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RESEARCH ARTICLE
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Exploring Students' Attitudes Towards Open Lessons Conducted by Physics Teachers

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Abstract: This study examines secondary school students' attitudes and perceptions regarding Open Lessons conducted by physics teachers in Kazakhstan. Employing a quantitative research design, the study explores variations in student perceptions based on gender, grade level, and academic performance, assessing how these factors influence engagement, perceived effectiveness, and emotional responses. Data were collected from a sample of 566 students across diverse school settings in Kazakhstan. Exploratory and confirmatory factor analyses identified three key dimensions of perception: Attitude, Belief, and Negative Perception. The findings indicate that female students and high academic achievers reported more favorable experiences, particularly in terms of lesson clarity, motivation, and teacher enthusiasm. Conversely, older students (especially 12th graders) exhibited greater skepticism, perceiving a decline in the authenticity and relevance of Open Lessons. Additionally, students with higher academic achievement demonstrated greater receptiveness to innovative teaching methods. These results underscore the pedagogical value of Open Lessons in physics education while emphasizing the need for lesson design to align with student needs and subject complexity. The study suggests that differentiated instructional strategies, tailored to learner profiles, could enhance the efficacy of Open Lessons and improve learning outcomes in science education.

Keywords: physics education, open lesson, student perception, teacher development, academic achievement, gender differences, Kazakhstan

INTRODUCTION

An Open Lesson is a unique class organized by a skilled educator to showcase their knowledge and experience to fellow teachers, school leaders, or the general public. The role of innovation and the creative practices of educators has become essential in today's education system. In this context, Open Lessons serve as a valuable tool for teachers to exchange ideas, particularly in scientific fields such as physics (Alekseeva, M., & Mednikov, N., 2004). During these physics Open Lessons, educators frequently employ engaging and innovative techniques to clarify difficult subjects and enhance student interest in learning (Sekerin et al., 2017; Rashidova, 2014). Open Lessons are commonly implemented in the educational frameworks of Kazakhstan and the countries within the Commonwealth of

Independent States.This format is also seen in international practice—for example, open lesson in Japan (Miyakawa & Winsløw, 2013), open class in China (Liang, 2011; Wu & Clarke, 2018), and public research lessons in the USA (Lewis et al., 2006). In Europe, the Open Lesson corresponds to the demonstration class format (Grierson & Gallagher, 2009). A common feature of these lessons is the integration of innovative approaches into teaching and the opportunity for teachers to observe and learn from each other's methods (Clarke & Hollingsworth, 2002).

Although the open lesson approach is widely used in CIS countries, scientific research remains insufficient. Most of the existing studies focus on methodology and organizational aspects of open lessons (Ilayeva, 2017; Sekerin et al., 2017; Rashidova, 2014). The attitudes and beliefs of students towards open lessons have not yet been sufficiently studied. These constructs are crucial, as they influence whether students are engaged and whether teachers adopt innovative strategies (Shen et al., 2007; Sun et al., 2015). In order to expand the existing body of literature, this study examines student attitudes towards open lessons in physics, with attention to gender, grade level, and year-end assessments.

This research paper may be of interest to scholars for two main reasons. First, it allows exploration of the specificities of open lessons across different countries—currently, available studies mostly represent Japan (Miyakawa & Winsløw, 2013), China (Liang, 2011; Wu & Clarke, 2018), the USA (Lewis et al., 2006), and a few European cases (Grierson & Gallagher, 2009). Second, it offers a comparative perspective on student attitudes and beliefs about open physics lessons in contrast to those in other subjects.

The research was conducted based on the following key questions:

- What are the beliefs and attitudes of students towards Open Lesson?
- Do the beliefs and attitudes differ across gender, grade level and end-term marks for students?

LITERATURE REVIEW

The Aims of Open Lessons in Physics

An open lesson is an organized and publicly observed learning session designed to demonstrate effective teaching methods and encourage participants to reflect on their workplace. Observers, such as peers, facilitators, or school administrators, observe the session and evaluate content, methods, and student participation. This format is aimed at both student learning and the continuous development of teachers (Abdulbakioglu et al. 2022).

By providing a structured teaching demonstration in a public setting, open lessons encourage the exchange of ideas and teaching methods among peers. Educational programs are particularly important in Kazakhstan and other CIS countries, where they are an important part of school practice and teacher assessment (Abdulbakioglu et al. 2022). Open lessons allow teachers in physics and other fields to demonstrate scientifically proven teaching, use modern teaching methods, and receive feedback for improvement from observers.

