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DEVELOPMENT OF AN ATTITUDE SCALE FOR PHYSICS COURSES AND A REVIEW OF STUDENT ATTITUDES

Balgyn Zhumabek

A thesis submitted to the Faculty of Education and Humanities
in partial fulfillment of the requirements for the degree of

MASTER OF PEDAGOGICAL SCIENCES
in Physics

«SDU University»
Department of Pedagogy of Natural Sciences

Thesis Advisor:
PhD, Associate Professor Maxutov Samat

«SDU University»

Faculty of Education and Humanities
Department of Pedagogy of Natural Sciences

This is to certify that the Master's Thesis of

Balgyn Zhumabek

has met the thesis requirements of
SDU University

Kaskelen, 2025

Approved by:

____
PhD., Associate Professor Maxutov Samat
Thesis Supervisor

____
Master of Science, Lecturer Ayatolla Gabdullin
Program Coordinator

____
PhD., Associate Professor Zhangyl Abilbek
Head of the Department

Minutes №3, 06.03.2025

____
PhD., Associate Professor Zhainagul Duisebekova
Dean, Faculty of Education and Humanities

Table of Contents

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____

PhD., Associate Professor Duisebekova Zhainagul
Dean, Faculty of Education and Humanities

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Table of Contents

List of Tables

Abstract

This study examines the attitudes of Kazakhstani students in grades 9 to 11 toward physics, using a sample of 195 participants from public, private, and specialized schools, including Nazarbayev Intellectual Schools (NIS) and Bilim-Innovation Lyceums (BIL). The sample included 106 girls and 89 boys, reflecting a diverse educational context. Data were collected through a 21-item attitude scale adapted from Aydın Gürler and Baykara (2020), covering six factors: Motivation, Interest, Self-efficacy, Academic Engagement, Physics Anxiety, and Math-related Anxiety. Internal consistency was excellent, with Cronbach's alpha values ranging from 0.96 to 1.00. Items were rated on a five-point Likert scale.

Descriptive statistics (means, SDs, variances) and independent samples t-tests were used to analyze differences by gender and school type. Students showed generally positive attitudes toward physics: Motivation and Interest (M = 3.48), Self-efficacy (M = 3.46), and Engagement (M = 3.41) were relatively high. Physics Anxiety (M = 2.63) and Math Anxiety (M = 3.10) revealed the emotional complexity of physics learning. While gender differences were minimal, female students reported slightly higher anxiety levels. School type was more influential: students from NIS and BIL scored higher in motivation, engagement, and confidence than those in general schools, highlighting the role of institutional context and teaching approach. The findings emphasize the need for physics educators to address both cognitive and emotional aspects of learning. Especially in general schools, student-centered and inquiry-based strategies could improve engagement and reduce anxiety. Curriculum developers should also consider pacing and content design in early physics instruction.

This study offers reliable data on student attitudes in Kazakhstan and validates a six-factor scale as a tool for measuring affective dimensions of physics learning. Future research could include qualitative methods, longitudinal tracking, or intervention studies.

Keywords: physics education, student attitudes, motivation, anxiety, self-efficacy, Kazakhstan, secondary school, school type, STEM, attitude scale, t-test

Аннотация

Данное исследование изучает отношение казахстанских школьников 9–11 классов к физике на выборке из 195 участников из государственных, частных и специализированных школ, включая Назарбаев Интеллектуальные школы (НИШ) и Лицей Билим-Инновация (БИЛ). В выборку вошли 106 девочек и 89 мальчиков, что отражает разнообразие образовательных условий. Данные собирались с помощью 21-пунктной шкалы отношения, адаптированной из работы Айдын Гюрлер и Байкара (2020), охватывающей шесть факторов: мотивация, интерес, самоэффективность, учебная вовлечённость, тревожность по физике и тревожность, связанная с математикой. Внутренняя согласованность шкалы была высокой (альфа Кронбаха от 0,96 до 1,00). Оценка проводилась по пятибалльной шкале Лайкерта.

Для анализа использовались описательная статистика (средние, стандартные отклонения, дисперсии) и t-тесты для независимых выборок по полу и типу школы. В целом, ученики проявляют положительное отношение к физике: мотивация и интерес ($M = 3,48$), самоэффективность ($M = 3,46$) и вовлечённость ($M = 3,41$) были относительно высокими. Тревожность по физике ($M = 2,63$) и тревожность по математике ($M = 3,10$) отражают эмоциональную сложность изучения предмета. Гендерные различия были минимальными, однако девочки показали немного более высокий уровень тревожности. Влияние типа школы было заметнее: учащиеся НИШ и БИЛ демонстрировали более высокие показатели мотивации, вовлечённости и уверенности, чем ученики обычных школ, что подчёркивает значение институционального контекста и методов преподавания. Результаты подчёркивают необходимость учёта как когнитивных, так и эмоциональных аспектов обучения физике. Особенно в обычных школах рекомендуется использовать методы, ориентированные на ученика и исследовательский подход, чтобы повысить вовлечённость и снизить тревожность. Разработчикам учебных программ следует учитывать темп и содержание материала на начальных этапах изучения физики.

Исследование предоставляет надежные данные об отношении учащихся к физике в Казахстане и подтверждает валидность шестифакторной шкалы для измерения аффективных аспектов изучения физики. В будущем возможны качественные исследования, лонгитюдные исследования или интервенционные работы.

Ключевые слова: физическое образование, отношение учащихся, мотивация, тревожность, самоэффективность, Казахстан, средняя школа, тип школы, STEM, шкала отношения, t-тест

Аңдатпа

Бұл зерттеу Қазақстандағы 9-11 сынып оқушыларының физикаға деген көзқарасын зерттейді. Зерттеуге жалпы саны 195 қатысушы кірді, олардың ішінде мемлекеттік, жекеменшік және арнайы мектептерден, соның ішінде Назарбаев Зияткерлік мектептері (НЗМ) мен Білім-Инновация лицейлерінен (БИЛ) оқушылар бар. Үлгіге 106 қыз және 89 ұл қатысты, бұл білім беру контекстінің әртүрлілігін көрсетеді. Деректер Айдын Гюрлер мен Байкара (2020) еңбегінен алынған 21 тармақты қатынас шкаласы арқылы жиналды, ол алты факторды қамтиды: мотивация, қызығушылық, өзіндік тиімділік, оқу үрдісіне қатысу, физикаға қатысты алаңдау және математикаға байланысты алаңдау. Ішкі сенімділік жоғары болды (Кронбах альфасы 0,96-дан 1,00-ге дейін). Бағалау бес балдық Лайкер шкаласы бойынша жүргізілді.

Талдау үшін сипаттамалық статистика (орташа мәндер, стандартты ауытқулар, дисперсиялар) және тәуелсіз топтар гендер мен мектеп түріне байланысты айырмашылықтарды қарау мақсатында бойынша t-тест қолданылды,. Оқушылардың физикаға деген көзқарасы негізінен оң болды: мотивация мен қызығушылық (M = 3,48), өзіндік тиімділік (M = 3,46) және оқу үрдісіне қатысу (M = 3,41) салыстырмалы түрде жоғары болды. Физикаға қатысты алаңдау (M = 2,63) және математикаға қатысты алаңдау (M = 3,10) пәнді үйренудегі эмоционалды күрделілікті көрсетеді. Жыныстық айырмашылықтар аз болды, бірақ қыздарда алаңдау деңгейі сәл жоғары болды. Мектеп түрінің әсері айқын болды: НЗМ мен БИЛ оқушылары мотивация, қатысу және сенімділік көрсеткіштері бойынша жалпы мектеп оқушыларынан жоғары болды, бұл институционалдық контекст пен оқыту тәсілдерінің маңыздылығын көрсетеді. Нәтижелер физиканы үйренудегі когнитивтік және эмоционалдық аспектілерді ескеру қажеттігін көрсетеді. Әсіресе жалпы мектептерде оқушыға бағытталған және зерттеушілік әдістерді қолдану оқу процесіне қатысуды арттырып, алаңдауды төмендетуі мүмкін. Оқу бағдарламаларын әзірлеушілер бастапқы физика курсының мазмұны мен жылдамдығын ескеруі қажет.

Бұл зерттеу Қазақстандағы оқушылардың физикаға деген көзқарасы туралы сенімді мәліметтер ұсынады және физиканы үйренудің аффективтік аспектілерін өлшеуге арналған алты факторлы шкаланың жарамдылығын растайды. Болашақта сапалық зерттеулер, ұзақ мерзімді бақылау зерттеулері жүргізілуі мүмкін.

Түйінді сөздер: физика білім беру, оқушылардың көзқарасы, мотивация, алаңдау, өзіндік тиімділік, Қазақстан, орта мектеп, мектеп түрі, STEM, қатынас шкаласы, t-тест

1 Introduction

1.1 Background of the study

Physics, as a fundamental discipline within STEM, shapes students' scientific literacy, problem-solving skills, and analytical reasoning. Physics remains central for scientific advancement, also for technology progress, but still school students perceive physics as abstract and inaccessible since it depends on mathematics. The motivation and the confidence of students are influenced in a large way by these perceptions. Future academic career choices and also choices are often formed early in the educational process for them.

Cognitive achievement in physics and affective-motivational factors such as interest, self-efficacy, anxiety, and engagement relate complexly as educational researchers globally acknowledge. Generally, physics has been assessed via achievement scores, with content mastery. Student attitudes predict learning according to recent pedagogical models then result from it. Recognizing cognitive along with affective domains are interdependent has prompted educators to shift toward more holistic approaches when they evaluate physics education outcomes.

In many educational systems, Kazakhstan's included, physics often strikes students as a very hard subject at school. This perception stems from factors that combine for concepts abstract, mathematics depends strongly, terminology is unfamiliar, instruction lacks applications in real life frequently. How a piece of content is presented will often cause students to battle with more things than what the content itself does because it's typically in theoretical or formulaic terms disconnected from experience each day. Even capable students may develop avoidance behaviors or low self-confidence in response. These issues do then feed into a cycle of disengagement and of underachievement.

In Kazakhstan, the government had substantially endeavored for the purpose of modernizing science education since the time that it introduced updated curricula and revised teacher training standards in addition to internationally benchmarked programs such as Nazarbayev Intellectual Schools (NIS). These efforts are now in place, but physics still challenges many students. Different school types view this subject as quite a challenge. NIS and Bilim-Innovation Lyceums (BIL) provide to elite institutions' students improved science programs, laboratory facilities, and Olympiad preparation, while general and rural schools' students often lack access to such resources. Disparities within teacher qualification as well as instructional style augment these structural inequities. Inequities also result from student support systems.

Kazakhstan stresses STEM education nationally as pointed out inside "State Program for the Development of Education and Science" documents. However, there have been no gains that correspond in student attitudes also participation in more advanced physics courses. Student perception is also the problem, not just curriculum or assessment: students may avoid real physics engagement if they view it as scary or pointless, even given formal importance.

Research indicates that negative attitudes toward physics tend to crystallize during secondary school especially around grade 9 when students get formal instruction. People decide about subject specialization at this time and choose academic pathways later. Educators and researchers are therefore greatly interested in attitude formation early within grade 9 and its evolution through grades 10 and 11.

1.2 Focus on Affective and Motivational Factors

In the context of science learning, affective and motivational factors, especially in physics, play a major role in shaping students' academic engagement, performance, and long-term interest in the subject. These factors involve emotional reactions such as enjoying, feeling anxious, fearing, wondering, and holding attitudes toward self (e.g., confidence, or self-efficacy), alongside cognitive drivers like perceiving value of the subject and intrinsically motivating. Affective factors have an influence on the way that students feel about learning as on how they react to challenges. These factors also determine if students persist within complex or abstract content, unlike cognitive abilities, which relate to knowledge and reasoning. For example, a student may be capable of solving physics problems yet still avoid the subject because of anxiety or low confidence. Interest shown for phenomena that are physical and success are motivating factors. Goal orientation can determine also if students invest effort toward learning. Research then shows that when people are highly motivated, they often persist more as well as learn better even in difficult subjects like physics (Pintrich & De Groot, 1990). Furthermore, negative affective states which are existing do especially include math-related anxiety which has been shown so as to interfere within physics learning because physics largely relies upon symbolic and mathematical reasoning (Ashcraft & Kirk, 2001). Thus, understanding the affective and motivational profiles of students is necessary both for explaining their attitudes now and for designing interventions supporting emotional comfort, confidence, and sustained physics engagement.

Among the various, six attitude components have emerged consistently as relevant in physics education.

1. Motivation: the student shows a willingness in order to invest effort for learning physics.

2. Interest is the subject's emotional and intellectual appeal.

3. Self-efficacy (Self-sufficiency): the confidence within one's ability regarding physics assignment successes

4. Student Engagement: readiness for exploring physics outside school or for taking additional physics courses

5. During the classes in physics or for the evaluations of physics: the emotional discomfort can be experienced as anxiety about physics.

6. Math-related Anxiety involves stress of sorts. Stress in particular is associated with aspects of mathematics in physics.

Each of these dimensions reflects a different aspect for student interaction with the subject. Together, these dimensions provide above a thorough framework for analyzing student attitudes. Some of the students might be quite motivated. Math anxiety or even low confidence may still be obstructing their progress. A lack of any perceived relevance or of enjoyment can then cause disengaged confidence. Therefore, an approach toward measuring multiple dimensions is key.

1.3 Local Research Gap

While a substantial body of international research has explored students' attitudes toward science as well as physics, specifically among secondary school students in Kazakhstan, focused data-driven empirical studies are quite noticeably lacking. In almost all existing Kazakhstani studies, curriculum reform as well as textbook development and even general achievement outcomes are stressed. These studies occur within the larger field of science education itself. However, there are relatively few that have examined the affective as well as motivational dimensions that are found in physics learning. These dimensions do grow now in importance within the global educational discourse and include interest, and also anxiety, self-confidence, and engagement too. In addition, studies of Kazakh student views tend to be qualitative studies or small studies since they examine one school or area without comparing diverse institution types. Students are regarded often as just one similar group so little attention is paid to key factors which are gender, school, or emotional maturity to then grasp topics that are difficult like physics. As the country stresses STEM education increasingly therefore national initiatives like the Kazakhstan 2050 Strategy plus updated educational standards back it, the reality strong local data do not exist on how students relate emotionally including motivationally to physics represents a key research plus policy gap. Lacking such data, designing effective interventions, teacher training programs, or curriculum adjustments grounded in the lived experiences of Kazakhstani students becomes difficult. Because of the fact that this study uses a validated six-factor attitude scale with a sample size of 195 students from a number of different types of schools, including general secondary schools, Nazarbayev Intellectual Schools (NIS), as well as Bilim-Innovation Lyceums (BIL), it seeks to fill such a gap. The study analyzes both the quantitative results and the subgroup differences to provide a more subtle understanding. It also uses data for support of Kazakhstan students' feelings on physics learning plus emotional or institutional effects.

The research thus contributes to the national academic discourse and offers practical evidence improving teaching, supporting students, and ensuring the country’s STEM aspirations are matched by student readiness, interest, and confidence.In Kazakhstan, only a few studies have looked into the attitudes of students toward physics with tools that are multidimensional and that are psychometrically validated. National education reports often focus on standardized test scores as well as enrollment data, though they rarely attend to the emotional and motivational experiences that cause those outcomes. PISA and TIMSS, international large-scale assessments, are not tailored for specific school contexts providing only limited indicators of science-related affect.

By employing an attitude scale that was adapted from Aydın Gürler and Baykara (2020), this research seeks to fill that gap, a scale structured and validated around six key dimensions. This study contributes original context-specific perceptions into how students perceive physics as well as what factors influence their orientation toward the subject via collecting and analyzing data from students in both specialized and general schools across Kazakhstan.

1.4 Research Objectives and Questions

This study does have a central objective which is this: It is for exploration of the attitudes of students in grades 9 through 11 toward physics. A six-factor model including motivational and emotional variables will be used. The study aims for more specific goals which are namely:

Assess students’ interest, motivation levels, anxiety, engagement, and self-efficacy linked to physics and mathematics.

Differences in attitudes across school types that are statistically important should be identified. This should be done via a comparison of specialized and of general schools.

Gender may affect student attitudes. Explore possible gender-based variations during.

Assess the interrelationships. Do analyze these of six attitude dimensions.

These research questions direct the study using those aims.

In general, how do Kazakhstani students in grades 9–11 feel toward physics?

Do school types create noticeably different views from students?

Are there in motivation any differences of gender that are prominent? Are there differences that exist also in anxiety or in self-efficacy?

How do interest and engagement correlate to other dimensions such as both physics anxiety and math anxiety?

1.5 Importance of Grades 9–11

Focusing closely upon grades 9 through 11 is both pedagogical and also practical. Most of the students who reside in Kazakhstan begin formal instruction when they are in Grade 9 for physics. It also molds their school traits plus tastes, working as a core item. Students begin to specialize around grades 10 as well as 11. These choices have an influence upon their higher education as well as career trajectories. To understand the ways in which attitudes change or attitudes stay stable across this period of three years can inform an early intervention, and it can help with the long-term curriculum planning.

Grades 9 to 11 represent a stage critical for psychological and academic development of a student, especially in science education's context. Throughout these years, students typically transition out of basic science literacy into more advanced as well as specialized subject learning. Students learn foundational topics also in physics, which include mechanics, electricity, and thermodynamics. During this period, students begin to make decisions regarding future academic paths as well as potential career interests plus they include whether to pursue STEM-related fields. Many educational systems, to include Kazakhstan’s, find that students in grades 9–11 encounter an increased academic pressure, a more complex content, as well as higher expectations for independent learning. Physics turns conceptually abstract plus mathematically demanding so students' motivation and confidence might encounter difficulties. These years do often coincide along with national assessments, university preparation, and a strengthened curricular focus. Therefore, students are more sensitive to how they perceive each subject's relevance and difficulty.

