Investigating Secondary School Teacher's Academic Achievement in Physics in Kazakhstan

Aigerim Sagynbayeva

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

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This is to certify that the Master's Thesis of

Aigerim Sagynbayeva

has met the thesis requirements of
SDU University

Kaskelen, 2025

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Abstract

This study explores how secondary school physics teachers in Kazakhstan achieve academically as we center particularly upon their qualifications, teaching experience, professional development, and workplace conditions. The nation aspires to fortify its STEM instructional framework thus pedagogical enhancement and social advancement matter. It is vital to comprehend all aspects affecting instructor skill within physics. Information was acquired from 75 physics instructors throughout an array of state and independent academic establishments. This data collection employed a cross-sectional survey design. Investigators delineated then deduced statistical assessments for examination of trends within instructor demographics, scholastic histories, Unified National Testing (UNT) scores, also involvement amid professional growth endeavors. Cronbach’s alpha was used to verify the reliability of the survey instrument, also all sections showed acceptable internal consistency.

Physics instructors, as findings divulged, exist as comparatively youthful and possess differing expertise degrees and credentials. A large quantity undertook postgraduate education, and most participants possessed at minimum a bachelor's degree. Although experts involved in growth greatly well-regarded, they viewed the training's effect upon classroom application as unremarkable. UNT scores were largely uniform. This suggested the specimen had been intellectually equipped to a commensurate degree. The study accentuates foremost institutional impediments like disparate access to resources along with erratic support for in-service training, which may affect teacher performance and student achievement. These conclusions stress that more focused initiatives are important to elevate physics instructors' scholarly and vocational competence especially in marginalized areas.

This investigation augments the burgeoning compendium concerning teacher skill inside STEM areas. Functional guidance is also extended for Kazakhstan's policymakers, school leaders, and teacher education providers. Physics instructors elevate scholastic successes then impart science skillfully while they groom the future cohort regarding innovators also problem solvers.

Абстракт

В этом исследовании изучается, как учителя физики средних школ в Казахстане достигают академических успехов, поскольку мы уделяем особое внимание их квалификации, опыту преподавания, профессиональному развитию и условиям на рабочем месте. Страна стремится укрепить свою образовательную структуру STEM, поэтому педагогическое совершенствование и социальное развитие имеют значение. Крайне важно понимать все аспекты, влияющие на мастерство преподавателя в физике. Информация была получена от 75 преподавателей физики из ряда государственных и независимых учебных заведений. Этот сбор данных использовал дизайн поперечного опроса. Исследователи очертили, а затем вывели статистические оценки для изучения тенденций в демографических данных преподавателей, школьных историях, результатах Единого национального тестирования (ЕНТ), а также вовлеченности в усилия по профессиональному росту. Альфа Кронбаха использовалась для проверки надежности инструмента опроса, и все разделы показали приемлемую внутреннюю согласованность.

Преподаватели физики, как было обнародовано, существуют как сравнительно молодые и обладают различными степенями и полномочиями. Большое количество обучалось в аспирантуре, и большинство участников имели как минимум степень бакалавра. Хотя эксперты, участвующие в развитии, пользовались большим уважением, они считали, что влияние обучения на поступление в класс ничем не примечательно. Результаты ЕНТ были в основном однородными. Это говорит о том, что выборка была интеллектуально оснащена в соразмерной степени. Исследование подчеркивает основные институциональные препятствия, такие как разрозненный доступ к ресурсам, а также нерегулярную поддержку обучения без отрыва от производства, что может повлиять на эффективность работы учителей и успеваемость учащихся. Эти выводы подчеркивают, что более целенаправленные инициативы важны для повышения научной и профессиональной компетентности преподавателей физики, особенно в маргинализированных районах. Это исследование дополняет растущий сборник, касающийся навыков учителей в областях STEM. Функциональное руководство также распространяется на политиков, руководителей школ и поставщиков педагогического образования Казахстана. Преподаватели физики повышают академические успехи, а затем умело передают науку, одновременно готовя будущую когорту новаторов и решателей проблем.