Physics is often considered abstract and difficult to relate to everyday experience. In physics, the goal of Open lessons inquiry is to integrate theories and practices. One of the goals of physics instruction is to develop students' scientific thinking and teach them the ability to use physical concepts to explain everyday situations. Physics instruction should include demonstration experiments, visual models, and focused discussions to help students better understand laws and principles (Feshchenko, 2012).

When learning is focused on exploration, experimentation and application of knowledge in real situations. This helps develop students' cognitive skills, their independence and broaden their horizons with the help of physical aids. This helps achieve the goals of educational development.

While models such as Japanese Lesson Study emphasize ongoing collaboration and exploration of students' knowledge, open lessons are typically structured as demonstrations during individual sessions designed for assessment and professional feedback. To assess student progress, Lesson Studies involve cycles of group planning, observation, and subsequent analysis. Unlike open lessons, which are one-time events, classroom studies encourage ongoing, inquiry-based collaboration among teachers. Although the two methods are different, both emphasize the value of self-reflection and public education. (Takahashi & McDougal, 2016).

Application of Open Lessons in Physics Classrooms

Open lessons in physics are usually structured in the following sequence: choosing a topic that is important to the students, planning activities that actively involve the students, teaching under observation, and conducting reflection after the lesson. Topics that involve phenomena that are easy to illustrate with examples or models, such as Newton's laws of physics, electricity, or optics, are often chosen by teachers.

It is very important to prepare well for open lessons. For an open lesson, teachers prepare a complete set of documents, including supporting materials, assessment tools, lesson plans, and learning objectives (Abdulbakioglu et al. 2022). In physics, this may also include experimental setups, equipment safety checks, data collection sheets, and demonstration materials.

Observers are fellow teachers, methodologists, or school administrators who evaluate the Open Lesson using an observation guide. Open Physics Lessons focus on how effectively the teacher connected abstract ideas with illustrations or real-life examples, how students responded to problem-solving tasks, and whether misconceptions were corrected. Observer feedback helps evaluate the teacher's interactions with complex material, the sequence of the lesson, and the effectiveness of the activities chosen.

Evaluation of Open Lessons and Their Influence on Students

Evaluation of open-ended physics lessons should go beyond the presentation and include the students' learning experience. According to Abdulbakioglu et al., 2022, the participants in their study, both teachers and university students, were slightly positive about open-ended lessons. Students rated the clarity, structure, and engagement strategies of open-ended lessons highly, especially when compared to traditional lessons.

At the same time, students' responses were more restrained in the sciences, such as physics. Social students were more interested in open lessons than physics students. Thus, the complexity of physics content may still be a barrier to student participation, despite the fact that teachers perform better during open lessons.

Teaching physics using inquiry-based activities has been shown to result in higher academic achievement and improved student attitudes towards the subject (Tekin & Muştu, 2021). This is consistent with the findings of Hazari et al. (2009) who emphasized the importance of making physics lessons more relevant to students' experiences. As a result, the effectiveness of open-ended physics lessons largely depends on how well the lesson is structured to help students connect theory with the phenomena they see in their daily lives.

Research on Students' Attitudes Toward Physics Open Lessons

Although most studies of open lessons focus on teacher development, recent studies have focused on student attitudes. Students who observed or participated in open lessons rated the teacher's effort, clear explanations, and interactive methods used (Abdulbakioglu et al. 2022). However, due to the presence of observers, fear of being asked questions, or pressure to not complete assignments, some students felt uncomfortable in open lessons.

Student behavior in physics education is closely related to teaching methods. Active learning and real-world application, methods that are often emphasized in open lessons, can mitigate students' perceptions of physics as difficult or irrelevant (Hazari et al., 2007). Furthermore, gender differences in attitudes toward physical exercise have been found to persist, with female students reporting lower levels of confidence even when their performance is comparable to that of their male peers (Yerdelen-Damar & Ai, 2018).

Influence of Gender, Grade Level, and Academic Performance

One of the objectives of this study is to find out whether students' attitudes toward open-ended lessons differ based on gender, grade level, or academic achievement. Science education has shown that these variables can significantly influence what students think. Students with higher academic achievement are more likely to respond positively to innovative teaching methods such as open-ended lessons because they feel more confident interacting with the material (Wilson, 2006).

In addition, the level of learning matters. According to Osborne et al. (2003), as students progressed through secondary school, their interest in science decreased. Older students may be more focused on exams and less inclined to open-ended exploration and experimental activities, while younger students may show more enthusiasm. This means that in the context of open-ended lessons, students' age and stage of development may influence how they perceive and evaluate Open Lessons in physics.

METHODOLOGY

This study used quantitative research methods. A survey was conducted to collect data from school students to gain insights into their attitudes toward open lessons conducted by physics teachers.