Research shows students often adopt declining attitudes toward science during secondary school, especially during these grades (Osborne et al., 2003). This decline often links teaching style, curriculum structure, and classroom emotional experiences being more pronounced in physics than science subjects. We can provide important perceptions into how educational systems can retain interest and engagement in physics if we capture students’ perspectives during this transitional stage before students opt out of the subject entirely. Also, identities develop during grades 9–11 which is a formative period. Students also view themselves at that time with regard to science as well as mathematics. If students especially like girls or students from general schools begin for to internalize a belief which states that physics is “not for them” they may then avoid all physics courses at a later time regardless of their real ability therefore it is important for us to understand students' emotional and motivational states during all these years for the purpose of designing inclusive supportive and future-oriented physics instruction. This age group is the focus of the present study informing theory and practice. This helps researchers understand attitude changes during this stage. It can also guide the teachers, school leaders, and policymakers as they work to improve student experiences in secondary physics education.

Additionally, when you are examining multiple grade levels, that allows for cross-sectional comparisons, and furthermore these comparisons are able to highlight developmental or institutional effects. For instance, motivation's decline from grade 9 to grade 11 may indicate frustration amasses or academic pressure rises, while self-efficacy's rise might reflect instructional quality improves or people develop personally.

1.6 Significance of the Study

This study has importance within several respects. First, it contributes to the growing field of science education by empirically offering data on how secondary school students feel as well as motivate themselves toward physics in Kazakhstan. Worldwide, many studies investigated students' views about science. In the Kazakhstani context, large-scale quantitative studies are in fact lacking especially those that are focusing on motivation, interest, confidence, and anxiety. Also, the study gives understanding into varied attitudes regarding gender and school setting. By understanding how girls and boys experience physics differently, educators and policymakers can identify equity gaps and target interventions more effectively. A comparison for students out from specialized schools such as NIS or BIL to those from general schools can also offer perceptions. In Kazakhstan, these particular findings happen to be especially relevant since educational reforms have stressed STEM unevenly throughout both institutions and regions. Third, this study uses above a validated six-factor scale. It also reliably diagnoses students' emotional and motivational engagement within physics. Educators can use these results for training programs since they allow recognition of the emotions involved in learning plus adoption of methods promoting confidence, reduced anxiety, and sustained interest within science.

Education strategists as well as curriculum developers can use the study practically. For example, findings that are related to math-related anxiety can guide curriculum pacing and also mathematics is integrated within physics instruction, most especially in early secondary grades. Beyond that of Kazakhstan, this study does provide a foundation for practical improvements in education quality, equity, and also accessibility in physics, filling an academic gap overall. Positive attitudes regarding physics are important for STEM fields' long-term engagement. Students are more apt to select higher science classes, join science contests, and seek science jobs if physics is fun, achievable, and applicable. Conversely, whenever students feel negative feelings—such as fear, boredom, or frustration—this affects how they perform academically to boot but can also close off entire educational and professional pathways. Kazakhstan gives priority to national STEM development making this a particularly relevant issue there. Favorable attitudes fostered in secondary education may improve science outcomes effectively. Such actions can serve to reduce both the gender and the school-type gaps observed in physics enrollment and achievement.

1.7 Structure of the Thesis

This thesis is organized within main chapters. These chapters total five.

Background, objectives, rationale, and research questions are in the introduction.

In the Literature Review, existing studies of student attitudes toward physics are surveyed, and the theoretical framework that is used in this research is described.

Methodology explains research design, participant selection, instrument adaptation, data collection process, and statistical methods.

“Results and Discussion” locates the core study outcomes and explains those outcomes given the questions and relevant literature.

Conclusion as well as Recommendations summarizes the study, offers practical suggestions for educational improvement, and acknowledges limitations.

These chapters explore in detail how secondary students in Kazakhstan see physics plus what shapes those viewpoints.

2 Literature Review

2.1 The Role of Attitudes in Science Education

Attitudes play a central role in the shaping of how students engage with science as well as with subjects such as physics. In educational research, people often define attitude as learning as well as predisposing them to respond in a consistently favorable or unfavorable manner toward a given object, person, idea, or subject according to Ajzen (2005). Students’ attitudes about science education affect how much they learn, how willingly they participate, whether they pursue study, and how they perceive competence. Higher achievement correlated to positive attitudes toward science in many studies. These attitudes also strengthened motivation and increased persistence within STEM fields as shown in Osborne et al., 2003 and George, 2006. Conversely, negative attitudes involving anxiety or low self-confidence can lead students to disengage, avoid the subject, or underperform despite cognitive ability (Mallow, 2006).

Attitudes have multiple dimensions of importance. They include:

Cognitive components as beliefs of science's difficulty or usefulness

Components that do affect something such as interest, enjoyment, or anxiety, And also a willingness to take some science courses in the future, such as behavioral intentions.

Students' attitudes toward physics are often influenced by their experiences with problem-solving and mathematical formulas. Teacher support and laboratory work contribute to these attitudes too. Since people often view physics as hard and not concrete, typical reactions include feeling confused, fearing failure, or getting frustrated. This is especially true for students lacking strong math skills as well as confidence. These emotional responses can evolve into more stable attitudes. These attitudes support long-term engagement or instead they obstruct it. Educators and researchers increasingly recognize teaching content knowledge as necessary as fostering positive attitudes. STEM pathways benefit from the students who do feel capable and do see science's relevance to their lives and do enjoy science because these students are likelier to succeed and continue. Thus understanding the attitudes of students can help teachers in tailoring instruction and in serving as an early indicator of disengagement. We must examine student attitudes toward physics then understand how these attitudes vary by gender, school context, or teaching approach because this improves science learning and equity.

This chapter gives a very thorough overview with regard to students' attitudes toward physics research literature. It begins by addressing the global importance of affective and motivational factors in science education, then explores the theoretical and empirical foundations of attitude research in physics. Special attention is given to validated scales that measure these attitudes plus studies in other post-Soviet countries like Kazakhstan. The chapter concludes along with a justification for the current study’s methodological approach. The context of the study is relevant too.

Student attitudes are viewed by scientists as key to students succeeding in academics, choosing courses, staying in learning, and pursuing careers long-term (Osborne, Simon, & Collins, 2003). Mindsets shape how learners engage the content. Attitudes can also affect their interpretation of what is their ability for success. Attitudes do incorporate just how one then responds emotionally, also what one values, as well as what one intends behaviorally, unlike how one performs cognitively alone.

In science learning, a number of affective constructs are relevant for it.

Motivation: interest and learning efforts sustained via a driving force.

Interest: that is the engagement, which includes both emotional and intellectual investment, with that content.

Self-efficacy: confidence that students have in their ability to do academic tasks.

Try to engage both behaviorally and psychologically so that you invest in learning.

Anxiety: a negative emotion, especially in difficult subjects, that may interfere with learning.

These elements each clarify the variations within student experiences of physics a topic seen as emotionally upsetting and mentally taxing.

2.2 Theoretical Frameworks that Describe an Attitude

In educational and psychological research, the idea of attitude has been widely theorized and studied. Attitudes are not just simple preferences; in fact, they are multi-component psychological constructs which can influence the way that people perceive, feel about, and behave toward particular subjects, and this includes school disciplines like physics. A widely accepted model describes attitude's three interrelated components and is the tripartite model of attitude.

1. Cognitive component – (e.g., “Physics is useful in real life”) beliefs plus thoughts about the

2. Affective component – emotional reactions such as enjoyment, anxiety, or boredom.

3. Behavioral component – intentions or tendencies imply action occurs a certain way like selecting additional physics courses.

This model is widely used within educational research because it captures students' thoughts, feelings, along with behaviors regarding a subject. It provides a thorough framework in analyzing student attitudes. It is especially useful within subjects like science and mathematics, where affect and behavior often diverge from cognitive ability (Ajzen, 2005). Ajzen's Theory of Planned Behavior (1991) widely applies yet another framework, in addition to the tripartite model. This theory states that attitudes toward a behavior join with subjective norms and perceived behavioral control. Each predicts an individual's intention when the person acts. A student is much more likely to pursue physics of their own volition if they feel capable of succeeding, believe that others support this interest of theirs, and hold a positive attitude when facing physics. Bandura's concept of self-efficacy (1997) is also another framework that is relevant from social cognitive theory. Attitudes are closely linked to self-efficacy development. It is representative of a belief in one's capability for success in such specific tasks. In science education, students that have high self-efficacy tend to act in a more positive way, motivate themselves to a higher degree, as well as persist better even when facing academic difficulties. Researchers have also stressed the affective-motivational dimension of learning recently. This includes constructs such as an intrinsic motivation, a task value, and a goal orientation. All of these do interact with attitudes now. For example, students are more likely to form a positive view of physics even when they think it hard if its relevance is valuable or solving science problems is enjoyable.

The present study adopts a multidimensional view of attitude that is grounded in the tripartite model. This view finds support from motivational psychology and self-efficacy theories. Reflecting this complexity is the six-factor attitude scale (Gürler & Baykara, 2020) used in this research because it captures cognitive beliefs (e.g., confidence), affective responses (e.g., anxiety, interest), as well as behavioral tendencies (e.g., engagement). These same theoretical foundations are important in interpreting student responses in a meaningful way. Also too, they are indeed necessary in the designing of effective educational interventions that are aimed at improving attitudes toward physics.

Self-efficacy with task value are especially relevant in physics education. Students with the belief they are capable of understanding physics are more likely to engage within the subject. These are students that also value physics for its future utility for them.

2.3 The Role of Emotions in Learning Physics

The learning of physics is frequently connected to intense emotional responses and cognitive work. As people learn, emotions like curiosity, frustration, fear, enjoyment, or confusion frequently arise, especially in subjects like physics that demand people reason mathematically and understand concepts. Researchers increasingly have recognized the central role of emotions within science education in recent decades (Pekrun, 2006; Mallow, 2006). Emotions are not secondary to academic performance yet affect student engagement, persistence, and success. Increased attention coupled with deeper cognitive processing with longer-lasting retention of content have all been linked to positive emotions such as enjoyment, interest, together with satisfaction (Pekrun & Linnenbrink-Garcia, 2014). Students with emotional connections to learning will likely invest effort. Those students are also more likely to take intellectual risks. Negative emotions like anxiety, boredom, and hopelessness can interfere in memory. When this occurs, then attention can be reduced, and students may avoid material that is challenging.

Anxiety is among the most commonly reported emotional obstacles in physics education. Varied sources such as abstract content, fast-paced instruction, fear of equations, or failure experiences can cause physics anxiety. Anxiety involving math matters greatly. This is often because of the symbolic quantitative nature of physics in the context of physics. Physics is perceived as quite threatening, also students are even more prone to disengagement, if they happen to experience math anxiety as shown by Ashcraft and Kirk (2001).

Self-confidence or also self-efficacy is as well another important emotional dimension. Students with optimism and resilience feel they can succeed in physics when approaching it. Self-efficacy beliefs affect academic performance according to Bandura (1997) yet make people react emotionally to challenges. When facing more difficult of tasks, a student with low self-efficacy is more likely to feel overwhelmed, even if they have skills.

Classroom environment shapes emotional responses, like teacher behavior and peer interactions. Emotional responses are shaped by contextual factors. Respectful, supportive, and safe for mistakes classrooms likely promote positive emotions. Environments that are stressing competition, speed, or punishment for error may in turn increase anxiety and reduce any long-term interest in the subject (Beilock & Ramirez, 2011). For female students in gendered terms it is often the case that they report higher anxiety levels in physics, research shows, even when their academic performance equals that of male peers (George, 2006; Cheung, 2009). Social stereotypes, classroom dynamics, or science fields with lacking female representation may root this emotional gap.

In the end, feelings greatly mold pupils' views and sway how they do in physics. The valid, important elements of learning should be recognized as emotional responses by educators and by curriculum developers. Schools are able to address emotional barriers and also foster positive affect in order to help students to perform better. They also enable for students a connection to physics in a way that is more sustainable and meaningful.

2.4 Physics Education Challenges

Despite its fundamental role in scientific literacy coupled with technology's advancement, physics educators face multiple challenges within secondary and post-secondary levels. These challenges span across curriculum complexity. Students' engagement and achievement are influenced by emotional and psychological barriers.

Difficulties exist in physics education because the subject is mainly abstract and mathematical. Physics requires one to reason symbolically, to manipulate formulas, and to think abstractly. These requirements are high in contrast with biology or environmental science and other science disciplines. A lot of students battle even when they understand core concepts such as force, motion, or electricity that are presented in purely mathematical terms (Redish, 1994). This complexity often disengages from students. For the teaching approach there especially needs to be concrete examples or interactive learning tools. One of the unique challenges with learning physics is that it deeply integrates mathematical thinking. Mathematics, while it gives useful tools to model processes, may also turn into a mental hurdle. Physics is often perceived by students as being inaccessible to those struggling with algebra or with symbols or with formulaic manipulation. Typical education methods strengthen this idea when computation receives emphasis. These styles do not tend to make concepts clear at all. Math-related anxiety accordingly becomes a major affective barrier, especially among students with limited math preparation or in general education schools.

Physics creates major difficulty due to students' feelings. This is known as the second major challenge. Many studies have documented that physics anxiety exists as a form of subject-specific apprehension that can make people nervous, confused, or even fearful when dealing with physics content (Mallow, 2006). In that physics does rely so heavily on algebra along with trigonometry and also problem-solving strategies, math-related anxiety often compounds this anxiety. As per Ashcraft and Kirk (2001), students do report high math anxiety plus tend to underperform in physics-related tasks, even when they possess enough intellectual ability. Another important barrier is perceived relevance lacking. Physics often fails in connecting to students' daily lives or future careers if instruction focuses too much on theory or exams. When teachers teach physics devoid of real-world phenomena or interdisciplinary concepts, physics can appear irrelevant, which reduces both interest and motivation (Osborne et al., 2003). The problem exists with acuteness especially in the general secondary schools wherein laboratory facilities happen to be underdeveloped and curriculum time happens to be limited. Physics education still does have a persistent challenge for it. Gender disparity also remains. Female students, even in the instance of performing just as well as their male counterparts, often report a lower level of confidence and a higher amount of anxiety, and all of this results in the reduced participation in elective courses as well as STEM-related career choices (Cheung, 2009; Wang & Degol, 2017). Cultural stereotypes plus classroom dynamics together with limited representation of women in physics-related fields, rather than ability differences, produce these patterns.

In many educational systems, Kazakhstan's included, physics often strikes students as a very hard subject at school. This perception stems from factors that combine for concepts abstract, mathematics depends strongly, terminology is unfamiliar, instruction lacks applications in real life frequently. How a piece of content is presented will often cause students to battle with more things than what the content itself does because it's typically in theoretical or formulaic terms disconnected from experience each day. Even capable students may develop avoidance behaviors or low self-confidence in response. These issues do then feed into a cycle of disengagement and of underachievement.

Student outcomes are affected by teacher training and school resource disparities. This occurs on a systemic level in education. Schools exist in many countries including Kazakhstan where urban pupils or pupils in specialized schools like NIS and BIL can access modern labs, digital technology, and inquiry-based learning. Overcrowded classrooms coupled with customary lecture-based methods plus limited exposure to experimental science might confront students when in general education schools instead. These inequalities work to worsen attitude gaps and disengage people in total with the subject. Physics assessment practices often prioritize calculation speed and correct answers. Conceptual understanding or creative thinking are not as valued along with analytical skill. This focus might deter students lacking procedural fluency yet interested in it. High-stakes exams and a performance-oriented culture may strengthen anxiety created, weakening intrinsic motivation.

In summary, there are a range of pedagogical, emotional, cultural, and also systemic factors that shape physics education. These factors work together toward shaping the education. To address all of these challenges does require much better instructional materials and teacher training, and also it requires a shift in educational philosophy from just rote memorization and test-preparation to more student-centered, emotionally supportive, and relevance-driven educational settings.

2.5 Studies Empirically Based on Physics Attitudes

Empirical research on student attitudes toward physics has expanded greatly in recent decades because educators increasingly recognize motivational as well as affective variables' influence on learning science. In different educational plus cultural contexts, many studies have investigated how students feel about physics as well as how they perceive their abilities and also what factors make them engage with it. As a major strand, this research focuses on quantitative survey-based studies. Validated attitude scales are used for measuring constructs like interest, motivation, self-efficacy, also anxiety. Aydın Gürler with Baykara (2020) made a sample work. It used a six-factor attitude scale made specifically for students in Turkish high schools. Their instrument gauges motivation and student interest regarding physics. Additionally, it measures one's self-efficacy in addition to one's academic engagement as well as general physics anxiety and math-related anxiety. Since Cronbach’s alpha values ranged from about 0.88 up to 0.95, the scale demonstrated high internal consistency, and it makes it a reliable tool intended for cross-cultural adaptation. This current study adopts this model so as to examine the attitudes of Kazakhstani students, and it uses the original English version of it. Students' attitudes are affected in terms of gender differences, other researchers have explored. Cheung

(2009) found girls were more likely to experience anxiety throughout school, although boys and girls expressed similar science interest in early secondary years. Likewise, George (2006) noted that emotional reactions often vary by gender, and girls are more likely to doubt their physics competence. His findings also suggest gender may not affect science cognitive comprehension. Several studies examine school context with instructional quality. Osborne, Simon, and Collins (2003) stressed that students' attitudes are highly sensitive to perceived relevance of content, teacher enthusiasm, and classroom experiences in their thorough literature review. Sadler and Tai (2001) confirmed that prior experience along with instructional style in high school physics greatly influence when students succeed and persist in college-level science. According to empirical findings, physics attitudes are also impacted by math-related anxiety. Ashcraft and Kirk (2001) demonstrated that high math anxiety students avoid subjects such as physics more, regardless of performance. The current study's data aligns with this, especially among female students as well as those from general education schools, in which math anxiety was a strongly expressed negative emotion. Some mixed-methods designs provided perceptions that are richer. For example, Tobias (1990) used some qualitative interviews in order to investigate the reasons why capable students opt out of physics, and he found that affective alienation—not any cognitive difficulty—was the most common explanation. Mallow (2006) along with others stressed that social and institutional signals do reinforce learned science anxiety over a period of time often.