Аннотация

Бұл зерттеу Қазақстандағы орта мектеп физика мұғалімдерінің академиялық жетістіктерге қалай қол жеткізгенін зерттейді, өйткені біз олардың біліктілігіне, педагогикалық тәжірибесіне, кәсіби дамуы мен жұмыс орнындағы жағдайына ерекше көңіл бөлеміз. Ұлт өзінің STEM оқу базасын нығайтуға ұмтылады, осылайша педагогикалық жетілдіру және әлеуметтік ілгерілеу маңызды. Физикадағы оқытушының шеберлігіне әсер ететін барлық аспектілерді түсіну өте маңызды. Ақпарат мемлекеттік және тәуелсіз оқу орындарының 75 физика оқытушыларынан алынды. Бұл деректер жинауда көлденең қималық сауалнама жобасы қолданылды. Зерттеушілер оқытушылардың демографиясы, оқу тарихы, ұлттық бірыңғай тестілеу (ҰБТ) ұпайлары, сондай-ақ кәсіби өсу талпыныстары аясындағы тенденцияларды тексеру үшін статистикалық бағалауларды анықтады. Сауалнама құралының сенімділігін тексеру үшін Кронбах альфасы қолданылды, сонымен қатар барлық бөлімдер қолайлы ішкі үйлесімділікті көрсетті.

Физика оқытушылары, ашылған мәліметтерге сәйкес, салыстырмалы түрде жас және әртүрлі сараптамалық дәрежелер мен куәліктерге ие. Көп бөлігі жоғары оқу орнынан кейінгі білім алды, ал қатысушылардың көпшілігінде ең аз дегенде бакалавр дәрежесі бар. Өсуге қатысқан сарапшылар өте жақсы бағалағанымен, олар оқудың сыныптағы қолдануына әсерін ерекше деп санады. ҰБТ ұпайлары негізінен біркелкі болды. Бұл үлгінің сәйкес дәрежеде интеллектуалды жабдықталғанын көрсетті. Зерттеу мұғалімдердің жұмысына және оқушылардың жетістіктеріне әсер етуі мүмкін ресурстарға әртүрлі қолжетімділік және біліктілікті арттыруға тұрақты қолдау көрсету сияқты ең басты институционалдық кедергілерді атап көрсетеді. Бұл тұжырымдар, әсіресе маргиналды аймақтарда физика оқытушыларының ғылыми және кәсіптік құзыреттілігін арттыру үшін көбірек бағытталған бастамалардың маңызды екенін атап көрсетеді.

Бұл зерттеу STEM саласындағы мұғалімдердің шеберлігіне қатысты дамып келе жатқан жинақты толықтырады. Функционалдық нұсқаулық сонымен қатар қазақстандық саясаткерлерге, мектеп басшыларына және мұғалімдерге білім беру провайдерлеріне арналған. Физика оқытушылары оқу жетістіктерін жоғарылатады, содан кейін ғылымды шеберлікпен таратады, сонымен қатар инноваторлар мен проблемаларды шешушілерге қатысты болашақ когортты дайындайды.

1. Introduction

1.1 Background of the study

A fundamental discipline in the natural sciences, the physical universe is understood essentially by that of physics. In order to explain various natural phenomena, create several technological solutions, and further advance scientific reasoning, it provides relevant practical knowledge and also the particular theoretical framework which is needed. Physics develops modern civilization, according to quantum theory, cosmology, Newtonian mechanics as well as thermodynamics (Halliday, Resnick, & Walker, 2013). Physics is important within the school curriculum due to its fundamental nature. In addition, it does greatly help students in the development of critical thinking and of problem solving skills (Bybee, 2010).

In secondary education, the abilities as well as academic achievements of the instructors who provide the curriculum closely do tie to the quality of physics instruction. Physics instructors must have knowledge of their subject and must have taught before now. They must also be able to motivate the students and to transform scientific concepts into lessons that are understandable for adolescent children (Shulman, 1986; Grossman, 1990). Thus, physics teachers' academic achievements importantly improve somewhat instructional efficacy. They assess the degree to which they know the subject matter, the degree to which they handle science that is complex, and their capability to create lessons encouraging scientific inquiry and curiosity (Darling-Hammond 2000)

Many international studies relate teacher academic background in a helpful way to student achievement, particularly in STEM fields (OECD, 2019). These findings do highlight the fact that support for teachers' academic and professional development does improve physics learning outcomes.