Instrument

A special questionnaire was developed to investigate students' opinions, experiences and attitudes towards open physics lessons. Its structure and content were based on the results of previous studies (Abdulbakioglu et al., 2022) and checked by experts for validity and relevance.

The questionnaire consisted of two parts. The first part, demographic information, in which data about the student were collected: gender, grade, and physics performance. The second part, questions related to open classes, included 15 statements aimed at finding out students' opinions about teaching effectiveness and learning outcomes of open classes.

The Sample Specification

This study examined the perceptions and experiences of students who participated in open physics lessons across schools in Kazakhstan. The sample consisted of 566 students, representing a diverse range of grade levels and academic performance groups. The participants were selected from various schools to ensure a broad representation of student perspectives from different educational contexts.

The student participants were categorized according to three key characteristics: gender (male/female), grade level (8th grade, 9th–10th grades, and 12th grade), and end-term marks (graded as 3, 4, or 5). This stratification enabled a more detailed analysis of how students' academic performance and educational stages influenced their perceptions of open physics lessons.

Furthermore, the geographic diversity of the sample, encompassing different regions of Kazakhstan, enhances the generalizability of the study's findings. By including students from multiple school environments, this research provides a more comprehensive understanding of how open lessons in physics are experienced, evaluated, and valued across the country.

Data Collection

The survey was distributed via Google Forms and offered in three languages—English, Kazakh, and Russian—to ensure accessibility for all participants. The original survey items were developed in English and carefully translated into Kazakh and Russian to maintain clarity and accuracy.

The questionnaire included two main sections. The first collected demographic details, such as gender, age, grade level. The second section explored participants' perceptions and experiences with open lessons, using a five-point Likert scale to gauge their responses.

Participation was voluntary and anonymous, as emphasized in the Ethical Approval Request included in the survey. This approach encouraged respondents to provide honest and unbiased feedback, fostering a safe environment for sharing their perspectives.

Data Analysis

The collected data were analyzed using Jamovi statistical software. Initially, an Exploratory Factor Analysis (EFA) was conducted to identify the underlying dimensions within students' responses. This was followed by a Confirmatory Factor Analysis (CFA) to validate the identified factor structure.

Subsequently, a descriptive analysis of the factors was performed to gain insights into students' attitudes and beliefs towards Open Lessons. This analysis revealed distinct patterns in the mean scores for each factor, highlighting the overall perceptions of students regarding their engagement and the effectiveness of teaching methods employed during these lessons.

To further explore the data, differences based on gender were analyzed using an Independent Samples t-test. Additionally, variations in perceptions among students grouped by grade levels (8th, 9th–10th, and 12th grades) and end-term marks (3, 4, and 5) were assessed through separate One-Way ANOVA tests. Statistical significance was evaluated at a threshold of $p \leq 0.05$, ensuring a robust examination of the factors influencing students' attitudes towards Open Lessons.

This comprehensive approach provides a nuanced understanding of the data, setting the stage for the subsequent presentation of results.

RESULTS

Factor Analysis:

To establish the psychometric properties of the newly developed instrument measuring students' perceptions of open lessons, we conducted both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). This analytical approach was necessary given the absence of prior validation studies for this instrument and the need to identify its underlying factor structure.

Exploratory Factor Analysis

Prior to conducting the EFA, we assessed the suitability of the data for factor analysis. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was .859, indicating meritorious adequacy for factor analysis (Kaiser, 1974). Bartlett's test of sphericity was significant ($p < .001$), further confirming the appropriateness of factor analysis (see Appendix A for detailed KMO results). All individual measures of sampling adequacy (MSA) exceeded .60, meeting the minimum threshold for inclusion (Hair et al., 2019).

We conducted an EFA using the minimum residual extraction method with oblimin rotation to allow for correlated factors. The analysis was performed on data from 566 participants. Items with factor loadings below .40 were considered for removal to ensure adequate factor structure (Stevens, 2012).

Table 1 displays the factor loadings for all items following the EFA procedure.