Researchers have conducted limited studies within Kazakhstan and Central Asia. Reforms to science education, especially in NIS and BIL schools, recently provided new opportunities for research. This study makes a contribution to the filling of that gap with the offering of large-scale data that is school-type-comparative. Additionally, the study highlights the ways in which attitudes toward physics are shaped within this unique regional context. In general, empirical studies consistently reveal that students' attitudes toward physics are shaped by individual traits such as confidence as well as anxiety. Contextual factors such as school type as well as teaching style in addition to gender norms also shape them. These findings underline that policies and practices designed for science education should engage motivation with positive emotional responses.

2.6 Six Attitudes on the Subject of Gender Differences

Studies show opinions of physics vary with different outcomes concerning gender. While some studies report meaningful disparities, especially when people feel confident or anxious according to Cheung (2009) and Sadler & Tai (2001), others find minimal differences when people feel motivated or interested. Often, the variation depends upon the teaching style, the cultural context, and the role models' representation.

Girls might be considered as quite capable. They experience higher anxiety since gender and science involve social expectations or beliefs. Within male-dominated classroom environments, female students may too participate actively less frequently, which additionally influences their attitudes. Attitudes toward physics mold academic life plus students' self perceptions. Many students internalize the idea about physics as a subject for “smart” or “logical” people. This is often implicitly coded as being male or being competitive or being elite. Such perceptions based in identity can discourage capable students from viewing themselves as “physics people.” Environments in inclusive classrooms are created so as to normalize diverse approaches for thinking and for problem-solving which may help students connect physics to their future goals and to their own identities, therefore making the subject more appealing and accessible.

2.7 Attitudes link up with School Type.

School type especially shapes how students feel due to institutional context. School type is surely a meaningful contextual factor as it influences students’ attitudes toward academic subjects, including physics. A growing body of literature indicates that the institutional culture, teaching practices, resource availability, plus academic expectations associated with different school types often shape students' emotional and motivational responses to science learning. For students that are in academically selective schools or that are in well-resourced schools like magnet schools, private institutions, or specialized STEM lyceums, these students tend to express more positive attitudes toward science subjects in many education systems. Often, beyond student background and prior achievement are other attributes like a school climate fostering academic ambition, confidence, and engaging instructional practices (Osborne et al., 2003; George, 2006).

Kazakhstan created schools like Nazarbayev Intellectual Schools (NIS) and Bilim-Innovation Lyceums (BIL). They further STEM education that is advanced. These institutions often offer:

1. Instruction can be in trilingual formats or in English formats.

2. Accessing into laboratory resources and digital platforms, Teachers have international training. These are the teachers that have the best training for them.

3. Curricula improved via inquiry and problem-solving.

For students, supportive conditions for the learning of physics are more likely in these environments. Higher self-efficacy, together with motivation, plus sustained interest regarding the subject will then result. Teacher expertise, peer culture, and institutional prestige reinforce a sense about physics being valuable, doable, and worth pursuing. In Kazakhstan, many general secondary schools, in contrast, operate with class sizes that are larger and opportunities that are fewer in labs using methods more customary. Often physics within these settings is presented like abstract, exam-oriented, also formula-driven. Though capable as well as motivated, students in such schools are more likely to develop negative emotional responses, such as disinterest or physics anxiety, particularly if external support is lacking.

A school's portrayal of physics either casts it as key for all or as an elite subject shaping student identity and desire to stay in STEM. Research from Sadler and Tai (2001) shows if students feel that their educational settings “see” and give support to them, it heavily influences their long-term engagement with science. Other variables such as gender and language intersect with school type. These variables can cause compounding of the affective experiences for students or cause a reduction. Girls in high-performing schools, for instance, may feel more empowered in physics classes because of female role models along with peer norms, while boys may experience demotivation in under-resourced schools despite initial strong interest.

School type, to summarize, structurally increases negative or positive attitudes. The present study does include a diverse sample of students coming from NIS and BIL and general schools. It seeks to probe how context within institutions molds physics engagement that is emotive and inspiring. Through comparing these groups, the research seeks to identify not only what students feel, but also how the school environment helps to produce and sustain those feelings. Students in selective schools or schools improved academically report higher motivation, lower anxiety, and also greater interest in science subjects per studies in Turkey, Singapore, and Finland. These are the contributing factors for this case.

1. Access to qualified teachers

2. Well-equipped laboratories

3. Exposure toward science competitions can be helpful. Olympiads are also helpful.

4. Emphasis on STEM careers

NIS schools of Kazakhstan and BIL students often show greater achievement and more positive attitudes toward science than peers in general schools.

2.8 Attitude Measurement Scales

Over the years, physics education researchers have developed quite a few tools for the gauging of students’ views of physics as well as similar sciences. The dimensions that they capture, a theoretical orientation, and a structure are all different in these measurement tools, but still a common goal is shared: to better understand just how students emotionally and also cognitively engage with the subject.

Researchers use eight attitude measurement scales in empirical studies of science and physics education below because they are widely cited.

1. A 21-item scale was validated for the high school students and specifically developed. Six subscales that are included are Motivation, Interest, Self-Efficacy, Academic Engagement, Physics Anxiety, and Math-Related Anxiety. The scale is useful for national use and cross-cultural use, showing prominent reliability (Cronbach's alpha from 0.88 to 0.95). This scale was used in this study.

2. Adams et al. (2006) developed the CLASS instrument to assess students' beliefs about physics alignment with expert views. Across 42 items it covers categories such as problem-solving confidence, personal interest, and real-world connections. CLASS has been used within university physics courses extensively. University physics courses widely use CLASS.

3. Redish et al. (1998) designed this survey to evaluate students' expectations about physics learning. Its six dimensions include independence, coherence, and equations' role. Instructional impact often is assessed through using MPEX pre- and post-instruction.

4. ATSI, which was developed by Germann (1988), includes 48 items that are covering enjoyment, value, and anxiety toward general attitudes of students. Although it is not physics-specific, it has been adapted into physics education studies and remains widely cited.

5. These scales which are the Mathematics Anxiety and Confidence in Learning Math subscales have been used in studies that link math attitudes to performance in physics like Ashcraft & Kirk (2001) though they were originally intended for mathematics.

6. Halloun & Hestenes (1998) developed VASS which explores students' views on science and physics learning. It uses forced-choice items in order that it compares student responses as against idealized scientific reasoning.

7. This scale measured attitudes toward science in both middle school students and high school students (Fraser, 1981). Attitude Toward Scientific Inquiry and Normality of Scientists along with Social Implications of Science are those seven subscales that are included.

8. Glynn et al. (2011) developed upon the SMQ. It measures science motivation with regard to intrinsic motivation, self-efficacy, self-determination, and career motivation. Motivational constructs are better understood when used alongside physics-specific tools.

Through these instruments researchers can assess students' attitudes toward physics. These instruments can provide diverse lenses for vision. Some focus upon emotional responses like anxiety. Others will focus upon motivational factors or belief systems. Instrument choice depends on research objectives, age group, and educational context. The scale from Gürler & Baykara (2020) was chosen within this study because of its specificity for physics, plus its strong psychometric properties, along with its alignment with the six-factor theoretical framework of the study

2.9 This Study is Justification for the Research and Fills a Gap.

Despite a substantial body of international research on students' attitudes toward science as well as physics, there remains a noticeable lack of empirical studies that explore the affective plus motivational dimensions of physics learning conducted in Kazakhstan and other Central Asian countries. Many studies stress cognitive results such as conceptual understanding, curriculum coverage, or test scores, but students' feelings regarding physics or emotional barriers or confidence receive scant attention. Many prior studies have used general science attitude measures instead or focused first on mathematics or chemistry. Very few instruments tailor themselves to capture the complexity of attitudes specifically toward physics—a subject that combines conceptual abstraction coupled with mathematical reasoning and often fascinates and frightens students.

By applying a validated, physics-specific, six-factor scale that was originally developed by Aydın Gürler and Baykara (2020), this study addresses this gap with such dimensions as math-related anxiety and academic engagement, those not always present within earlier tools. This research generates localized reliable data about students' affective experiences in physics classrooms including variation across gender and school type (e.g. specialized vs. general schools). This research uses such scale within the Kazakhstani secondary school context.

This research is justified additionally by the need for support of efforts at STEM education reform in Kazakhstan. It is especially justified regarding the country's aims for digitalization, innovation, and global competitiveness. Active curricular and instructional reforms occur in many schools such as NIS and BIL yet little is known about how students motivationally and emotionally respond to these changes or whether such reforms are improving long-term attitudes about physics. Another important aspect does provide justification for itself. It relates also to gender. Female physics students often feel less confident and more anxious according to international studies. It still remains unclear as to how these trends manifest within Kazakhstan, particularly within urban, multilingual, academically selective schools. To summarize, this study fills a gap of geographical also methodological by:

1. Physics-specific attitudes are targeted by a multidimensional, theory-grounded tool.

2. Data that is quantitative is given from Kazakhstani students in many grades and schools.

3. We explore emotional and motivational barriers, like anxiety, which are often underexamined in local educational research. It does offer practical perceptions now for teachers and for administrators and policymakers. These views depict how physics involvement and fairness are improved.

This study contributes to the academic literature and also functions as a practical resource since stakeholders seek to create more emotionally inclusive, motivating, and effective physics educational settings in Kazakhstan and in similar contexts.

2.10 Physics in the Context of STEM Education

Physics plays a central role inside STEM education's larger structure because it involves Science, Technology, Engineering, and Mathematics. Physics is a discipline providing basic knowledge toward understanding nature. Also, it aids us in designing technical systems to solve engineering problems. Analytical thinking, problem-solving skills, and quantitative reasoning—skills transferable into many areas of science and technology—are also cultivated. STEM field development is a priority within the educational policies of many countries, including Kazakhstan. This has happened during recent years. These efforts reflect global recognition that technological innovation and scientific literacy will increasingly drive future economies. Within this landscape, physics acts as a “gateway subject” that gives students intellectual tools along with conceptual frameworks. These tools and frameworks are necessary ones for that future study of engineering along with computer science as well as architecture with other technical professions (Sadler & Tai, 2001).

Physics often is challenging to place within the school curriculum though it is important. Physics seems abstract, mathematical, and difficult to students more than biology or chemistry does. This perception is able to negatively affect student motivation also to cause a low enrollment within elective physics courses, especially at more high grade levels. Globally, the underrepresentation of students specifically of girls in university physics programs in addition to advanced physics tracks is a well-documented issue (Wang & Degol, 2017). For the purpose of addressing all of these challenges, STEM education advocates stress that physics instruction has to be conceptually rich and emotionally engaging. Physics education needs to impart theoretical knowledge for STEM effectiveness. Also, it must apply real-world applications to hands-on experiences along with inquiry-based learning. When students see physics explain everyday phenomena or they support exciting careers in innovation, then interest and motivation increase. Furthermore, integrated STEM approaches, because they do blend content from multiple disciplines, allow students to see just how physics relates to technology, engineering design, and also digital tools. Projects for combining principles of physics with either robotics or with programming are creating emotional experiences which are positive for reducing anxiety plus fostering confidence while still deepening understanding. Nazarbayev Intellectual Schools (NIS) as well as Bilim-Innovation Lyceums (BIL) have already begun implementing such interdisciplinary approaches within. These institutions exist inside of the Kazakhstani context. Variations within physics attitudes across schools may arise because general education students lack laboratories, digital tools, and new teaching methods at times. Ultimately, to improve students’ attitudes about physics is not only a matter of academic success—it is important that we build the next generation of STEM professionals. Content mastery is not as important as emotional engagement or motivational support and purpose. Educators are able to help students to connect abstract ideas with meaningful outcomes through embedding physics inside a broader STEM vision. This transforms the way that the subject is perceived and experienced.

2.11 International Comparisons in Physics Attitudes

Understanding how students in different countries view physics offers perspective to assess and increase physics learning in Kazakhstan. Many cross-national studies have investigated students' attitudes, interest, and emotional responses about physics. These studies revealed universal trends along with culturally specific patterns. The ROSE project (Relevance of Science Education) provides for one of the most wide-ranging of the datasets. It surveyed 15 year olds in more than 40 nations. The study revealed that physics receives little enthusiasm coupled with much worry from students in rich nations such as Norway, Japan, and Germany given its perceived difficulty and detachment from real life (Sjøberg & Schreiner, 2005). In contrast, students from several developing countries, including Ghana, the Philippines, and Uganda, were more enthusiastic, although people sometimes attributed this to they had limited exposure to practical science also they idealized science careers.

The Trends in International Mathematics and Science Study (TIMSS) also gives perception into students' science attitudes. From East Asian countries (e.g., Singapore, Korea), students performed well in physics and reported relatively high confidence levels in the 2019 round. They did express test-related stress and pressure to perform though. Interest levels were moderate for students in the United States plus some European nations yet gender gaps were quite persistent especially in physics-related topics (Mullis et al., 2020). That the attitudes with respect to physics tend to decline along with age especially throughout the middle to upper secondary school transition many studies reveal. That decline is more severe in physics than it is in biology or chemistry as highlighted by Osborne et al. (2003) and by George (2006). Researchers say abstraction increased as math demands grew heavier, also teaching methods fail to maintain emotional engagement as students progress. Researchers attribute this trend to each of those failures. In Turkey, Aydın Gürler and Baykara (2020) developed a six-factor attitude scale similar to this study's. The patterns their findings revealed were similar to Kazakhstan patterns so students were interested as well as generally motivated, but girls especially had high math and physics-related anxiety. The work stresses treating emotional responses as critical for science education reform. Emotional responses should not have to be viewed as being peripheral.

Studies do show that students in Finland, a nation known for its top-performing education system, view physics in a more favorable way when instruction is inquiry-driven or student-centered and also practical. Emotional support, teacher autonomy, and a lack of standardized pressure contrasting with many exam-oriented systems result in a more relaxed attitude toward learning science. Student attitudes can improve inside the UK and US systems when physics is made more relevant to future careers and everyday life. Programs connecting physics with climate change as well as sports biomechanics or medical imaging, for example, have had positive effects on perceived value and on interest (Sadler & Tai, 2001). Some of the patterns across all of these international contexts happen to be consistent. Girls can be more anxious as well as more confident than are boys. Still, girls achieve likewise. Student motivation and enjoyment receive large influence through school culture. Teacher attitude also has an influence on student motivation along with enjoyment. Engagement increases when you integrate real-life applications. Math related stress is a large factor as people globally avoid physics. This study highlights the local solutions that include the stronger teacher training as well as emotional scaffolding and the improved access to resources for non-elite schools, while underscoring the global nature of challenges that are present in physics education via comparing Kazakhstani data to these international patterns.

3 Research Methodology and Design

3.1 Overview of the Research Approach

This study investigates the attitudes of secondary school students in Kazakhstan toward the subject of physics, and it uses a quantitative cross-sectional survey design for the study. Examining how students' demographic background with school environment relate to affective including motivational dimensions like interest, anxiety, motivation, and confidence is the central purpose. Because students form strong academic identities and make important educational decisions during this important developmental period, the study focuses on learners in grades 9, 10, and 11.

3.1.1 Rationale for Quantitative Design

Several of the reasons did lead to the selection of a quantitative approach. The study seeks for measurement of internal attitudes of students. The measurement should be structured, systematic, and analyzed statistically. For investigating psychological constructs like interest, motivation, and anxiety, quantitative designs work well. Likert-type scales are especially useful in these designs because they allow for comparison across people as well as groups. Qualitative research seeks for one to understand individual meaning-making within its depth. This study seeks to identify broader patterns and differences within a large sample of students.

Second, the research required a design of sorts. This design allows for the process of standardization and also replicability. An instrument for surveys that was validated enabled data collection using a format that was consistent. It did so across multiple school types, grade levels, along with regions. To determine if differences are observed as being between groups such as boys and girls or specialized compared with general students, enabling inferential analyses such as t-tests was important to do.

Third, a quantitative method had been also favored within time and resource limits. Many schools and pupils were participating. Therefore, conducting interviews or focus groups would not have been feasible then. Students' schedules, exam periods, and school policies restricted data collection time. To complete a short anonymous survey took 15–20 minutes plus it offered a practical solution. The survey yielded rich data still.

3.1.2 Justification for a Cross-Sectional Design

A cross-sectional design was adopted for this research. This means data collection occurred at just a single point in time. This design is one that is commonly used in educational research. It particularly helps with assessing present beliefs, behaviors, or attitudes. It is particularly appropriate in studies that involve school students, as longitudinal follow-up can be difficult because class composition, grade level, or school enrollment changes.