The education system in Kazakhstan has undergone large reform for modernization and to meet global standards. The Kazakhstan 2050 Strategy and also National Human Capital Development Policy are prioritizing STEM education quality. Physics, as one core STEM subject, prepares students considerably for university science education, and they will participate within the knowledge-based economy at some future time.

Active concerns do persist in regard to Kazakh students' performance within science-related disciplines in spite of this calculated emphasis. Kazakhstan pupils still lag behind their peers in OECD nations in terms of scientific literacy per international tests such as the Programme for International Student Assessment (PISA) (OECD, 2018). These particular findings have, in fact, spurred an active nationwide discussion regarding the particular variables that do contribute to a lower science performance. There is now an increased emphasis on science instructor quality as well as training, including for those who teach physics (NUGSE, 2019).

Although growing recognition exists regarding how central teacher quality is to student achievement, current Kazakhstan literature is focused mainly on curriculum reforms, school infrastructure, and student-level outcomes. A prominent gap does exist in empirical research of the academic achievement and subject matter competence of teachers themselves, particularly within physics. Existing studies tend to stress teacher preparation and/or general qualifications. Often, the depth and relevance of teachers' academic experiences in physics is not explicitly examined (Abdimomynova, 2021).

Teacher academic achievement, a multidimensional construct, includes such elements as universities grade, subjects advance, they research, they develop professionally, and subjects teach knowledge (Ball, Thames, & Phelps, 2008). In order to assess physics teachers' readiness for meeting secondary education demands and for effectively supporting student learning, one must understand in a thorough way these dimensions.

Within physics, a very strong academic background is especially important now, and it is often considered as one of the toughest subjects within the school curriculum. Educators can battle to impart subject matter in an effective manner when such educators do not have confidence regarding their own academic preparation, and then learners get alienated and then perform badly in assessments. Also, insufficient academic preparation may limit teachers so they cannot include hands-on experiments, demonstrations, and problem-solving activities—all of which are necessary for effective physics teaching.

Certain regional differences in Kazakhstan do further complicate such a situation. Teachers in urban areas often have increased access to multiple resources, different training opportunities, and diverse institutions of higher learning. In comparison, such challenges as a smaller number of professional development opportunities, less access to laboratories, and more outdated teaching materials may be faced by those working in rural or remote schools. It is because of all of these differences that the quality in physics education is just not uniform. The disparities occur throughout the expanse of the country. Studying teacher academic preparation in different regions of Kazakhstan is important in order to identify gaps as well as ensure equal accessibility to high-quality education for all students.

Furthermore, the professional development in Kazakhstan for physics teachers often focuses less on content mastery and more on pedagogy. Even though training programs are available, the particular academic needs of physics teachers may not always be met. To adapt to new teaching methods, teachers need active support for strengthening content knowledge, as the national curriculum integrates inquiry-based learning as well as technological applications and critical thinking elements while becoming more complex. More effective training programs develop from a comprehension of teachers' current academic foundations from the start.

Teachers with strong academic performance in their subject area are more likely to achieve higher student outcomes, as well as support differentiated instruction and implement advanced instructional strategies internationally, research has shown.

For example, in Finland, Singapore, and South Korea, research stresses the importance of teachers rigorously preparing academically, especially in science subjects within countries known for their highly effective education systems. These countries stress theoretical knowledge together with research-based practices, as they each invest heavily within teacher education. To raise its global educational level, Kazakhstan may gain ground by using like methods. Still, initiatives should precisely determine the faculty members' present scholarly standing.

This study seeks to address a current gap within research here. It looks into the academic achievements that belong to Kazakhstan's secondary school physics teachers. The study will collect various data from a diverse sample group of teachers out from different regions, different types of schools, as well as diverse demographic groups through a cross-sectional survey design. The study will examine the ways in which academics are able to achieve key indicators such as earning qualifications, performing well at universities, participating within physics courses or during research, and assessing their own readiness for teaching.