Table 1. Exploratory Factor Analysis Results

	Factor			
	1	**2**	**3**	**Uniqueness**
Q1		0.505		0.658
Q2		0.509		0.632
Q3		0.640		0.561
Q4		0.601		0.623
Q5		0.665		0.474
Q6				0.755
Q7			0.430	0.752
Q8	0.641			0.593
Q9	0.709			0.522
Q10	0.685			0.533
Q11	0.492			0.447
Q12	0.609			0.587
Q13			0.809	0.349
Q14			0.786	0.364
Q15	0.489			0.704

Note. 'Minimum residual' extraction method was used in combination with a 'oblimin' rotation

The EFA yielded a three-factor solution that accounted for 43% of the total variance. One item ("Open lesson is too time-consuming") was removed due to insufficient loading (< .40). The remaining items demonstrated clear factor structure with minimal cross-loadings. The three factors were interpreted as: (a) Attitude toward open lessons (6 items: Q8, Q9, Q10, Q11, Q12, Q15), (b) Belief about open lessons (5 items: Q1, Q2, Q3, Q4, Q5), and (c) Negative Perception of open lessons (3 items: Q7, Q13, Q14). All retained items loaded substantially on their respective factors (loadings ≥ .40), supporting the interpretability of the factor solution.

Confirmatory Factor Analysis

Following the EFA, we conducted a CFA to test the validity of the three-factor model using maximum likelihood estimation. The CFA was performed to confirm whether the factor structure identified in the exploratory phase adequately represented the data.

Initially, all 14 items were included in the CFA model. However, Item Q7 ("Teachers do not seem genuine in teaching Open Lesson") demonstrated a low standardized factor loading of 0.367 and was excluded from the final model to improve overall model fit and factor clarity (see Table 2). This removal was consistent with established guidelines for maintaining adequate factor structure (Hair et al., 2019). Following this adjustment, the model retained a three-factor structure. It is worth noting, however, that the Negative Perception factor was ultimately represented by only two items (Q13 and Q14), which may limit the robustness and reliability of this construct. Future research should consider expanding this dimension to enhance its psychometric strength.

Following the item removal, modification indices suggested correlations between error terms for certain items: Q8 and Q9, Q10 and Q9, and Q12 and Q8. These modifications were theoretically justifiable as they reflect related constructs of student engagement and perceived learning. After applying these modifications, the model demonstrated improved fit indices.

Table 2 presents the standardized factor loadings, standard errors, critical ratios, and significance levels for each item in the final three-factor model, including details of the item removal and model modifications performed.

All factor loadings in the final model were statistically significant ($p < .001$) and ranged from .516 to .988, indicating strong relationships between observed variables and their respective latent constructs. The standardized factor loadings exceeded the minimum threshold of .50 recommended for adequate convergent validity (Hair et al., 2019), supporting the factorial validity of the three-factor structure. The error term correlations added to the model were modest and theoretically defensible, enhancing model fit without compromising the interpretability of the factor structure.

Table 2. Confirmatory Factor Analysis Factor Loadings and Model Modifications.

Factor	Indicator	Estimate	SE	Z	p	Stand. Estimate
Attitude	**Q8**	0.549	0.0428	12.82	<.001	0.560
	Q9	0.554	0.0402	13.77	<.001	0.592
	Q10	0.616	0.0412	14.96	<.001	0.630
	Q11	0.718	0.0364	19.72	<.001	0.780
	Q12	0.642	0.0413	15.52	<.001	0.647
Belief	**Q1**	0.516	0.0378	13.67	<.001	0.578
	Q2	0.606	0.0414	14.64	<.001	0.612
	Q3	0.605	0.0380	15.93	<.001	0.654
	Q4	0.601	0.0421	14.28	<.001	0.599
	Q5	0.653	0.0351	18.61	<.001	0.739
Negative Perception	**Q13**	0.812	0.0918	8.85	<.001	0.755
	Q14	0.988	0.1082	9.13	<.001	0.872

Model Fit Evaluation

We evaluated the adequacy of the three-factor model using multiple fit indices following established guidelines (Hu & Bentler, 1999). Table 3 summarizes the model fit statistics for the confirmatory factor analysis.

Table 3. Model Fit Indices for Three-Factor Model

Test for Exact Fit

χ^2	df	p
123	48	<.001

Fit Measures

				RMSEA 90% CI	
CFI	**TLI**	**SRMR**	**RMSEA**	**Lower**	**Upper**
0.965	0.951	0.0362	0.0525	0.0411	0.0640

The model demonstrated excellent fit to the data. The comparative fit index (CFI = .965) and Tucker-Lewis index (TLI = .951) both exceeded the recommended threshold of .95, indicating excellent model fit (Hu & Bentler, 1999). The standardized root mean square residual (SRMR = .036) was well below the acceptable threshold of .08, and the root mean square error of approximation (RMSEA = .053, 90% CI [.041, .064]) fell within the acceptable range of .05-.08 (Browne & Cudeck, 1992). Although the chi-square test was significant, $\chi^2(48) = 123.00$, $p < .001$, this is commonly observed in large samples and does not necessarily indicate poor model fit when other indices are satisfactory (Kline, 2016).

