that online learning in chemistry subjects can boost learning motivation. This demonstrates the importance of motivation in learning in cultivating a sense of fun, passion, and passion for learning. A similar study [19,38] found that the learning motivation of students in tent grade in MAN 1 Lamongan during online learning was 71% for the very high category, 27% for the high category, and 0.82% for the low category. According to research [20], online learning positively impacts student motivation, with an average score of 63% for indicators of attention, 65% for interest, 71% for activity, 65% for satisfaction, and 72% for confidence.

**Table 2.** Analyze The Chemistry Test Scores Obtained by Tenth and Eleventh Grade Students in The Science Program.

| Subjects | minimum passing threshold | Class | Number of Students Who Get Grades | | | | Amount |
|---|---|---|---|---|---|---|---|
| | | | A (Very Good) 89 < A ≤ 100 | B (Good) 79 < B ≤ 89 | C (Enough) 70 ≤ C ≤ 79 | D (Need Guidance) D < 70 | |
| Chemistry | 75 | Tenth Science 1 | 2 | 16 | 9 | 4 | 31 |
| | | Tenth Science 2 | 3 | 13 | 13 | 8 | 37 |
| | | Tenth Science 3 | 10 | 10 | 8 | 6 | 34 |
| | | Tenth Science 4 | 3 | 6 | 8 | 5 | 22 |
| Number of Class Tenth grade in Science Program | | | | | | | |
| Students | | | 18 | 45 | 38 | 23 | 124 |
| Percentage | | | 14.50 | 36.30 | 30.65 | 18.55 | 100 |
| The number of students who passed the minimum passing threshold | | | | | 101 (81.45%) | | |
| Chemistry | 75 | Eleventh Science 1 | 15 | 10 | 9 | 3 | 37 |
| | | Eleventh Science 2 | 17 | 9 | 5 | 5 | 36 |
| | | Eleventh Science 3 | 11 | 15 | 7 | 3 | 36 |
| | | Eleventh Science 4 | 11 | 10 | 9 | 4 | 34 |
| Number of Eleventh Grade Students | | | 54 | 44 | 30 | 15 | 143 |
| In Science Program Percentage | | | 37.77 | 30.77 | 20.98 | 10.48 | 100 |
| The number of students who passed the minimum passing threshold | | | | | 128 (89.52%) | | |

The variable of learning achievements holds an average score of 3.76 and a TCR (Total Coefficient of Response) of 75%, signifying the consensus among students that online learning can enhance academic outcomes and serve as a metric for gauging accomplishment. A successful learning process implies that all participating students attain the predefined competencies. Moreover, investigating the chemistry test scores of tenth and eleventh-grade students in the science program within online learning made it evident that many students had yet to attain the minimum passing threshold.

Examination outcomes reveal that among 124 tenth-grade science program students, 101, or approximately 81.45%, secured scores surpassing the minimum passing threshold for the chemistry subject assessment, garnering grades in the A, B, and C categories. However, a notable 23 students, 18.55%, received a D grade. Correspondingly, the eleventh-grade science program cohort encompasses 143 students, of which 128 students, accounting for 89.52%, exceeded the minimum passing threshold benchmark, while 15 students, or 10.48%, did not. Based on these insights, it becomes apparent that the fusion of respondents' questionnaire feedback and data from chemistry test scores during online learning culminated in favorable academic outcomes.

Concomitantly, research outcomes [21] underscore the affirmative impact of online learning on student learning achievements, recording a frequency of 70%. Additionally, students achieved a 71% rating, indicative of a moderately good criterion, with their average learning outcomes across the three schools where the study was conducted surpassing the minimum passing threshold score of 75%. The average learning outcome values were reported as 77.30%, 79%, and 76% in the respective institutions [22].

**2. Teacher Response to Online Learning**

Based on the data processing results, it is clear that online learning meets the demands of educational development in the current digital era, with an average score of 4.52 and a TCR of 90%, with which the category strongly agrees. This demonstrates how education in the digital age can improve the effectiveness and flexibility of chemistry learning. Chemistry subject matter can be accessed anytime and from anywhere via online learning, and it can also be enriched with various learning resources such as multimedia and quickly updated by the teacher. Chemistry teachers can design chemistry learning designs that will be implemented in their respective classrooms, physically and virtually, as facilitators for organizing activities. The teacher's role in developing learning activities must be able to engineer interesting, varied, repetitive, and increasing student learning experiences.

The findings from the study [23] indicated that the mean score of questionnaires administered to educators was 3.91 or 78%. Following the established criteria, it is evident that teachers respond positively to online learning and are adequately prepared for its execution. Another study [24] demonstrated that the mean outcomes of alternate responses regarding motivation fall within the agreement bracket, approximately 70%, underscoring that online learning can inspire instructors to enhance their teaching competencies and capabilities.