Key groups including grade level, gender, and school type can be compared within a cross-sectional snapshot without long-term tracking. To describe current views, finding key gaps or strengths works well, but this method fails to show attitude growth. Later longitudinal or intervention-based research can use these findings as basis.

3.1.3 Importance of Studying Grades 9 to 11

Educators took into consideration pedagogy and also development. Therefore, they made a decision for focusing upon students in grades 9 and also through 11. Physics within the Kazakhstani education system is quite often introduced formally as just a distinct subject when all students reach into grade 9. At this point, students begin to engage with abstract concepts in addition to mathematical representations influencing their emotional as well as cognitive responses to the subject.

In grade 10, students are able to begin to specialize in vocational, in humanities, or in science tracks. Often, their experiences shape these choices. These events happen during grade 9. Grade 11 marks the final year of secondary education for many students as well as heavily orients itself toward preparing for university entrance. Usually, these grade's students possess the most firm attitudes toward subjects like physics plus great academic pressure.

Researchers can examine developmental trends through studying all three grades. For example, one may hypothesize that motivation declines across time while anxiety increases, or that interest peaks in grade 9 then fades by grade 11. Cross-sectional design limits change over time conclusions, but comparing cohorts from each grade gives perceptions into how students’ attitudes evolve during this stage.

3.1.4 Kazakhstan-Specific Context and Relevance

Because of its unique context, student attitudes toward physics can be studied in Kazakhstan. Educational reform, including science and mathematics, has received heavy investment from the country. Updated are the curricula, and trained are the teachers plus international assessments and well-equipped laboratories make institutions such as Nazarbayev Intellectual Schools (NIS) and Bilim-Innovation Lyceums (BIL) flagships for modern pedagogy. However, the majority of students still attend at general or customary public schools. Instructional quality as well as access to resources can vary a great deal in these schools.

These systemic differences that exist in a school context are likely to affect student achievement and do also engage them emotionally with physics. Specialized school students may be more confident and interested given academic environment and teacher quality while general school students may have higher anxiety or lower self-efficacy. For policymakers as well as educators, focused actions that support underrepresented groups can be designed through understanding variations.

Furthermore, Kazakhstan is lacking in large-scale empirical research. This research should focus specifically upon the emotional and also motivational orientation for students toward physics. Most national studies focus on performance outcomes or curriculum content, with little attention toward the psychological factors that influence how students learn. To address this gap, internationally recognized theoretical models and instruments are used in this study.

3.2 Population and Sampling Strategy

For this study, the sample in Kazakhstan consisted of 195 secondary school students in grades 9 through 11. Purposive sampling, being a non-probability technique for ensuring inclusion of participants originating from diverse educational settings, was used for the selecting of the students. Sampling intended to show variance within curriculum framework. Student academic background alongside instructional environment was also considered.

3.2.1 Gender Distribution

Total students included in the survey numbered 195.

106 were girls (54.4%)

89 were boys (45.6%)

Table 1. Gender Distribution

Gender	Amount	Percentage
Female	106	54.36%
Male	89	45.64%

3.2.2 School Types and Institutional Characteristics

The sample included students among these school types:

Nazarbayev Intellectual Schools (NIS) Schools are academically superior and state-funded. These are schools that receive government funding. A focus regarding international benchmarks as well as inquiry-based science Admission selectively based upon academic performance

Bilim-Innovation Lyceums (BIL) Private and also highly academic schools do educate them in STEM fields. They are known because they prepare the students for physics Olympiads and competitions. Schools divide boys and girls (e.g., Kokshetau BIL, Almaty BIL)

Zaman International School Instruction in multiple languages with a curriculum that is global. It stresses on the 21st-century competencies in the project-based learning.

General Public Schools such as those like SDL Nurorda Nurmakov. Customary Kazakhstan curriculum Instruction varies to a wide degree based on resources, teacher training, and the region.

This sampling approach captures students from general education systems, specialized systems, and international systems enabling comparative analysis of school environment's influence on physics attitudes.

Table 2. Type of School

Type of School	Amount	Percentage
Lyceum / NIS (Physics-Math)	146	74.87%
Private School	49	25.13%

3.3 Research Instrument: Structure and Content

The study measured students' attitudes on physics using a 21-item survey instrument Aydın Gürler and Baykara (2020) adapted. Originally, they developed and validated the scale in Turkey for high school students and it has demonstrated high reliability across multiple contexts. The Kazakhstani adaptation retained much of the same six-factor structure, while they made an adjustment to it linguistically and also contextually.

3.3.1 Dimensions of the Attitude Scale

There were a total of 21 items organized into six separate subscales. The list that follows details each of these subscales. Physics tasks are a reflection of the effort and of the persistence that students show. Example: "In a physics lesson I do my best in spite of how hard the task might be." Measures of engagement intellectually and of enjoyment. Example: "Physics courses can be interesting for me." Physics students have a belief that they can have success. For instance: "I am a good student. I can earn good marks in physics." Continued interest and also behavioral intentions are thereby reflected. I wish to enroll in all physics courses available. I want to do this during the course of my educational life. Emotional reactions like fear or discomfort occur in class. Anxiety can fill me up when I do some physics courses. Fret about math's physics portions An attempt to read a sentence full of mathematical physics formulas with unfamiliar symbols scares me.

1 = Strongly disagree

2 = Disagree

3 = Undecided

4 = Agree

5 = Strongly agree

Table 3. Factors

Factors	Questions
Motivation	8, 9, 10, 11
Anxiety about Physics	4, 5, 6, 7
Interest in Physics Courses	1, 2, 3
Self-sufficiency	12, 13, 14, 15
Student Interest	16, 17, 18, 19
Anxiety about Math	20, 21

3.4 Translation, Adaptation, and Validation of the Instrument

The original version of the attitude scale, developed in English by Aydın Gürler as well as Baykara (2020), was used without translation in the current study. All participating schools instructed partially or fully in English like NIS and BIL, and students accessed academic content in English. Therefore, adaptation to the language within the items was not done at all. It was unneeded. The wording of all 21 items remained unchanged and the scale was administered in its original form.

3.5 Reliability Analysis

Cronbach's alpha coefficients using the full dataset (N = 195) were calculated for each of the six subscales to confirm the scale's internal consistency as well. All subscales exceeded the commonly accepted threshold of $\alpha = 0.70$ showing very high reliability.

Table 4. Cronbach's alpha

Factors	Cronbach's alpha (α)
Interest in Physics Courses	0,98
Anxiety about Physics	1,00
Motivation	1,00
Self-sufficiency	0,97
Student Interest	0,96
Anxiety about Math	1,00

These coefficients indicate precision measurement for a single underlying construct also high correlation of items within each scale. Students' consistent comprehension for the attitudinal dimensions and the clarity of item wording may reflect the high values. Alpha values in this context confirm outstanding reliability of the instrument, though values near 1.00 sometimes signal item redundancy.

3.6 Data Collection Procedure

The survey was administered through Google Forms, a secure and user-friendly platform, and this platform enables remote data collection while ensuring automatic response recording. For cutting paper use, for easing access across school settings, and for allowing real-time participation monitoring, the digital format was chosen.

From April to May 2025 data collection occurred for three weeks. Each participating school received a briefing email containing:

1.The research project's description

2.Survey link available.

3.A script for teachers tells students the purpose and procedures.

4.Guidelines about participation's anonymous and voluntary nature

Physics teachers at each school distributed the survey during regular class hours at what was typically the last 20 minutes of a physics lesson. The survey had to be completed by students on an individual basis. Classmates were not to receive answers from them. Teachers did remain present so that they could supervise tasks but they were instructed not to interpret those items or offer them help.

1.Reliability is in fact increased plus response bias is as well reduced by:

2.Each of the questions needed to be answered in their entirety.

3.They randomized the order of questions for each student in part.

4.Students were assured responses would remain as confidential also anonymous.

5.The survey did not request names or grades. The survey did also omit requests for personal identifiers.

Most students completed the form within the given time. That time was in the range of 15 to 20 minutes. Responses were automatically stored upon submission in a secure Google Drive folder accessible only to the principal researcher, university-affiliated. After exporting to Microsoft Excel, IBM SPSS Statistics 25.0 analyzed the dataset. All schools had high participation rates, and technical difficulties were not reported during the test administration.

3.7 Data Processing and Screening

Data collection completed, responses were exported from Google Forms into Microsoft Excel thereafter. The data was then subjected to further processing and also analysis after being imported into IBM SPSS Statistics 25.0. Several screening steps ensured the quality of the data when conducted.

Google Forms required all questions to be completed prior to submission thus none were found. Each student could submit only once therefore no duplicates existed. Response patterns that were suspicious: No such cases were detected at all, but data were checked strictly for “straight-lining” (that is, selecting the same answer throughout the survey). Since all of those responses were each completed inside of a reasonable time frame (10–25 minutes), none of them were then excluded. Following screening, the final dataset consisted of 195 complete valid responses. The average of the relevant ratings was used to find the mean score. Each of the six subscales had this calculation done.

3.8 Statistical Analysis Techniques

SPSS was used for analysis of the data using descriptive and comparative statistics. Two main types underwent analysis.

Descriptive statistics were found regarding each of the six subscales—Motivation, Interest, Self-efficacy, Academic Engagement, Anxiety about Physics, and Math Anxiety. The mean as well as standard deviation in addition to variance were calculated for the purpose of getting these statistics. Students' attitudes along with emotional responses toward physics were viewed overall using these values.

For comparing average scores between those two groups, researchers involved independent samples t-tests. Gender comparison: Boys as well as girls differ throughout each of the six subscales. In school type comparison: Students who are from general education schools and students who are from specialized academic schools such as NIS and BIL do differ. A threshold of importance of $p < 0.05$ was what was used, and all of the comparisons were evaluated then. The difference was viewed as being statistically important. This was only in the event the p-value was below 0.05. In this case, no other statistical procedures were in use. The analysis was relevant to the research questions in addition to being kept simple. Interpretations and results of the t-tests are in the next chapter.

3.9 Ethical Considerations

During the study, ethical guidelines got followed. These principles happen to be the following: Students participated by choice: They were told that they could stop or decline at any moment. There were no names collected or any of the personal data: only anonymity and also confidentiality. The responses were stored securely for academic purposes alone. The study's aims plus methods were disclosed to teachers therefore their help distributing surveys during physics classes was helped by school cooperation. Before the survey began, students were informed about the purpose of the research. Also, they were told their responses would be kept private. Research supervision involved review coupled with approval by an academic advisor. The advisor was in affiliation with such a university. The data collection presented absolutely no ethical violations at all. Neither did the analysis.

3.10 Limitations of the Methodology

The research design suited the study goals while we acknowledge several limitations about it. Some items were able to be misunderstood, or students may have answered in such a socially desirable way: Self-report bias. Cross-sectional design reflects student attitudes during a single point in time. The study is one that does not track changes across time.

Sample limitations: The sample included academically focused urban school students only on its own. Attitudes of students from rural, vocational, or under-resourced schools were not captured. Open-ended questions and interviews were not included for the reason that deeper perceptions into student reasoning and feelings could have been provided. Within Kazakhstan, the study gives a quantitative snapshot of students' physics attitudes despite limitations.

4 Results and Discussion

4.1 Descriptive Results

This chapter presents the results for when we statistically analyze students' attitudes toward physics and deeply discusses all of the findings. It is the seek to explore the overall trends that are in student responses, to identify statistically meaningful differences across gender and school types, and to interpret the results in the context of existing literature and also educational practice in Kazakhstan.

A scale of 21 items was the tool that was used for the collection of data. It was covered in six key dimensions.

1. Motivation toward physics
2. Interest in physics courses
3. Physics self-reliance, also self-assurance
4. Academic engagement (future orientation)
5. Meaningful physics class anxiety exists.
6. Physics learning with math-related anxiety

Independent samples t-tests and descriptive statistics were used in order to analyze each dimension. Overall averages and patterns observed throughout the entire sample (N = 195) are presented at first, after that comparisons founded on both gender and school type do proceed, and at the last point the broader implications from the findings are interpreted.

Descriptive statistics were calculated by using the full sample of 195 students for each of the six attitude dimensions. These statistics include the mean, variance, and standard deviation (SD).

Table 5. Descriptive statistics

Factors	Mean	Variance	SD
Interest in Physics Courses	3,48	1,21	1,10
Anxiety about Physics	2,63	1,38	1,17
Motivation	3,48	1,21	1,10
Self-sufficiency	3,46	1,16	1,08
Student Interest	3,41	1,42	1,19
Anxiety about Math	3,1	1,7	1,3

These values reveal several important perceptions into students' emotional and cognitive relationship toward physics and this is why:

1. Motivation Toward Physics

Students generally report a level of personal effort in physics courses that is moderately high, as the average motivation score of 3.48 suggests. A standard deviation of 1.10 is fairly low showing similar responses from students. Variation of or among the students was fairly limited. With positive agreement, students reported statements like "I do my best in physics courses" and "I try even harder when I fail". Many of the students are committed to trying for their best, despite of challenges within the subject, this suggests. This result is heartening because motivation predicts effort and academic resilience strongly. It agrees with earlier studies showing that students often persist. If students do value the subject, they show persistence despite struggling with anxiety or with confidence (Pintrich & De Groot, 1990).

2. Interest in Physics

Subjects were equally motivated by interest averaging 3.48. This suggests the idea that most of the students engage in physics intellectually or do at least partially enjoy physics. "I find physics courses interesting" and "I'd like to know more about physics" were statements rated with positivity by students. This level of interest exists in Kazakhstan, seeing that physics is often perceived across countries as quite difficult and abstract. Some international studies (e.g., Salta & Tzougraki, 2004) have shown a decline of interest as physics becomes more mathematical. However, the data here suggest many students remain engaged, possibly from efforts in Kazakhstani schools to modernize instruction.

3. Efficacy or Self-Sufficiency

For students, belief in their ability for succeeding in physics showed a mean score of 3.46 for self-efficacy, with low variability. This suggests that many students can be confident of their own abilities, but such confidence is not overwhelming. A moderate level of agreement was consistent with statements such as “I am smart enough to handle physics”. This outcome could show how academic streaming impacts Kazakhstan: schools focused on academics often put students in science tracks. Confidence could then be able to be increased. Meaningful differences according to gender or school type could also be masked through this average (analyzed later).

4. Academic Engagement

Academic engagement had an average score of 3.41. It was a bit less high than other good scales. This subscale reflects the orientation of students toward their futures whether or not they want to take physics beyond the curriculum that is required. This slight drop could indicate fewer students now see physics as a subject they want to pursue long-term although they are motivated and interested. Items such as “I want to take as many physics classes as I can” or “I’d like to take physics even if I don’t have to” had more varied answers. A smaller number of students opt to specialize in physics, in alignment with international trends. Their general attitudes can be positive, even so. External pressure, difficulty, and career interest may influence these decisions.

5. Anxiety About Physics

That average physics-related anxiety level was 2.63 which is below the scale midpoint. Generally, this suggests students report not high levels of emotional discomfort during physics classes. However, it is the higher standard deviation (1.17) that indicates responses do vary greatly. Some students probably feel much anxiety, but others feel relaxed. Many students expressed moderate disagreement toward items like “Physics makes me nervous and confused” and “Physics courses fill me with anxiety”. Nevertheless, this subscale reflects just a real emotional barrier. It does so within a portion of the sample.

6. Math-Related Anxiety

Among all the subscales math-related anxiety had a variance figure of 1.70 and a standard deviation figure of 1.30. The mean score was 3.10, a value slightly above the midpoint. For many of the students, this indicates that stress remains due to aspects of physics that are mathematical. This has been shown to be the case here. Many respondents showed high agreement with items like “Trying to read a sentence full of mathematical physics formulas scares me”. Prior research reveals math anxiety may reduce confidence also limit engagement. In subjects like physics this is especially true since they rely heavily on symbolic language (Ashcraft & Kirk, 2001).

4.2 Comparison by Gender

Independent samples t-tests for each of the six subscales explored differences between male and female students' attitudes toward physics. For potential differences, motivation and interest along with confidence and engagement with anxiety levels were examined. Attitudes toward physics mold academic life plus students' self perceptions. Many students internalize the idea about physics as a subject for “smart” or “logical” people. This is often implicitly coded as being male or being competitive or being elite. Such perceptions based in identity can discourage capable students from viewing themselves as “physics people.” Environments in inclusive classrooms are created so as to normalize diverse approaches for thinking and for problem-solving which may help students connect physics to their future goals and to their own identities, therefore making the subject more appealing and accessible.

Below are the results. These arise via gender comparisons.

Table 6. Gender comparisons

Factor	Girls (Mean)	Boys (Mean)	p-value	Significant
Motivation	3.46	3.51	> 0.05	No
Interest in Physics	3.44	3.53	> 0.05	No
Self-Sufficiency	3.40	3.54	> 0.05	No
Academic Engagement	3.36	3.47	> 0.05	No
Anxiety about Physics	2.78	2.45	< 0.05	Yes
Math-Related Anxiety	3.29	2.88	< 0.05	Yes

Observed statistically meaningful gender differences appeared only within two anxiety subscales shown in the table.

Girls reported greatly higher anxiety about mathematics in physics and about physics.

No important differences between male students and female students existed for the motivation and for interest and for self-efficacy and engagement subscales. Gender continues to be a relevant factor for one in physics education, especially when you are examining interest, anxiety, and also confidence plus affective and motivational dimensions. Many studies showed comparable physics achievements between boys and girls. However, girls reported more anxiety and felt less self-confident, even performing likewise. These differences are often linked to social expectations or classroom dynamics however are not necessarily based upon ability as well as the lack of female role models in STEM fields. Investigating gender-related patterns helps one identify emotional barriers preventing capable students especially girls from engaging with physics fully or pursuing it after school.