Descriptive Analysis of Factors

The descriptive analysis examined the mean scores for each factor to address the first research question: "What are the beliefs and attitudes of students towards Open Lesson?" The analysis revealed distinct patterns across the three factors identified through confirmatory factor analysis.

Attitude Factor

The Attitude factor, comprising six items (M = 3.57), assessed students' engagement and perceived benefits of open lessons. Item-level analysis revealed that students most strongly agreed that "Lessons through Open Lesson are more engaging" (M = 3.86), indicating positive perceptions of lesson engagement. Conversely, students showed relatively lower agreement with "I am more actively engaged in learning in Open Lesson compared" (M = 3.39), suggesting some variability in perceived personal engagement levels. The factor demonstrated moderate variability across items (range = 0.47).

Belief Factor

The Belief factor, consisting of five items (M = 3.75), evaluated students' perceptions of teacher effectiveness during open lessons. This factor yielded the highest overall mean score among the three factors, indicating strong positive beliefs about teacher performance. Students expressed strongest agreement with "Teachers are more enthusiastic in Open Lesson" (M = 3.96), while "Teachers use more technologies in Open Lesson" received the lowest rating within this factor (M = 3.61). Despite this variation, all items within the Belief factor exceeded the scale midpoint, demonstrating consistently positive perceptions.

Negative Perception Factor

The Negative Perception factor, measured through two items (M = 2.29), captured students' critical views of open lessons. Both items demonstrated consistently low mean scores below the scale midpoint, with minimal variation between them (MQ14 = 2.32; MQ13 = 2.26; difference = 0.06). This pattern indicates that students generally disagreed with negative statements about open lessons, suggesting predominantly positive overall perceptions of the open lesson approach.

Descriptive statistics for all factor items are presented in Table 4.

Table 4. Descriptive Statistics for Factor Items

Attitude Descriptives

	Q8	Q9	Q10	Q11	Q12	Q15
Mean	3.39	3.63	3.59	3.86	3.49	3.44

Belief Descriptives

	Q1	Q2	Q3	Q4	Q5
Mean	3.66	3.63	3.90	3.61	3.96

Negative Perception Descriptives

	Q13	Q14
Mean	2.26	2.32

Note. Response scale ranged from 1 (strongly disagree) to 5 (strongly agree). N = 566.

Overall, the descriptive analysis revealed that students held positive attitudes (M = 3.57) and beliefs (M = 3.75) toward open lessons, while expressing low levels of negative perception (M = 2.29). The Belief factor demonstrated the most positive responses, suggesting that students particularly valued teacher performance during open lessons.

Differences

Gender Differences

An independent samples t-test was conducted to examine differences between male and female students' perceptions of open lessons conducted by physics teachers. The analysis revealed a statistically significant difference only in Q11. Lessons through Open Lesson are more engaging, with female students reporting a significantly higher level of agreement than male students (Mean Difference = 0.23652, p = .003, see Table 5).

Table 5. Summary of Significant Gender Differences in Student Attitudes Toward Open Lessons

	Statistic	df	p	Mean difference	SE difference
Q11	0.0891	564	0.003	0.23652	0.0780

Note. H_a $\mu F \neq \mu M$

[a] Levene's test is significant ($p < .05$), suggesting a violation of the assumption of equal variances

Female students were more likely to report that open lessons were engaging, while all other perceptions appeared to be shared across gender groups. The complete results of the t-test are available in Appendix B Table B1.

Grade-Level Differences

A one-way ANOVA (Welch's) was conducted to examine whether students' perceptions of open lessons varied across grade levels: 8th grade (1), 9th–10th grades (2), and 12th grade (3). Statistically significant differences were found for Q1 ($p = .027$), Q2 ($p = .018$), Q4 ($p = .006$), Q9 ($p = .024$), Q10 ($p = .048$), Q11 ($p = .049$), and Q12 ($p = .048$) (see Table 6).

Table 6. Summary of Significant Grade-Level Differences in Student Attitudes Toward Open Lessons

One-Way ANOVA (Welch's)				
	F	**df1**	**df2**	**p**
Q1	3.785	2	80.8	0.027
Q2	4.209	2	81.4	0.018
Q4	5.514	2	81.7	0.006
Q9	3.915	2	80.3	0.024
Q10	3.162	2	81.5	0.048
Q11	3.137	2	80.2	0.049
Q12	3.143	2	82.2	0.048

Note. Items Q1, Q2, Q4, Q9, Q10, Q11, and Q12 reached statistical significance ($p < .05$), indicating meaningful differences in perception across grade levels.