**3. Student responses to teachers' efforts in online learning**

An educator is responsible for the teaching that goes well. This success depends a lot on the efforts of educators to generate interest and motivation in learning for students and will affect their learning outcomes.

Table 3 shows the average value of students' responses to teachers' efforts to implement online learning in chemistry

subjects is 3.90, with a TCR of 78%. Students respond positively to the teacher's efforts. Students agree that learning is a subset of education that requires a teacher to continue teaching even in extreme circumstances, such as a pandemic. In chemistry lessons, the learning process is carried out using an online system that uses existing technology. Furthermore, it was obtained at 3.94 with a TCR of 79% based on the results of the average student response to the learning interest variable (good category). Furthermore, with a TCR of 78%, the motivation variable to learn chemistry received an average of 3.91. The response on the learning outcomes variable was good, with an average of 3.97 and a TCR of 79%. According to students, this average result is possible if the learning objectives are clearly stated.

**Table 3.** Student Responses to Teachers' Efforts to Implement Online Learning

| Variable | N | Score | Mean | TRC (%) | Detail |
|---|---|---|---|---|---|
| Online learning | 648 | 2529 | 3.90 | 78 | Good |
| Interest to learn | 504 | 1983 | 3.94 | 79 | Good |
| Motivation to learn | 288 | 1128 | 3.91 | 78 | Good |
| Learning outcomes | 216 | 858 | 3.97 | 79 | Good |

What is important in the effort to achieve these learning objectives is students' interest. The teaching and learning process will be effective if the students are enthusiastic. This interest will also have an impact on students' learning outcomes. This is the teacher's role as a motivator. The teacher tries to motivate students to be interested in and pay attention to these subjects. According to [25], learning outcomes are the most important factor in learning because they describe students' understanding of the material the teacher presents. The teacher gave a positive response to the online learning that was carried out. This is driven by the desire to continue learning despite the pandemic. In addition, they get the opportunity to develop themselves by applying technology in their learning, motivating students to always be patient in facing all trials from the creator. In addition, teachers can increase their creativity by utilizing electronic media to support their learning [34,35,39].

Assessment of learning outcomes can provide teachers with an overview of student's progress toward achieving learning objectives. Learning outcomes define the abilities, skills, knowledge, or measurable values that students must possess [26]. In this case, the teacher must be able to optimally develop all students' potential by developing an encouraging and motivating teaching and learning process.

## 4. Interview Results Of Teachers And Students

Various problems or obstacles arise during the online learning process. Learning barriers interfere with students' concentration or focus on understanding the material presented [27]. Thus, learning barriers are anything that can become an impediment to learning. Because online learning is heavily reliant on advances in information technology, it is unavoidable that students will face obstacles and learning difficulties. This can impact low learning achievement, even create a difficult situation, and lead to a sense

of hopelessness, forcing students to pull over in the middle of the road.

According to the findings of the interviews, the teacher used WhatsApp, Google Meet, and video media in the online learning process. Teachers must be completely prepared with the media and material they will teach in online learning. Research [28] shows that PowerPoint media has the highest percentage, namely 60%, of students feeling enthusiastic and motivated to learn when teachers use PowerPoint learning media. According to research [29], up to 86% of Google Classroom and Zoom meeting applications are learning media that positively impact online learning. Then, there are the challenges of online learning, such as the internet network. In contrast, an internet connection is required for teachers and students to learn online. According to research [30], up to 75% of students complained about the instability of the internet network, which made it difficult for them to absorb the material delivered by the teacher.

## CONCLUSION

Based on the results of the study, there was an effect of online learning in chemistry subjects on students' learning interest at a public high school in Seunagan, with an average student response score of 3.78, a TCR of 76%, and an average score of teacher effort of 3.94 and a TCR of 79%. Online learning in chemistry affects student learning motivation, with an average student score of 3.94, a TCR of 79%, an average score of teacher effort of 3.91, and a TCR of 78%. Online learning in chemistry subjects affects learning outcomes, with an average student response score of 3.76 and a TCR of 75%, an average teacher effort score of 3.97 and a TCR of 79%. After conducting research, it was identified that the internet network was the main obstacle to implementing online learning in chemistry subjects on students' interest and learning motivation at a public high school in Seunagan. Internet network is a basic requirement for teachers and students in online learning. However, with these obstacles, teachers can still send material when the network is stable, and students can repeat learning material anytime and anywhere. It was proven during the research that students could cope with the conditions during their learning.

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