4.2.1 Analysis of Non-Significant Differences

The lack of meaningful differences in motivation, interest, and self-confidence suggests that both boys and girls feel likewise engaged and capable when it comes to physics. This is a result that is positive contrasting with typical stereotypes. Those stereotypes suggest girls have less motivation or confidence within STEM.

Recent research supports these findings alongside indicating gender gaps in physics motivation tend to disappear upon given equal access to resources and instruction (Cheung, 2009; Sadler & Tai, 2001). Since girls and boys experience physics education more equally, NIS and BIL schools in Kazakhstan may provide environments that reduce typical gender-based differences.

Boys' motivation, interest, and self-efficacy scores were a bit higher, interestingly, yet these minor differences lacked statistical importance. Generally, this indicates opinions within these key mental fields stay equal between sexes.

4.2.2 Anxiety Differences by Gender

Emotional responses that were given to the subject revealed a statistically meaningful gender gap especially in: During the course of physics lessons, girls reported even more feelings of nervousness in addition to confusion as well as discomfort and also anxiety.

For girls, it was more likely that they would report physics formulas caused a feeling of stress or fear. Anxiety that is Math-Related may be responsible in some cases for their feelings about unfamiliar symbols. Consistent with international findings, female students report more academic anxiety particularly in math or symbolic reasoning subjects (George, 2006; Ashcraft & Kirk, 2001).

Higher anxiety for female students within this study did not correspond with lower confidence as with interest. This suggests that it is such that while girls remain motivated and engaged, they may feel more of emotional pressure or stress in the physics classes. They can especially feel that when they solve those problems or use some formulas. Observed gender differences within anxiety do include several possible reasons.

Girls may internalize that physics is a “male-dominated” field because of social expectations and stereotypes; stress increases performance in this subject. Within classrooms, boys might speak more often or control problem solving, which could change how girls feel and their desire to join in. Typical methods that assess instruction often feature tasks with timed problems that could make students more anxious particularly those fearing failure. That girls scored equally to boys in motivation along with interest is an important fact despite these pressures. It shows their caring about the subject with their wanting to succeed even if they experience more anxiety.

4.2.3 Educational Implications

The findings of this study do have several important implications in Kazakhstan with respect to teaching practices, curriculum design, also school-level decision-making. The need for targeted educational responses is suggested by emotional barriers such as physics-related and math-related anxiety particularly among girls as well as students from general schools, although students overall expressed positive attitudes toward physics especially in terms of motivation and interest. Teachers are often the factor most influential at shaping students' attitudes toward physics. Learners are more likely to develop curiosity coupled with resilience when instructors are enthusiastic, supportive, as well as relatable in teaching abstract content. Anxiety is able to increase and also motivation is able to lower with such rigid exam-focused teaching without any emotional support. Conceptual challenges are especially high in subjects like physics even now. Emotional security and learning participation are affected by teacher behaviors. This behavior has an effect upon cognitive understanding.

First, teachers should give close attention to the ways that learning affects students. Lots of students may seem engaged but silently battle with anxiety. This battle is in fact especially obvious when you are working with equations or with symbolic content. Educators can reduce this pressure by fostering a classroom where students treat mistakes as learning and frame success as effort and progress instead of correctness.

Also, greater linkage of math with physics learning mainly in junior high classes is vital since pupils showed intense math-based unease. Prior to the task of introducing formal notation, teachers may wish to consider conceptual explanations, step-by-step scaffolding, and even visual aids. Math and physics departments could collaborate through cross-curricular ways. Students might then build confidence by degrees.

Third, teaching methods as well as resource access do shape attitudes, as the clear advantage for students in specialized schools (NIS, BIL) suggests. Programs for professional development with a focus on strategies for instruction that are inquiry-based, student-centered, and emotionally supportive would be of benefit to teachers in general education schools.

Fourth, curriculum developers should be considering a revision of how physics is introduced at the grade 9 level. It must stress curiosity along with exploration not heavy abstraction. Experiencing physics earlier can shape how long students engage, and a supportive start can help prevent students developing negative attitudes.

Ultimately, methods aware of gender matter. Girls in this study were motivated like boys yet higher anxiety scores imply strengthening emotional support while including more classrooms. If people promote female role models in physics, if people encourage equal participation in discussions, also if people offer mentoring opportunities, these actions may help close the emotional engagement gap.

In sum, we must address cognitive as well as emotional factors. This is needed by students in order to increase their experience of physics. Affective support, math preparation, inclusive pedagogy, also school equity are important focuses. These focuses help ensure all students can learn physics with curiosity and with confidence, not only those in elite institutions.

These results highlight the need for gender-sensitive strategies in physics education. Teachers should be aware about emotional differences and create a compassionate setting. This environment must reduce anxiety, especially when working via formulas and equations. For all students plus especially for those that are experiencing high anxiety confidence may gradually build through formative feedback with peer collaboration along with differentiated instruction. Physics content needs real-world applications plus diverse role models because this appeals to both genders reducing subject emotional distance. Addressing all of the emotional barriers in the classroom and understanding them may help to close down the participation gap for science careers and advanced physics courses.

4.3 Comparison by School Type

Comparing student attitudes in Kazakhstan who attend varied schools was an important objective of this study. For this analysis, the schools were grouped into two broad categories. School culture—including the way teachers teach, the feeling of classrooms, and peer expectations—strongly influences how students perceive subjects like physics. High standards will often pair with the improved resources with well-trained teachers and with academic confidence in the selective schools such as NIS or BIL. Positive attitudes are fostered along with fear of failure being reduced by this combination. Physics, in contrast, may seem distant, difficult, or imposed on students in general education schools. They experience it in that sort of way. Student attitudes become rather defensive or passive. They will more likely get this outcome without inquiry, project-based learning, or mentorship. To bridge such a cultural divide, system-level efforts actually are required because those particular efforts ensure that all students, with no regard to school type, do have access to educational settings engaging them emotionally and intellectually.

Specialized schools also include Nazarbayev Intellectual Schools (NIS), Bilim-Innovation Lyceums (BIL), and the Zaman International School. A rigid process helps these schools admit select students. Also, they can improve STEM programs, focus intently on international issues, and offer ready access to modern laboratories and other resources.

General schools – Nurmakov School, Nurorda Oskemen, SDL, and other public or non-selective schools are included, since the teaching of physics is more customary, and resources may be limited there. Independent samples t-tests occurred between the two groups to see if student attitudes differed greatly. In five of six categories, statistically meaningful differences between the types of school were revealed in these results. Reports for students came in specialized schools. Greater motivation, greater interest, stronger self-confidence, and higher academic engagement. Math-related anxiety levels that are under. Concerning general physics-related anxiety, the groups showed no statistically meaningful difference.

4.3.1 Physics Anxiety Is Generally the Same

Students from NIS, BIL, and Zaman consistently reported more positive attitudes toward physics. These students had more motivation for study as well as more interest regarding physics topics plus more confidence they could succeed.

Possible explanations include:

Specialized schools employ current inquiry-based tactics actively engaging students improving curriculum quality making physics more meaningful. For teacher qualification: It is that of following international standards and of receiving special training that are often done for teachers in these schools which can increase student trust and instruction quality. Well-equipped labs are able to improve comprehension as well as enjoyment of the subject. Also, digital resources may as well improve subject comprehension. School culture stresses academic excellence plus competition participation like Olympiads creating a climate valuing and rewarding physics. This aligns with that which Kazakhstani and international literature has found, suggesting school environment with resource quality powerfully predict student engagement within STEM (Osborne et al., 2003).

Students in specialized schools reported greatly less anxiety about mathematics in physics; the mean was 2.93 against 3.32 in general schools. More helpful school environments and improved preparation, this implies, may lessen emotional blocks to studying math-related material.

1. Factors that may act to lower anxiety can contribute these things.
2. Exposure early to math within physics (starting in grades lower)
3. Class sizes are smaller with support that is more personalized.
4. A smoother, more logical sequence about integrating math and physics topics
5. Teacher feedback builds confidence instead of fear.

Notably, anxiety that is math-related does strongly predict disengagement from physics. This worry has a special impact at top ranks. Schools that are specialized successfully reduce that anxiety, and this may explain something. Therefore, their students can be more willing to go after physics-related studies.

They found no meaningful difference for general anxiety about physics classes alone. Both groups achieved similar scores in totality. Students in general schools also said they had more anxiety. Even with the better instruction along with resources, this suggests that some students may still feel quite nervous. Some students also may feel confused within physics classes. Physics remains a subject that is cognitively demanding, and factors that exist in school types like conceptual difficulty, time pressure, or peer comparison can cause anxiety.

4.3.2 Educational Implications

Important implications do arise from that consistent pattern with more positive attitudes within specialized schools. Updated teaching materials, laboratory equipment, or professional development for teachers are examples of additional support that general schools may require. Student anxiety can be addressed by pedagogical strategies and curriculum alignment. These methods should build math confidence as well as reduce math anxiety too. Elite institutions transferring best practices into mainstream schools warrants consideration by policymakers preventing inequality replication. Focused actions inside general schools could help close the attitude gap. More students then would be encouraged toward science especially physics in higher education.

4.4 Cross-Factor Observations

The previous sections were focused upon the analysis of each attitude factor in a separate way. Thinking about just how the different subscales all relate to one another in practice is useful too. Patterns in all of the data with descriptive findings suggest a number of outstanding relationships. However, no formal correlation analysis was in fact conducted.

1.Motivation is what often goes together with interest.

A high interest in physics was observed along with high motivation in student responses. From intuition, this does make some sense: students are apt to exert effort in some subject that they enjoy. For example, students agreeing with “I find physics courses interesting” tended to agree with “I do my best no matter how hard the task”. This pairing reflects on a positive feedback loop that as students enjoy physics even more, they try even harder, and they feel much more successful. In specialized schools, motivation and interest reached their highest average scores. That connection was quite obvious there.

2.Self-Sufficiency Tends to Support Engagement

Students agreeing with statements such as “I am smart enough to handle physics” who thought of themselves as capable were more likely to want to keep studying physics later. This proposal shows self-efficacy promotes something. People dedicate themselves to goals of the long term through self-efficacy. This connection matters since it shows helping students build confidence could also engage them academically. It highlights that teachers need to stress progress and mastery more than grades or rankings.

3.Anxiety is something that weakens all confidence. Anxiety also weakens engagement.

In contrast to the relationships of positivity that are above, students with feelings of high anxiety often reported a lower feeling of self-sufficiency especially when related to math. Students agreeing with “Physics formulas scare me” often disagreed even with “I am capable of getting good grades” for example. This suggests that anxiety not only affects emotional comfort, but directly reduces students’ willingness as well as confidence to engage. Learning is limited so participation lowers; reinforcing anxiety, a negative cycle creates fear of failure. One of the unique challenges with learning physics is that it deeply integrates mathematical thinking. Mathematics, while it gives useful tools to model processes, may also turn into a mental hurdle. Physics is often perceived by students as being inaccessible to those struggling with algebra or with symbols or with formulaic manipulation. Typical education methods strengthen this idea when computation receives emphasis. These styles do not tend to make concepts clear at all. Math-related anxiety accordingly becomes a major affective barrier, especially among students with limited math preparation or in general education schools.

In general schools, many female students interestingly reported on this pattern: high levels of anxiety appeared for the purpose of suppressing engagement and self-efficacy, despite moderate interest existing in physics. This underscores addressing anxiety as a barrier to learning.

4.5 Discussion of Key Findings

The study's findings reveal a complex picture of how secondary school students in Kazakhstan perceive physics education. A few key patterns came up that align with global research efforts. The patterns do also reflect upon the unique features of the educational system in Kazakhstan. In many classrooms, especially those driven by standardized assessments, teachers instruct students to value correct answers and to hurry instead of exploring and understanding. In the short term, this approach may raise test scores. High emotional costs are often the result, though. Anxiety about failure develops, pressure associates with learning, also intellectual risks are avoided. Physics shows this issue well so that students might hesitate in order to speak in a class. Other problem-solving strategies may be tried by students or confusion may be expressed. Such emotional tension is something by which long-term learning is reduced, and which can also distort perceptions of students' ability. In order to address this issue, we must not only change classroom management, but also rethink what counts as success within physics education.

1. Students show interest and motivation but lack full engagement.

Across the sample, students generally report moderately high motivation plus interest levels in physics a most encouraging finding. That students “hate physics” or avoid it since it is too difficult contradicts the common stereotype. Indeed many students enjoy physics and will work hard. However, this enthusiasm does not always translate toward a desire. Physics might not be something students want to keep studying after required classes. Averages were a bit lower on the subscale, which shows work from the students now. However, a lot of them are not planning on specializing in physics later on. This gap might result from perceived career limits, exam stress, or lacking real application exposure.

2. Anxiety Still Persists, But Some Confidence Is Present

In general, students had exhibited high self-confidence within physics, and it was at a point that was especially high for students at specialized schools. Two kinds of anxiety exist, however. They remain persistent problems. General physics makes students anxious as they get nervous during class, they feel discomfort. Math-related anxiety includes that very real fear of certain equations. It also includes confusion about using formulas. The second type was particularly strong with girls. It was also found to be strong among the students in general education schools. Even if students feel capable plus motivated, emotional barriers interfere with their learning process still. These data upholding previous work (Ashcraft & Kirk, 2001; George, 2006) show math anxiety hurts science learning often. Even in the event students perform well, it often leads for them to avoid courses related to physics.

3. Gender differences are emotional but not motivational.

One quite impressive result is just that boys and also girls showed absolutely no truly meaningful difference with regard to motivation, interest, or self-sufficiency. This shows girls match boys in confidence plus engagement concerning physics topics. Girls reported greatly higher anxiety levels however, math-related and general. This suggests emotional experience in learning physics is gendered if effort and performance are not. Even when academically successful, girls may feel self-doubt, more pressure, or fear from failure. According to this finding, teacher sensitivity is important. Atmosphere inside classrooms is also important. Supportive environments with reduced fear, normalized mistakes, also encouraged participation must be created by teachers.

School type truly is a major influence. Attitudes are affected by it strongly. Students from specialized schools (NIS, BIL, Zaman) consistently reported more positive attitudes. This was in fact the case for almost all of the factors.

1. Higher motivation

2. Greater interest

3. Stronger confidence

4. Increased desire for continued physics study

5. Lower math-related anxiety

Improved curricula, experienced teachers, bilingual resources, also extracurricular opportunities reflect these advantages of schools. They point to a risk of educational inequality also, however. Although students within general schools may be equally capable, they cannot access the resources and support systems that foster positive attitudes.

4.5.1 Instructional Practices Matter

Classroom climate and also teaching methods can be linked to many differences observed within this study especially anxiety and confidence. With instruction, students are more likely to persist in physics and enjoy it.

Clear and supportive

With some real-world examples that are contextualized

Conceptual understanding is favored over simple memorization.

Practice and theory find balance.

Teacher behavior importantly shapes how students feel about a subject. Anxiety can be reduced and also self-efficacy increased through structured guidance and empathy and patience and praise.

4.6 Implications for Educational Practice

Kazakhstan's teachers, leaders, developers, and policymakers all have important implications in the study's findings. While people generally felt moderately positive toward physics, key challenges—particularly because schools create anxiety as well as have unequal conditions—still exist. If these issues are addressed, student outcomes may improve in a large way through increasing interest that is long-term in science. To build inclusive and supportive physics classrooms, both structural and interpersonal strategies must be considered by educators. They are able to adopt some mixed teaching formats that do structurally include discussion, visual models, hands-on experiments, and also scaffolded problem-solving. Formats like these help with varied learning styles. Also, they work to reduce math-related barriers. Teachers can create classroom norms stressing effort, growth, and respectful collaboration interpersonally. Simple changes—like instructors acknowledge different types of intelligence, use gender-neutral language, also celebrate partial solutions—can make students feel more welcomed. Inclusion also means we recognize those left out, such as students with low confidence or those from under-resourced schools. An inclusive physics classroom is built where all thrive plus belong in our community.

4.6.1 For Teachers

How students do feel in regard to the subject is shaped in a central way by physics teachers. Based upon what it is they found, teachers should try all of these strategies:

1. Teachers can normalize confusion feelings, allow more problem-solving time, with providing low-stress formula practice opportunities: Recognize and respond to anxiety.

2. Showing of how physics connects into a daily life and also a future career may increase an engagement. The perception for physics being abstract or even irrelevant may thus be able to be reduced.

3. Support self-efficacy: Teachers should reinforce positively, stress progress, and scaffold with help so students gradually build confidence.

4. Classroom inclusivity: It is an environment that encourages participation without a fear of judgment and may especially benefit girls.

Teachers are able to better support students who have diverse psychological needs by way of professional development workshops focusing on emotional intelligence that is within science instruction.

4.6.2 For School Administrators

A meaningful difference may be made by school leadership through use of:

1. Investing into laboratory and digital resources is important. This is especially true within general schools.

2. Participation in Olympiads, science clubs, and project-based learning was encouraged.

3. Students who are not confident but show interest in physics get academic counseling.

4. Training supports teachers, especially via differentiated instruction and student-centered pedagogies.

For students' affective engagement with physics, leadership vision with teaching culture and also resource allocation have a direct impact according to the contrast in this study between general schools and specialized schools.