Students in 9th–10th grades expressed the most favorable views overall, especially on instructional quality and engagement. While 8th graders found lessons more engaging, they also reported them as more demanding. In contrast, 12th-grade students evaluated open lessons more critically. Full ANOVA outputs are provided in Appendix C Table C1 , and grade-level descriptive data appear in Appendix C Table C2.

Differences Based on End-Term Marks

A one-way ANOVA (Welch's) was conducted to assess whether students' perceptions of open lessons differed by academic performance level (low, average, high). Statistically significant differences were found for Q2 ($p = .012$), Q5 ($p = .003$), Q9 ($p < .001$), Q10 ($p = .003$), Q12 ($p = .036$), and Q14 ($p = .021$) (see Table 7).

Table 7. Summary of Significant End-Term Mark Differences in Student Attitudes Toward Open Lessons

One-Way ANOVA (Welch's)				
	F	**df1**	**df2**	**p**
Q2	4.589	2	140	0.012
Q5	6.061	2	139	0.003
Q9	8.054	2	148	<.001
Q10	6.126	2	142	0.003
Q12	3.408	2	139	0.036
Q14	3.979	2	143	0.021

Note. Items Q2, Q5, Q9, Q10, Q12, and Q14 showed significant variation across academic performance groups ($p < .05$), reflecting differing perceptions of open lessons by achievement level.

High-performing students consistently rated open lessons more positively across teaching quality, motivation, and perceived academic support. In contrast, average-performing students expressed greater disagreement with the open lesson format, as reflected in higher agreement with Q14. Full ANOVA results are presented in Appendix D Table D1, with descriptive statistics in Appendix D Table D2.

DISCUSSION

The article was mainly concentrated on studying the view of students on Open Lessons taking into account their gender, grade and academic achievement differences. The results of this research present several key tendencies which support and contribute to the conclusions of pre-existing research.

To begin with, according to the findings of Abdulbakioglu et al. (2022), students have manifested a positive outlook towards Open Lessons, especially noting instructor passion, transparency and interactive programmes involvement. However, the research also mentioned the difference between physics open lessons and social sciences, where the physics students appeared to be more retained. Yet, both researches, fairly confirm the positive influence of Open Lesson in terms of student engagement into the educational process.

Due to analysis, there is not much of a difference between genders, however female students appreciate Open Lesson format way better than their male peers. It corresponds to research results done by Yerdelen-Damar and Ai (2018), which state that female students react favourably about interactive and supporting formats, despite the lower self-confidence compared to male group.

The difference in attitude to Open Lesson between different grades was clearly seen. The students of 9-10th grades were the most responsive about the lesson format which indicates that this is the most appropriate period to do Open Lessons. At the same time, 8th grade students, despite being interested, called Open Lesson to be too long. Students studying 12th year were the most critical about Open Lessons. Findings of Osborne et al. (2003) suggest the decline of students' interest in science over time: the younger students are the most enthusiastic, and elders become more concentrated on exam preparation and are less open to new teaching formats. It shows that the results of the original and the observed studies are not directly proportional, nor totally contradict each other.

Academic achievement is also worth discussing. Academically high performing students illustrated the better disposition towards the Open Lesson in all ways. Research done by Wilson in 2006 totally supports the results, stating that students succeeding in education feel more self-confident and more willingly accept new creative teaching formats.

Regardless of optimistic results, certain problems are still unsolved. Open Lesson requires full immersion, however due to complex content some students might experience certain difficulties with comprehension of the topic. Moreover, the presence of observers on the lessons might cause worry and anxiety, particularly on those students who are low-performing and less self-confident.

In general, results show that Open Lesson requires adaptability to individual characteristics of students. During planning the Open Lesson, teachers should take into account age, gender and academic performance factors. Individualisation of the lesson format might facilitate students to engage more, to understand better and have fair academic experience.

IMPLICATIONS

The results of this study suggest that open lessons can positively influence student engagement and motivation in physics when they include interactive methods and hands-on activities. These findings highlight the need for teacher training focused on designing effective, student-centered open lessons. Furthermore, the role of open lessons should go beyond evaluation and serve as a space for meaningful pedagogical innovation. To achieve this, school leaders must foster a supportive environment that encourages authentic teaching practices. These insights also open the door for future research on how open lessons function in other subjects and educational contexts.

LIMITATIONS

While this study provides valuable insights into students’ perceptions of open lessons in physics, several limitations warrant consideration. First, the data were collected through self-administered questionnaires, which inherently rely on students’ personal experiences and reflections. This reliance may introduce a degree of subjectivity or potential inaccuracies in the responses. Second, the scope of the study sample was limited to secondary school students from specific regions of Kazakhstan, thereby restricting the generalizability of the findings to other geographical areas or subject domains.

Furthermore, the study focused exclusively on the perspectives of students. Incorporating the viewpoints of teachers and external observers could have enriched the analysis, offering a more comprehensive understanding of how open lessons are conducted and perceived in practice. Additionally, during the confirmatory factor analysis (CFA), Item Q7 ("Teachers do not seem genuine in teaching Open Lesson") was excluded due to a low standardized factor loading of 0.367. While this adjustment improved the overall model fit, it raises concerns regarding the robustness and reliability of the Negative Perception factor, which is ultimately represented by only two items (Q13 and Q14). This limitation suggests that the construct may not fully encapsulate the complexity of students' perceptions regarding the negative aspects of open lessons.

Lastly, the cross-sectional nature of the study should be acknowledged. Since data were collected at a single point in time, it was not possible to explore how students' perceptions of open lessons might evolve over time or following repeated participation. These limitations highlight important avenues for future research, which could benefit from broader sampling strategies, the inclusion of multiple perspectives, and the adoption of longitudinal designs to gain a deeper understanding of the educational potential of open lessons.

FUTURE RESEARCH DIRECTIONS

Future studies could expand on these findings by exploring open lessons in other subject areas such as chemistry, biology, or mathematics to determine whether student perceptions differ across disciplines. Including teacher and observer perspectives could provide a more comprehensive understanding of the effectiveness and challenges of open lessons. Longitudinal research is also recommended to examine how repeated exposure to open lessons influences student engagement and academic performance over time. Additionally, qualitative methods such as interviews or classroom observations may uncover deeper insights into student experiences and teaching practices that are not easily captured through surveys.

CONCLUSION

Open Lessons in physics are perceived by students more positive than negative. They note such factors as engagement into the educational process, motivation and assistance from instructors. Negative aspects such as boredom and formality are mentioned way less. Differences in perception between various groups as male - female, different grades and academic performance were clearly identified. Female contestants of the research and high-performing students came to appreciate Open Lesson format more than others. In terms of grade, 9th and 10th grades appeared to be the most optimal period to implement Open Lesson. Thus, Open Lessons express a high potential as an effective tool to teach and learn physics. Nevertheless, in order to increase its efficiency, it is important to adapt the teaching method toward the academic needs, performances and characteristics of students.

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APPENDICES

Appendix A

Table A1. KMO and Individual MSA Values

	MSA
Overall	0.859
Q1	0.930
Q2	0.927
Q3	0.880
Q4	0.895
Q5	0.891
Q6	0.751
Q7	0.751
Q8	0.889
Q9	0.886
Q10	0.875
Q11	0.901
Q12	0.896
Q13	0.628
Q14	0.649
Q15	0.896

Appendix B

Table B1. Complete Independent Samples t-Test Results for Gender Differences

		Statistic	df	p	Mean difference	SE difference
Q1	Student's t	0.6116[a]	564	0.541	0.04658	0.0762
Q2	Student's t	1.8902	564	0.059	0.15920	0.0842
Q3	Student's t	1.7151[a]	564	0.087	0.13494	0.0787
Q4	Student's t	0.3586	564	0.720	0.03067	0.0855
Q5	Student's t	1.4226	564	0.155	0.10694	0.0752
Q8	Student's t	-0.7729	564	0.440	-0.06461	0.0836
Q9	Student's t	-0.0658	564	0.948	-0.00525	0.0799
Q10	Student's t	0.0891	564	0.929	0.00743	0.0834
Q11	Student's t	3.0338[a]	564	0.003	0.23652	0.0780
Q12	Student's t	0.6630	564	0.508	0.05611	0.0846
Q13	Student's t	-2.6736[a]	564	0.008	-0.24367	0.0911
Q14	Student's t	-2.1647[a]	564	0.031	-0.20832	0.0962
Q15	Student's t	2.2030	564	0.028	0.18636	0.0846

Appendix C

Table C1. Complete One-Way ANOVA Results for Grade-Level Differences

	F	df1	df2	p
Q1	3.785	2	80.8	0.027
Q2	4.209	2	81.4	0.018
Q3	2.800	2	80.0	0.067
Q4	5.514	2	81.7	0.006
Q5	1.590	2	79.3	0.210
Q8	0.925	2	82.6	0.401
Q9	3.915	2	80.3	0.024
Q10	3.162	2	81.5	0.048
Q11	3.137	2	80.2	0.049
Q12	3.143	2	82.2	0.048
Q13	1.567	2	84.4	0.215
Q14	0.789	2	84.3	0.458
Q15	0.847	2	81.3	0.433