4.6.3 For Curriculum and Policy Developers

The policy level creates recommendations. These recommendations are several. Integrate into the physics curriculum affective objectives like self-confidence building, stress management, real-world relevance. There is program support for schools throughout the nation where science education underperforms. By highlighting role models in physics textbooks and media, inspire students from diverse backgrounds. Initiatives for promoting similar instruction conditions in all school types should focus upon equity. National education strategies must treat students' emotional experience relating to physics just as seriously as academic performance. This is of particular importance during the key decision-making years like grades 9–11.

4.7 In-Depth Interpretation of Each of the Six Attitudinal Factors

To better understand how students experience physics emotionally and motivationally, through this section interprets each of the six measured factors in the attitude scale in depth: Motivation, Interest, Self-Efficacy, Academic Engagement, Physics Anxiety, and Math-Related Anxiety. These mean scores, variance, and observed differences appear in Chapter 4 by gender and school type. The interpretations are based upon this presentation.

Motivation within the data, with variance of 1.21 and a 3.48 mean score, is strongest. This suggests that most of the students, irrespective of their background, willingly exert an effort so as to learn physics. Despite difficult tasks, they strive for success also persevere confronting challenges. Boys and girls showed notably steady high motivation across school types though students in schools like NIS and BIL reported higher scores. Motivation may exist across the board for everyone, yet it is nurtured and is reinforced in those better-resourced educational settings. Students may feel more motivated when they perceive that they can achieve success, teachers as well as peers support it, and they value it. Confidence and interest can be built upon the positive foundation that is reflected by the strong showing in motivation. An opening is visible too. Students that are with motivation may be more receptive to the interventions.

Interest received a high mean score of 3.48, indicating students find physics enjoyable and intellectually engaging. This interest, however, appears sensitive to teaching style, curriculum relevance, and classroom culture, also toward fragility.It is likely that interest was higher within specialized schools because the students do encounter real-world applications, and lab work, and much more interactive instruction. In contrast, general school students may receive more lecture-based, exam-oriented physics. This physics may be structured in form, but this structure may not sustain emotional engagement.

It is important to note long-term commitment is not always produced by interest. Some students expressed interest in physics now but felt uncertain about further study. This highlights the need then for continued stimulation to maintain student enthusiasm. Projects, competitions, also applied topics can help keep students engaged beyond grade-level requirements.

A strong mean score of about 3.46 was in fact yielded by that self-efficacy factor, also suggesting that students generally believe in their success in physics. Confidence among students in specialized schools was slightly higher. The reason was probably positive reinforcement, experienced teachers, and peer support. Girls scored marginally lower in self-efficacy, while being equally motivated, showing a gap consistent with global research. Assurance is quite vital because it impacts student methods when facing hard jobs. Those who have high self-efficacy try more often new strategies, seek help when needed, and recover from setbacks. However, disengaged students of low confidence may be performing adequately still. Physics participation increases from self-efficacy gains greatly. This is especially true among girls and students from under-resourced schools. This can happen through feedback that stresses growth, student mentoring, and progressively building assignments. For students, a willingness to study physics and to explore it on their own as well as to view it as life-relevant is engagement. The mean score in regard to this factor was 3.41, and even though it was positive, it was lower than that in regard to motivation and interest. This gap suggests that although students enjoy physics class as well as try hard in it, not all of them see that they would pursue it long-term.

Reasons may include external academic pressure like exams, limited awareness of physics careers, or the view that physics is only for “geniuses”. Since specialized schools provide Olympiads, advanced programs, or science extracurriculars, engagement there was likely much higher. For improved engagement, schools should consider projects that orient careers, physicists who do visit, or lessons that integrate disciplines showing how physics connects with engineering, biology, as well as real-life technologies.

Anxiety regarding physics scored the lowest among all of the factors, at a mean of 2.63. This indicates that a meaningful portion of the students can experience some fear or some confusion or emotional discomfort in physics lessons. High variation existed with some students showing a little anxiety and others reporting strong negative feelings. Girls reported high anxiety more often than did boys, plus students attending general schools felt greater discomfort than students attending NIS or BIL schools. Prior literature supports that anxiety relates to absent exposure to helpful instruction also relates to stereotyped beliefs about scientific belonging. Reducing anxiety should be a priority since it weakens performance, engagement, and interest directly. Helping is possible by way of strategies such as these: normalizing errors, encouraging questions, emotional check-ins, and reduced high-stakes testing.

Math-related anxiety had a 3.10 mean score because students seem to have moderate worry about math use in physics. Early math difficulties as well as the symbolic complexity that physics equations have, often create that anxiety. Girls and general school students did again report slightly higher levels of anxiety. Math anxiety is particularly dangerous for the reason that it can lead students to avoid physics entirely because students may think it is too mathematical or too abstract. Students with motivation might pause before studying physics more. They may not be feeling so confident with these formulas. For improved math-physics integration, using conceptual explanations before equations, plus a classroom culture welcoming questions about basic steps are needed.

4.8 Interrelations Between Attitudinal Factors

Although each of the six measured factors in this study was analyzed separately, they are not to be isolated and that is important for recognition. In educational psychology, motivation and emotion connect. Often, these interactions are complex and mutually reinforcing. Patterns within the present data suggest key relationships among the measured factors, specifically motivation, interest, confidence, along with anxiety. As suggested by the strong correlation of motivation (M = 3.48) and interest in physics (M = 3.48), students who enjoy physics are more likely to make an effort and persist. This lines up with what Pintrich & De Groot (1990) found. Often, inner interest sparks greater involvement, they said. High interest likely improves motivation within the context of this study, especially when relevant and meaningful content is provided to students. Interest declines may cause motivation to fade when content is irrelevant or instruction abstract. This type of interdependence suggests emotional appeal maintains in just the way reinforcing academic expectations does.

Self-efficacy averages 3.46. Engagement in academics, tightly connected, is 3.41 on average. Even when physics is not a required subject, students who are believing in their success ability pursue it even further of their own volition. Self-determination theory along with Bandura's social cognitive theory (Bandura, 1997) have documented well this kind of relationship. The data suggest greater voluntary participation within elective physics activities like competitions or in advanced courses may be as a result of improved confidence. Notably, even as self-efficacy improves slightly through successful experiences, praise, or peer support, it can increase effects on long-term engagement. Perhaps the most critical way they relate is anxiety inversely correlates with self-efficacy as well. For students reporting higher anxiety that was related to physics or to math, lower confidence and motivation were typical. Research supports Mallow (2006) and Ashcraft & Kirk's (2001) finding that anxiety limits capable students' ability to perform through eroding self-belief. Female students in the current study especially showed this relationship since they felt more anxiety, strong motivation, and interest. Students show willingness to try though blocked emotionally from engaging fully so creating "emotional dissonance". It is not only with regard to emotional comfort so as to reduce anxiety therefore it is as well a way in order to unlock latent confidence and motivation.

Math-related anxiety (M = 3.10) appears to affect nearly every other factor. Students with a fear of mathematical formulas are less confident and less interested. Generally, these students are also more under stress. Even when someone is motivated, mathematical elements which are in physics may discourage participation. These mathematical elements may cause task avoidance also. It confirms that math anxiety is in fact not just a math problem it is a physics problem as well. It is true that coordinated efforts are required so as to address it for both science and math teachers, for they can jointly design lessons that are emotionally accessible and conceptually coherent. As a psychological system operating, the study's six factors are not separate traits. Interest and confidence, positive emotions, motivate, engage, and reinforce, while anxiety, a negative emotion, can suppress them. Interventions for education seek to increase aspects like lessened anxiety. Outcomes that are likely from such interventions include secondary benefits on other dimensions. Since educators as well as curriculum designers can understand all of these relationships, they can target leverage points for the learning experience. For example, increasing of engagement and reducing of anxiety may improve self-efficacy simultaneously. Also, increasing interest can support motivation. Even so, content becomes harder.

4.9 Six Attitudes on the Subject of Gender Differences

Gender remains as one of the most examined variables in studies of student attitudes toward physics particularly science. Many international and national studies have shown gendered patterns exist, in that not only do children achieve, but they also engage emotionally and are motivated including anxiety, confidence, and interest. This study's gender-based analysis of attitude factors showed global literature-consistent patterns while noting main affective differences of female students and male students. Both of the male and female students' motivation scores were of a relatively high level without there being any statistically important gender difference. This suggests that, at least with regard to willingness to succeed and try hard in physics, both genders exert similar effort to orient themselves. Girls, however, may be driven intrinsically by mastery and by understanding, as qualitative research in other contexts suggests, while boys may express motivation by way of performance goals. People seemed to be interested in physics across all genders. However, boys did tend to rate physics as being slightly more enjoyable, or more exciting. Girls often reported interest yet it was sometimes framed using emotional caution like “I like physics, but I’m not confident with the math part.” This difference shows the coexistence of interest and anxiety, notably among female students.

A small self-efficacy gap appeared in male students constantly. Both groups did report moderate to high levels for confidence in their physics learning ability. Girls expressed a bit more of doubt about their own skills, even so, most especially when physics did involve complex calculations or symbolic representations. Worldwide research supports this, revealing girls underrate their skills more frequently in math subjects, even with equal performances. Reasons differed even though engagement levels for boys and girls were similar. Boys often cited reasons of competition or of career prospects to stay engaged, whereas girls more often mentioned reasons such as teacher support or classroom environment or subject enjoyment. Engagement for girls, this indicates, might be mediated in more emotional and relational ways, while boys might connect it to goals or expectations. For girls, there were greatly higher levels of nervousness, discomfort, and also emotional tension during physics classes, thus showing the most prominent gender difference found in the data related to physics anxiety. This mirroring of international patterns may be caused by cultural expectations, classroom dynamics, or internalized beliefs regarding typical physics achievers. Such emotional barriers can weaken self-confidence, and participation even among high-achieving female students be reduced.

Female students also had a higher anxiety with math. They also did report that equations and also formulas plus symbolic representations within physics did intimidate them much more frequently. Past experiences, stereotype threat, or lower exposure to supportive problem-solving strategies also may reflect this anxiety, instead of actual ability. Given that physics depends quite heavily on mathematical reasoning, this anxiety has a spillover effect which can lower confidence and engage people far less. The study suggests that female students are more affected by emotional factors, in particular anxiety as well as lower self-efficacy, while motivation with engagement are relatively equal across genders overall. These patterns stress that it is important for one to create emotionally safe, supportive, and also inclusive classroom environments in which all students do feel capable and welcomed in physics. Strengthening national STEM capacity involves both a calculated step and an equity issue: addressing gender-based affective gaps.

4.10 Summary

This chapter presents and then discusses the very results of a study. It studied the attitudes of students toward physics across six psychological dimensions including motivation, interest, self-sufficiency, academic engagement, general anxiety, and math-related anxiety. Overall moderate-to-positive attitudes were held by all students. Anxiety was higher for girls than boys, but motivation and interest were similar. More of the favorable attitudes and of the lower anxiety were reported by students who are from specialized schools. Anxiety about math greatly obstructs confidence. Also, such anxiety prevents any engagement.

In many educational systems, Kazakhstan's included, physics often strikes students as a very hard subject at school. This perception stems from factors that combine for concepts abstract, mathematics depends strongly, terminology is unfamiliar, instruction lacks applications in real life frequently. How a piece of content is presented will often cause students to battle with more things than what the content itself does because it's typically in theoretical or formulaic terms disconnected from experience each day. Even capable students may develop avoidance behaviors or low self-confidence in response. These issues do then feed into a cycle of disengagement and of underachievement.

Also, the chapter did interpret these findings since instructional quality and school support each play some role in Kazakhstan’s diverse educational system. Improved teaching, leadership, with policy initiatives can tackle emotional and motivational barriers. Recommendations toward realizing that aim were offered. Schools can build science education settings that are more inclusive, supportive, and inspiring, and these perceptions together improve comprehension of student experiences in physics.

5 Conclusion

5.1 Studies of an overview.

This study had the aim of examining the attitudes toward physics of Kazakhstani secondary school students with a focus on six key psychological dimensions such as motivation, interest, self-efficacy, academic engagement, general physics anxiety, and math-related anxiety. Using a quantitative survey method, data from 195 students in grades 9 to 11 across varied school types were collected including specialized academic institutions like Nazarbayev Intellectual Schools and Bilim-Innovation Lyceums plus general education schools.

1. The study is one that had a number of main objectives as follows:
2. Overall attitudes of students toward physics can be assessed by evaluators.
3. Attitudes of gender are identified for their differences
4. Attitudes of students in general and specialized schools compared.

These patterns should be interpreted under the light of educational practices. Think about some policies that are in Kazakhstan for assistance with this interpretation. Descriptive statistics in addition to independent samples t-tests were involved in the validated 21-item attitude scale analysis. Findings allow for a subtle understanding regarding students' physics experiences. Important motivational and emotional aspects shaping learning behavior surface.

5.2 Summary of Major Findings

The study's results showed strengths and challenges in students' psychological relationship with physics. I summarize the main results below by theme. I organize them in accordance with each of the six measured factors.

1. Motivation Toward Physics

The levels for motivation students reported were moderately high. This was found all across the entire sample. They indicated a willingness to make an effort on their part, to persevere onward through difficulty itself, and to strive forward to succeed within physics lessons. Gender as well as school type were not factors within this finding. However, students inside specialized schools reported a bit higher levels for motivation. This suggests that physics is not a subject at which students balk. Students do not passively endure in it either. Many do actively engage with it instead. They face conceptual or emotional challenges, even while they do. Deeper learning can be then built by the schools and by the teachers upon the quite valuable foundation of true motivation.

2. Physics Courses Interest

Students also were interested in physics to a strong degree. Many agreed with statements like “I find physics interesting” and “I want to learn more about physics” showing enjoyment and curiosity. As with motivation, interest was higher for students in specialized schools. Likely it was that improved curricula with quality instruction plus extracurricular opportunities had contributed. Gender differences in interest were minimal as well as statistically insignificant and this does challenge the stereotype that girls are less engaged in science.

3. Self-Sufficiency (Confidence).

For the ability to handle physics tasks was generally quite high among the students. This scale had one of the highest mean scores in the dataset. Students felt that they were able to understand the concepts, to complete the assignments, and to succeed in physics. However, this confidence was somewhat lower among girls and students within general schools statistically insignificantly. This suggests overall self-efficacy may be strong. The way that students evaluate their own abilities could be affected by contextual factors such as the teaching style and the classroom support.

4. Academic Engagement

Scores proved slightly lower upon considering longer-term interest like studying physics beyond school or taking more physics classes. The students are both motivated and also interested now. Yet, some students showed less desire to keep studying physics later on. Structural barriers such as curriculum requirements or elective option lack can reflect this, and external pressures such as university entrance exams or career uncertainty can reflect this. It may also be an indication that students see that physics is difficult or is demanding even if they do enjoy it.

5. Anxiety About Physics

Generally, overall anxiety relating to physics courses was somewhat low, but student variation was broad. Certain students expressed important emotional discomfort during physics lessons. Girls and those in general education schools especially experienced this. Feelings that involve nervousness with difficulty when concentrating within class along with fear about making some mistakes were what was reported. Anxiety levels represent an emotional burden upon some students and may contribute to avoidance or disengagement, but they were not overwhelming across the sample.

6. Math-Related Anxiety

This was the biggest problem element. It did create some problems in the dataset. Mathematical expressions in physics gave moderate to high anxiety to many students in particular. Students in normal schools were also affected like girls. Mathematics centrally constitutes physics thus this form matters. Students overwhelmed by formulas and equations may avoid participation, lose confidence, or reject physics as a possible future. For improved math and physics instruction integration and for emotional support strategies reducing fear and confusion concerning math content, an urgent need exists.

This study set out to examine the attitudes of Kazakhstan secondary school students toward physics, with a focus on six key psychological dimensions: motivation, interest, self-efficacy, academic engagement, general physics anxiety, and math-related anxiety. Using a quantitative survey method, data were collected from 195 students in grades 9 to 11 across a variety of school types, including specialized academic institutions (such as Nazarbayev Intellectual Schools and Bilim-Innovation Lyceums) and general education schools.

1. The study had several main objectives:
2. To assess students' overall attitudes toward physics
3. To identify differences in attitudes by gender
4. To compare attitudes between students in specialized and general schools
5. To interpret these patterns in light of educational practices and policies in Kazakhstan

A validated 21-item attitude scale was used, and the analysis involved descriptive statistics and independent samples t-tests. The findings provide a nuanced understanding of how students experience physics and reveal key emotional and motivational factors that shape their academic behavior.

5.3 Answers to the Research Questions

Research Questions each got answers. The answers had been the results coming from the research. The data analysis allows for clear answers now. The posed research questions at the start of the study can now be directly addressed.

1. Do Kazakhstan secondary school students possess general feelings about physics?

Physics was viewed by students generally moderately positively. A high confidence with which to succeed and a strong motivation with a good interest level were shown by them. However, their lasting involvement was somewhat restricted plus worry particularly math worry existed often. To sum, students work hard during class and seem to like physics, but many feel emotional struggles which might lower future interest or involvement.

2. Does gender have effect upon the students' attitudes?

Motivation including interest, self-efficacy, or engagement showed no important gender differences within the results. In these very dimensions, boys and girls were also quite positive. However, girls reported greatly higher levels of general and math-related anxiety. This indicates girls have equal motivation plus capability yet possibly experience greater anxiety within physics courses.

3. Are the attitudes of students different depending on the school type involved (specialized vs. general)?

Yes. Among students in specialized schools like NIS, BIL, and Zaman, motivation, interest, confidence, and also engagement greatly increased. These students showed scores that are higher. They reported that math-related anxiety levels were also lower. Student attitudes are shaped greatly by the learning climate. This environment includes resources, teaching quality, with school culture. In general, students who are in general schools may be just as capable as any others but elite schools do offer more structural support and more emotional support.

5.4 Implications for Stakeholders

For teachers, school leaders, curriculum designers, policymakers, and researchers in the Kazakhstani education system, this study's findings are relevant among the stakeholders.

5.4.1 For Teachers

The classroom experience of students is most directly influenced by the work of teachers. This study suggests several concrete actions. For teachers, recognizing that some students are emotionally affected by physics should be a priority. Address anxiety openly. It is of importance to build up a supportive atmosphere, a safe place in which to make mistakes. Math integration should reduce fear, build understanding by being gradual, clear: Formulas are explained step by step, related to problems, questions are allowed. To build inclusive classroom dynamics, teachers should try harder: Because girls had equal interest plus motivation yet more anxiety, treat all students equally.

5.4.2 For School Leaders

School administrators should ensure teachers have support and tools to engage students well. Provide access to teaching materials with laboratory equipment, most especially in general education schools Through professional development, support science teaching's motivational and emotional aspects. Encourage good feelings plus group aid promoting outside school activities like physics teams and contests.

5.4.3 For Policymakers and Curriculum Developers

The findings that are at the national level point toward some priorities that are key. You must develop curriculum guidelines so that you include emotional learning. Curriculum guidelines should also develop motivational learning outcomes. Equal accessibility to resources across school types is vital. Instructional practices that can build confidence and that center students should be promoted now. Highlight physics role models plus varied career paths, making the subject more appealing. These steps toward success can help all students in physics. Physics is something even those not in elite institutions can enjoy.

5.5 Limitations of the Study

Though the study gives worthy perceptions on attitudes about physics from Kazakhstani students, limitations exist.

A Likert-scale questionnaire relies on students' honesty and self-awareness for the self-report method. Some responses might be influenced by mood, guessing, or social desirability bias.

Cross-sectional design: The research captures attitudes as it occurs at one time. It is not possible to track just how student attitudes evolve across grade levels or within any response to interventions.

The sample focused mainly on academically oriented urban school students implying limited generalizability. In the findings, experiences of students from under-resourced or rural schools may not be reflected.

The study contains no qualitative data, like interviews or open-ended questions. Qualitative data such as this could have provided more deep perception into the personal experiences, into the emotions, and into the reasons from students for responses from them.

The study has limitations. However, its design and analysis provide a solid foundation to understand trends and differences in student attitudes toward physics in the context of Kazakhstan. Positive attitudes regarding physics are important for STEM fields' long-term engagement. Students are more apt to select higher science classes, join science contests, and seek science jobs if physics is fun, achievable, and applicable. Conversely, whenever students feel negative feelings—such as fear, boredom, or frustration—this affects how they perform academically to boot but can also close off entire educational and professional pathways. Kazakhstan gives priority to national STEM development making this a particularly relevant issue there. Favorable attitudes fostered in secondary education may improve science outcomes effectively. Such actions can serve to reduce both the gender and the school-type gaps observed in physics enrollment and achievement.

5.6 Recommendations for Future Research

While this study gives useful perceptions into the emotional as well as motivational aspects of student attitudes about physics in Kazakhstan, some areas needing more study are likewise noted. For future studies, limitations within method must be addressed to expand on the present findings. It would be helpful additionally for expanding the sample scope for exploring deeper explanatory mechanisms. Future studies might start using a mixed-methods design. This could involve combining quantitative surveys along together with qualitative interviews or focus groups. Researchers would better grasp students' personal stories behind their answers regarding worry, interest, and self-belief. Qualitative data may reveal emotional subtleties within classroom dynamics that closed-ended questionnaires cannot fully capture. Longitudinal research that follows students throughout academic years is also needed. Only just a snapshot of data is offered by way of a cross-sectional design. Just one such design was used in this study. Researchers are able to track attitude changes all throughout the course of time by using a longitudinal approach that is especially due to curricular reforms as well as teacher changes or external pressures just like exams. Third, future studies should aim for a sampling that can be broader and also more representative and include students out of rural areas, vocational schools, and under-resourced schools. An analysis comparing different regions plus socioeconomic contexts in Kazakhstan would improve the findings' generalizability. Researchers could, fourth, probe into specific interventions' effects on students' views. For some examples of these particular interventions, look at inquiry-based learning, at peer instruction, or at anxiety-reduction programs. Designs that are either experimental or quasi-experimental would assist one when helping to determine all of the teaching strategies that can most effectively motivate learners and also reduce emotional barriers. Fifth, more of gender-focused topics must be studied by the researchers. Future work could examine how gender interacts in conjunction with parental expectations, teacher feedback, and classroom participation since this research found that girls exhibited higher levels of anxiety despite equal motivation.

This study's attitude scale with six factors may be tested and adapted within multicultural multilingual school systems or other countries. Cross-cultural validation is just something that could indeed confirm its true robustness. International comparison of the students' emotional as well as motivational profiles within physics education should then be allowed to occur. Future research should seek ultimately to inform practical changes as well as seek to deepen theoretical understanding in classroom practice as well as in science education policy. About student attitudes it is necessary to expand the evidence base because physics will then be more accessible, inclusive, and engaging for all learners. To build on the findings of this study, future researchers could consider the following directions. Research in mixed methods would reveal all of the personal narratives that are behind attitudes of students providing data that is richer including surveys along with focus groups or interviews. Longitudinal studies: If researchers track the same students across multiple years, they would show just how motivation, confidence, as well as anxiety evolve with the passage of time—especially during transitions from one grade to another or exam stages.

5.7 Final Remarks

This study set out to explore how secondary school students in Kazakhstan perceive physics since the study focused on academic readiness and also students engaged emotionally and motivationally. Because of its use of a validated six-factor attitude scale with data from 195 students within diverse school types, the study has offered important perceptions into cognitive, affective, and contextual factors shaping student experiences within physics education. That positive sentiment about physics does exist is confirmed. This attitude has motivation interest and self-efficacy forms. Results also show continuing emotional obstacles for some student groups now. Math-related anxiety as well as general discomfort with physics content do most notably affect female students along with those from general education schools. These emotional dimensions do not necessarily show that one lacks ability but instead reflect differences in how one feels as confident, as supported, and as experienced in the classroom.

This research suggests attitudes are not fixed traits. This fact provides a very meaningful takeaway. Instructional quality and school environment along with teacher behavior plus peer interactions as well as curriculum design shape them. They are dynamic. Schools and teachers, therefore, can influence positively the feelings of students toward physics learning. Students are far more likely to remain engaged as well as to see themselves as capable science learners when they feel confident, supported, and intellectually stimulated. This study does also contribute methodologically through the validation of a thorough instrument that captures all of the full spectrum of student attitudes for motivating of them and for causing anxiety. Researchers along with teachers and school leaders wishing to improve classroom climate and student well-being can use the six-factor model as a diagnostic tool. Attention must be paid for sure, as Kazakhstan continues on to reform its education system with investment in STEM development, not only to the stuff that is taught, but also to just how students experience the act of learning emotionally and motivationally. Even the most well-designed curriculum, without attention to education's affective side, particularly in a difficult subject such as physics, may not inspire or retain future scientists, engineers, and innovators.

To conclude, this study indicates that if we understand just how students feel as well as think, in addition to how they respond to physics education, we can then begin creating more inclusive, empowering, and human-centered educational settings—not just for a select few, rather for every single student, in every type of school.

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Appendix A. Physics Attitude Survey

Motivation toward Physics

8. I do my best to succeed in physics courses.
9. I do my best no matter how hard the task in a physics lesson.
10. I try even harder when I fail in physics courses.
11. I try to do my best in physics courses.

Interest in Physics

1. Physics courses are fun.
2. I find physics courses interesting.
3. I look forward to physics courses.
4. I'd like to know more about physics.

Self-Sufficiency (Self-Efficacy)

12. I am proud of my skills in physics courses.
13. I am smart enough to handle physics.
14. I am proud of my success in physics courses.
15. I am capable of getting good grades in physics.

Academic Engagement

16. I'd like to take physics courses even if I don't have to.
17. I'd like to improve my skills in physics.
18. I want to take as many physics classes as I can during my educational life.

Anxiety about Physics

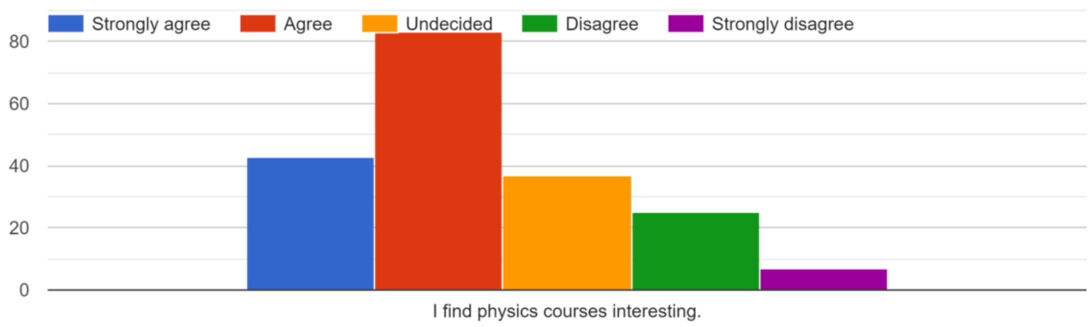
4. I feel anxious during physics courses.
5. Physics courses fill me with anxiety.
6. Physics courses make me feel uncomfortable and irritated.
7. Physics courses make me feel nervous and confused.

Math-Related Anxiety in Physics

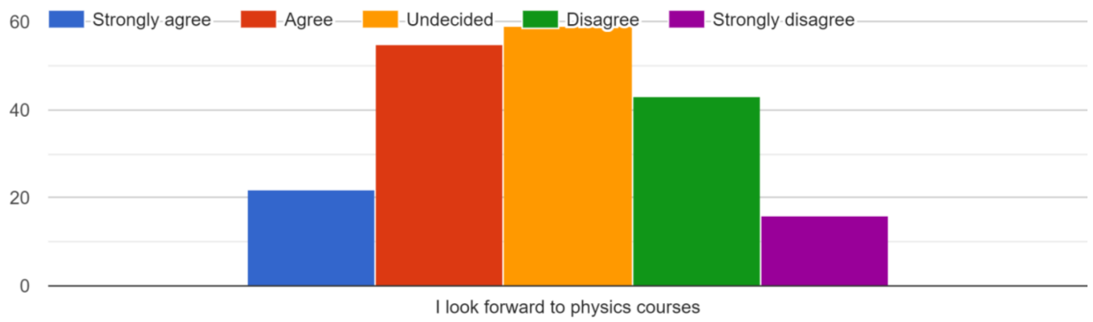
20. I am very worried about having to use mathematical expressions in physics.
21. Trying to read a sentence full of mathematical physics formulas containing unfamiliar symbols scares me a lot.

Appendix B. Answers

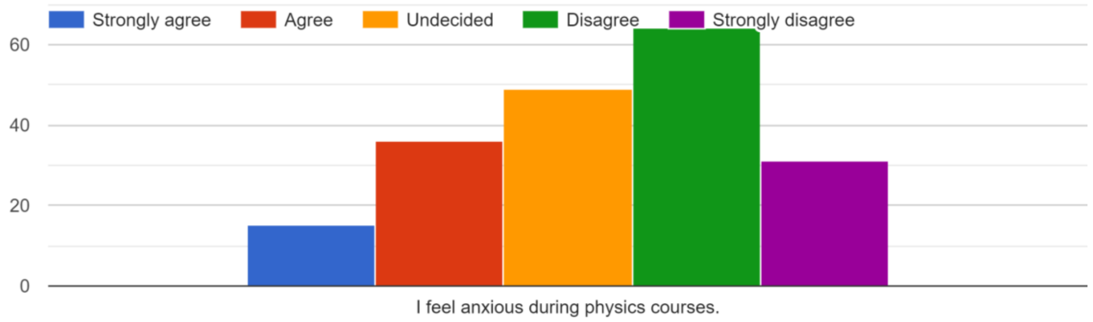
2. Answer the question



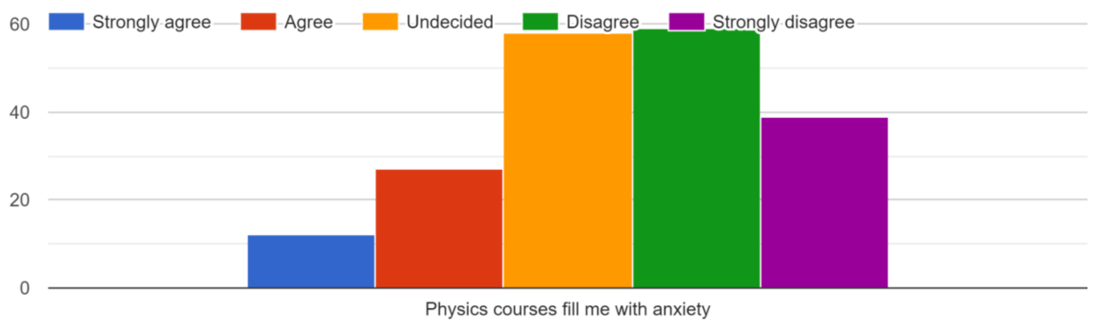
3. Answer the question



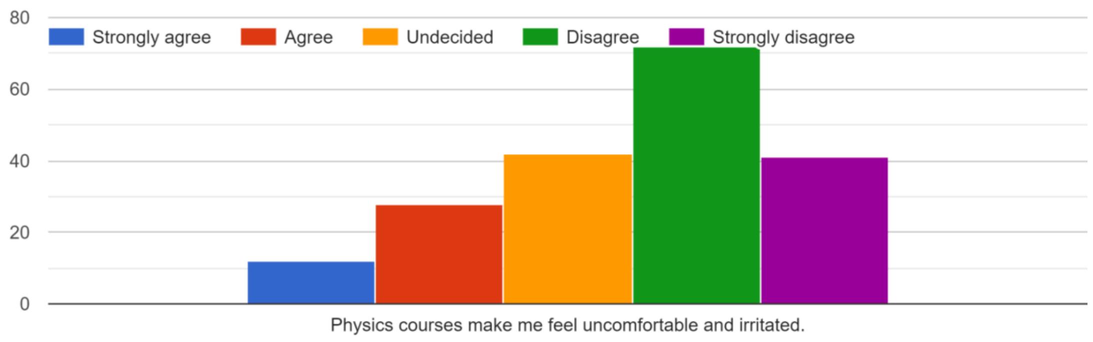
4. Answer the question



5. Answer the question



6. Answer the question



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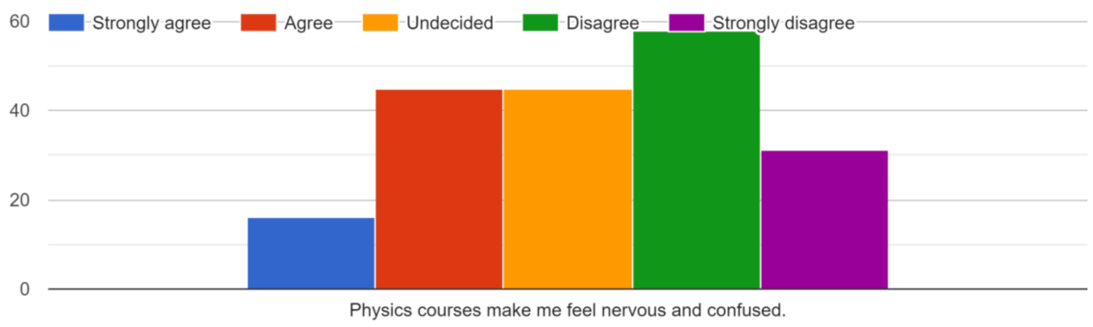

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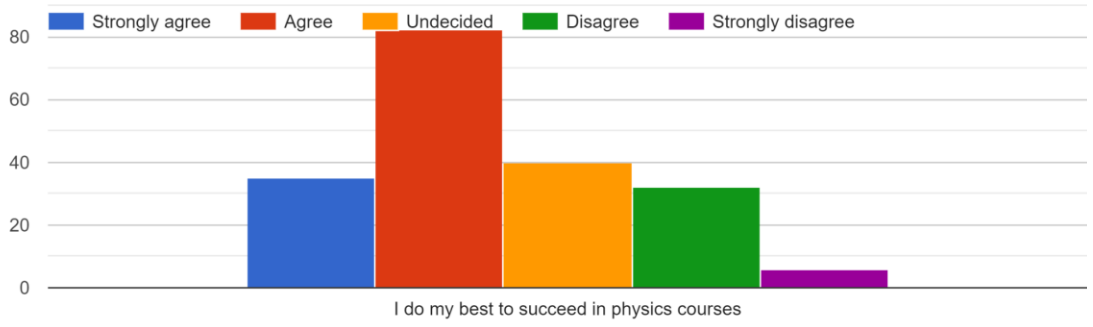