Table C2. Descriptive Statistics by Grade Level

	Grades	N	Mean	SD	SE
Q1	**1**	336	3.65	0.854	0.0466
	2	198	3.75	0.875	0.0622
	3	32	3.16	1.221	0.2159
Q2	**1**	336	3.62	0.983	0.0536
	2	198	3.75	0.915	0.0650
	3	32	3.09	1.329	0.2349
Q3	**1**	336	3.94	0.877	0.0479
	2	198	3.91	0.885	0.0629
	3	32	3.34	1.405	0.2484
Q4	**1**	336	3.57	0.993	0.0542

	2	198	3.76	0.935	0.0665
	3	32	3.06	1.294	0.2287
Q5	**1**	336	3.97	0.819	0.0447
	2	198	4.01	0.849	0.0603
	3	32	3.53	1.481	0.2618
Q8	**1**	336	3.39	0.989	0.0540
	2	198	3.42	0.930	0.0661
	3	32	3.13	1.185	0.2094
Q9	**1**	336	3.63	0.888	0.0485
	2	198	3.72	0.907	0.0645
	3	32	3.03	1.356	0.2396
Q10	**1**	336	3.59	0.933	0.0509
	2	198	3.67	0.992	0.0705
	3	32	3.09	1.228	0.2170
Q11	**1**	336	3.90	0.881	0.0480
	2	198	3.89	0.875	0.0622
	3	32	3.28	1.373	0.2428
Q12	**1**	336	3.52	0.989	0.0540
	2	198	3.53	0.938	0.0667
	3	32	2.97	1.231	0.2176
Q13	**1**	336	2.22	1.058	0.0577
	2	198	2.36	1.098	0.0780
	3	32	2.06	1.105	0.1954
Q14	**1**	336	2.28	1.123	0.0612
	2	198	2.39	1.147	0.0815
	3	32	2.19	1.176	0.2079
Q15	**1**	336	3.45	0.973	0.0531
	2	198	3.47	0.975	0.0693
	3	32	3.16	1.322	0.2338

Appendix D

Table D1. Complete One-Way ANOVA Results for End-Term Mark Differences

	F	df1	df2	p
Q1	0.652	2	137	0.523
Q2	4.589	2	140	0.012
Q3	0.930	2	142	0.397
Q4	2.218	2	141	0.113
Q5	6.061	2	139	0.003
Q8	2.797	2	145	0.064
Q9	8.054	2	148	<.001
Q10	6.126	2	142	0.003
Q11	2.389	2	140	0.095
Q12	3.408	2	139	0.036
Q13	0.942	2	139	0.392
Q14	3.979	2	143	0.021
Q15	1.222	2	142	0.298

Table D2. Descriptive Statistics by End-Term Marks

	End-term marks	N	Mean	SD	SE
Q1	**1**	52	3.50	1.057	0.1466
	2	269	3.67	0.828	0.0505
	3	245	3.68	0.927	0.0592
Q2	**1**	52	3.31	1.076	0.1493
	2	269	3.58	0.925	0.0564
	3	245	3.76	1.026	0.0655
Q3	**1**	52	3.73	0.952	0.1320
	2	269	3.90	0.856	0.0522
	3	245	3.93	0.991	0.0633

Q4	**1**	52	3.35	1.064	0.1476
	2	269	3.59	0.933	0.0569
	3	245	3.68	1.058	0.0676
Q5	**1**	52	3.65	0.988	0.1370
	2	269	3.90	0.864	0.0527
	3	245	4.09	0.861	0.0550
Q8	**1**	52	3.12	0.943	0.1307
	2	269	3.45	0.911	0.0556
	3	245	3.38	1.055	0.0674
Q9	**1**	52	3.19	0.841	0.1166
	2	269	3.62	0.871	0.0531
	3	245	3.73	1.001	0.0640
Q10	**1**	52	3.17	1.004	0.1393
	2	269	3.57	0.947	0.0577
	3	245	3.70	0.986	0.0630
Q11	**1**	52	3.67	0.985	0.1365
	2	269	3.82	0.833	0.0508
	3	245	3.96	0.993	0.0634
Q12	**1**	52	3.15	1.073	0.1489
	2	269	3.48	0.896	0.0546
	3	245	3.58	1.063	0.0679
Q13	**1**	52	2.37	1.205	0.1671
	2	269	2.30	1.034	0.0631
	3	245	2.19	1.093	0.0698
Q14	**1**	52	2.42	1.144	0.1586
	2	269	2.43	1.136	0.0693
	3	245	2.16	1.115	0.0712
Q15	**1**	52	3.29	1.035	0.1436
	2	269	3.41	0.987	0.0602
	3	245	3.51	0.998	0.0638

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