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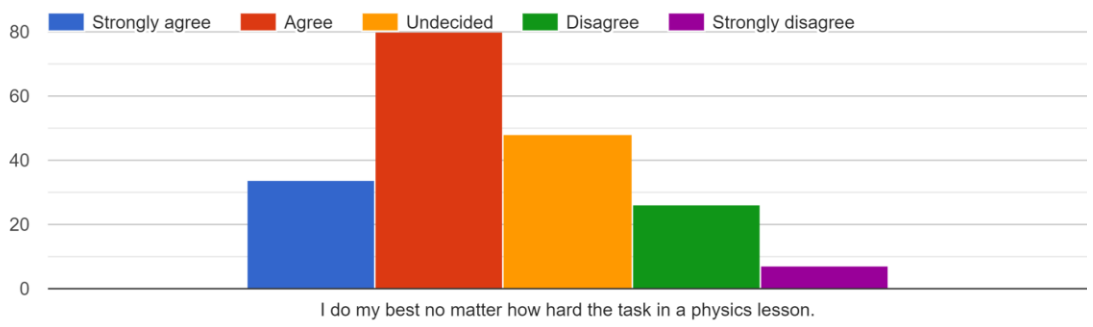
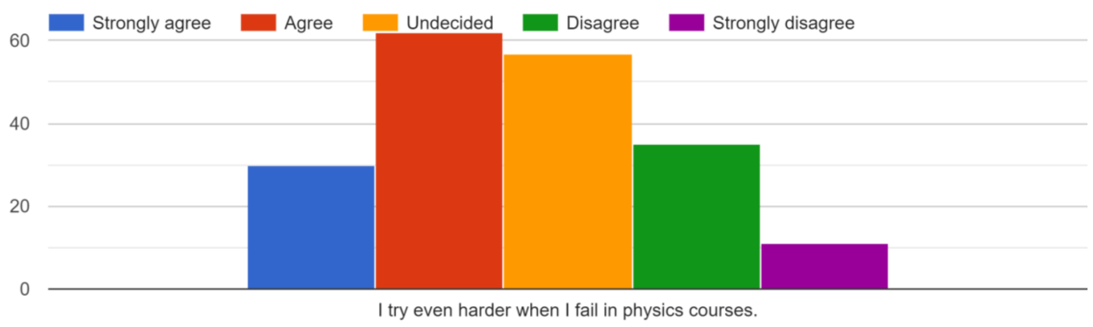
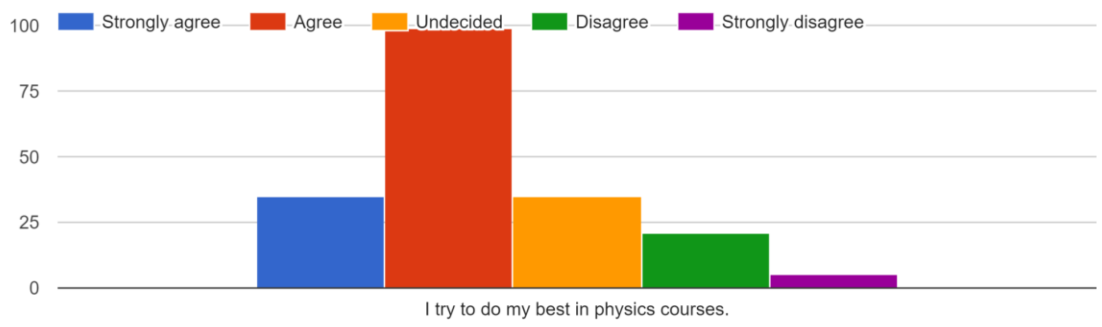


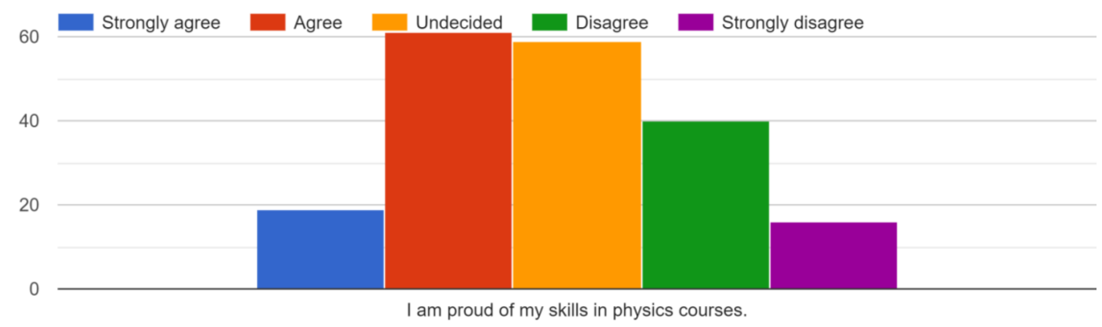
10. Answer the question



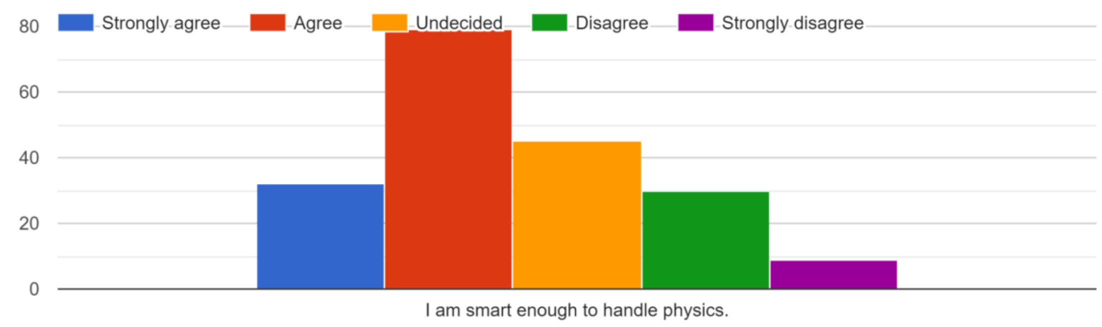
11. Answer the question



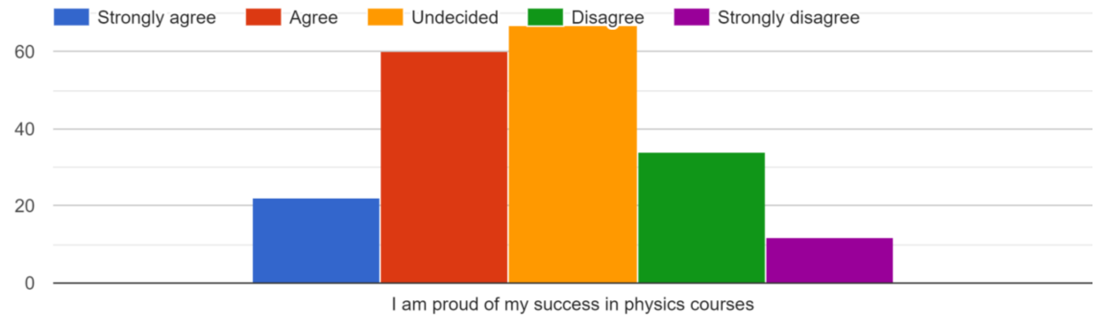
12. Answer the question



13. Answer the question



14. Answer the question



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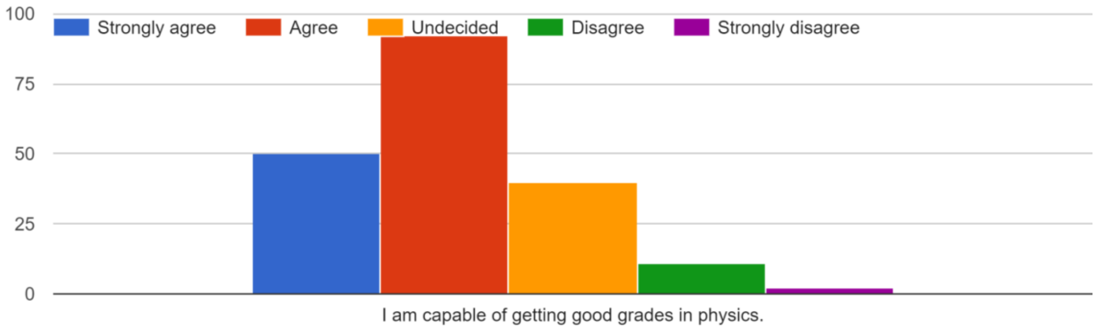

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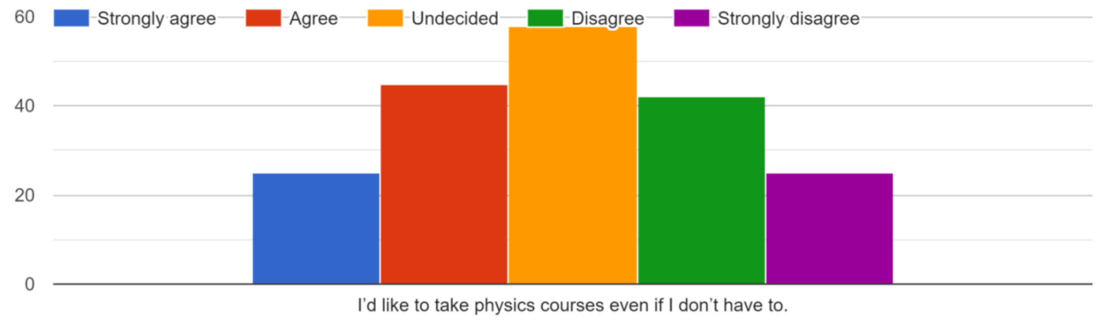
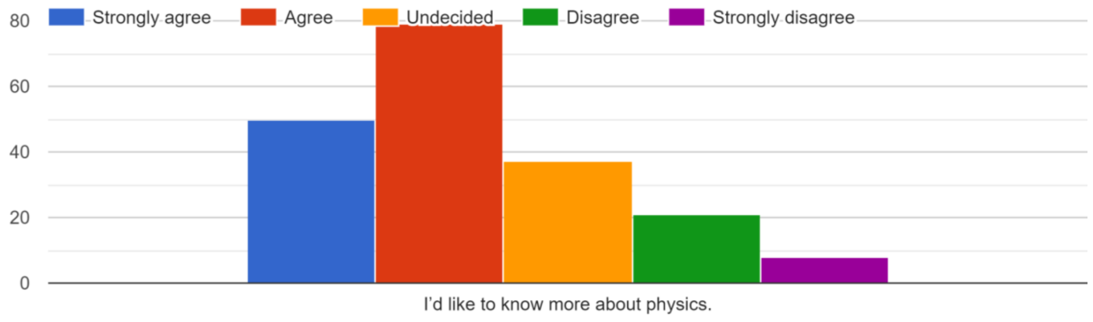
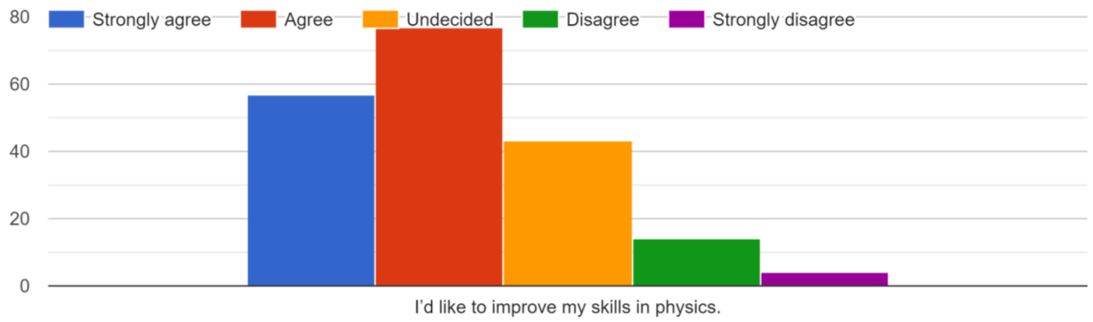


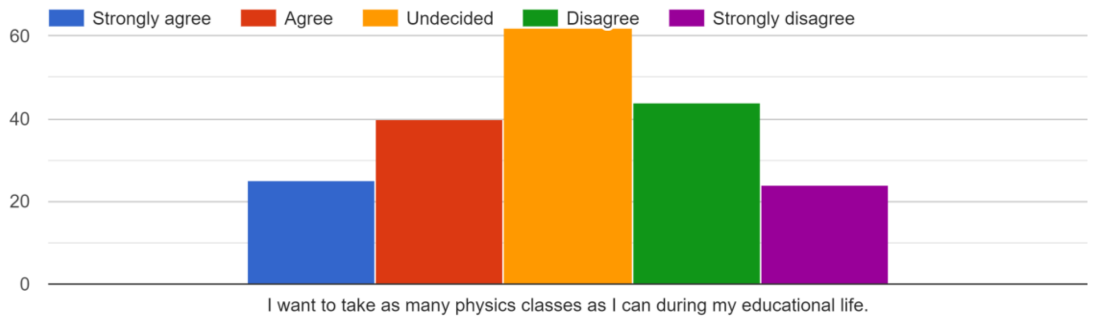
17. Answer the question



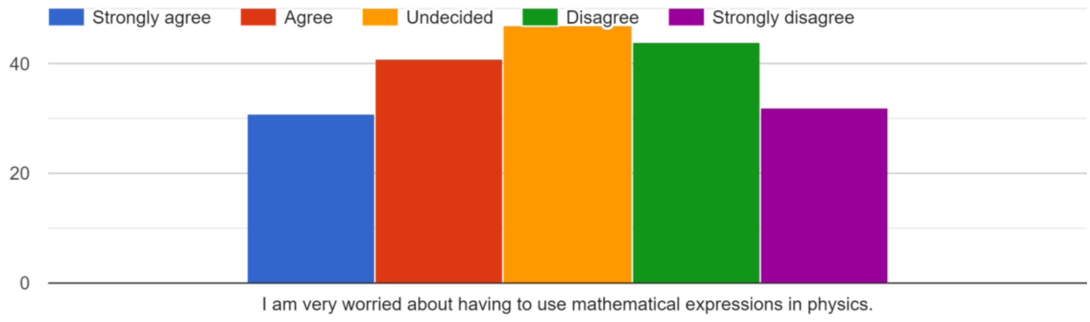
18. Answer the question



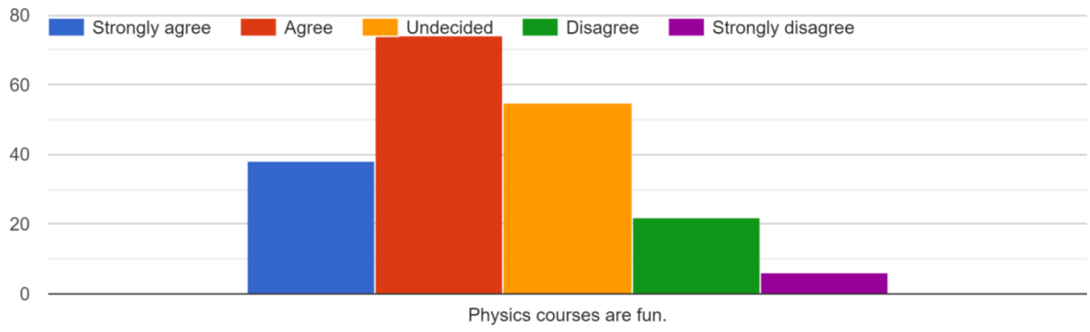
19. Answer the question



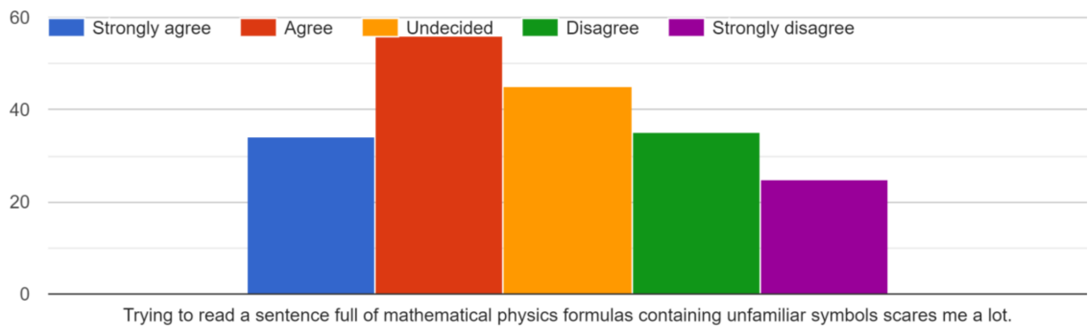
20. Answer the question



1. Answer the question



21. Answer the question



NO	Item	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
1	Physics courses are fun	38	74	55	22	6
2	I find physics courses interesting.	43	83	37	25	7
3	I look forward to physics courses.	22	55	59	43	16
4	I feel anxious during physics courses.	15	36	49	64	31
5	Physics courses fill me with anxiety.	12	27	58	59	39
6	Physics courses make me feel uncomfortable and irritated.	12	28	42	72	41
7	Physics courses make me feel nervous and confused.	16	45	45	58	31
8	I do my best to succeed in physics courses.	35	82	40	32	6
9	I do my best no matter how hard the task in a physics lesson.	34	80	48	26	7
10	I try even harder when I fail in physics courses.	30	62	57	35	11
11	I try to do my best in physics courses.	35	99	35	21	5

12	I am proud of my skills in physics courses.	19	61	59	40	16
13	I am smart enough to handle physics.	32	79	45	30	9
14	I am proud of my success in physics courses.	22	60	67	34	12
15	I am capable of getting good grades in physics.	50	92	40	11	2
16	I'd like to take physics courses even if I don't have to.	25	45	58	42	25
17	I'd like to know more about physics.	50	79	37	21	8
18	I'd like to improve my skills in physics.	57	77	43	14	4
19	I want to take as many physics classes as I can during my educational life.	25	40	62	44	24
20	I am very worried about having to use mathematical expressions in physics.	31	41	47	44	32
21	Trying to read a sentence full of mathematical physics formulas containing unfamiliar symbols scares me a lot.	34	56	45	35	25