The results from out of this study can be expected for the purpose of contributing to the continuing active dialogue. This dialogue is about teacher quality here in Kazakhstan. The study identifies several strengths and several weaknesses in physics teacher academic preparation. Policy decisions concerning teacher education, certification standards, as well as professional development programs can be informed by it. Such a thing could strengthen demands for elevating standards when recruiting and training physics teachers if research shows that teachers possessing greater academic backgrounds are more effective and confident during instruction. If gaps are identified in another way, actions can focus on strengthening teacher preparation as well as address specific academic deficiencies.

Curriculum reform and also school management practices may have implications from within the study. In order to give assistance to teachers in need of additional academic development, school administrators and educational leaders have the ability to develop systems using the results. For better meeting of the actual needs among physics teachers, teacher training institutions can revise around their programs, ensuring graduates are pedagogically capable and academically strong. Ultimately, a ripple effect from improved academic performance of high school physics teachers can occur throughout the education system. Kazakhstan's profile inside global education rankings can be raised via better trained teachers who inspire many students toward science and technology careers and contribute within the national goal for promoting innovation. Because the country still continues prioritizing STEM education as a main driver of economic development, a full comprehension of and support for teachers academically becomes more of a matter of national importance, and not just merely an educational issue.

1.2 Statement of the problem

The role of physics education is being increasingly acknowledged in further shaping critical thinking, problem-solving skills, and a more foundational comprehension of natural phenomena in this modern era of scientific and technological advancement (Bybee, 2013). The scientific literacy level is promoted through the secondary school physics, which prepares the students in STEM field careers. A number of further studies are made possible for students due to secondary school physics. However, the effectiveness of physics education does naturally depend upon the academic preparedness and subject mastery of teachers (Shulman, 1986). Kazakhstan reformed education through prioritizing modernizing curricula and pedagogical strategies (MoES RK, 2019) so it needs additional secondary school teachers for achievement academically in disciplines such as physics since people perceive physics as complex.

Despite various initiatives targeted at improving teacher qualifications, disparities in teacher performance as well as student outcomes persist across the country, despite active professional development programs and updated certification standards (OECD, 2020). For access to high-standard schooling and professional support for teachers remains limited, especially in rural regions. These particular challenges are quite obvious in several under-resourced regions (UNESCO, 2021). The scarcity of localized research on the academic achievement of physics teachers in Kazakhstan exacerbates the issue, so the implementation of evidence-based policies and interventions that address educator needs becomes quite difficult (Yessenova & Zhaksylykova, 2022).

Teachers can show academic achievement through their formal qualifications, knowledge of physics content, and pedagogical competencies. They do also show it at the time when they integrate modern teaching methodologies and at the time engage in professional learning (Darling-Hammond, 2000). Therefore, for identifying gaps existing and creating strategies targeted to improve instruction quality, understanding the current state of physics teachers' academic achievement is important. Additionally, exploring just how institutional, socio-economic, and policy-related factors influence teacher achievement plus impact student learning outcomes remains critical (Borko, 2004).

This study seeks to investigate into the academic achievement of Kazakhstan secondary school physics teachers now. To achieve this, we will extensively examine their teaching experience, educational background, performance indicators, and professional development opportunities. The research is targeted for the provision of valuable understandings into strengths and weaknesses in the current system and practical recommendations for educational stakeholders. Ultimately, when we get to improve upon the academic achievement for physics teachers, we then take a key step so as to improve upon the general quality for physics education in Kazakhstan and in ensuring all the students, regardless of geographic or socio-economic background, do have access to high-quality science instruction (World Bank, 2020).

This study investigates the academic achievement of secondary school physics teachers in Kazakhstan, also considering their subject matter knowledge, teaching qualifications, and professional development participation. In as much as physics is fundamental to the STEM curriculum, educators' academic preparedness and competencies do substantially determine the degree to which they instruct. Pinpointing existing strengths as well as addressing areas needing targeted support along with improvement is important for understanding teacher achievement's current status.

How teaching experience, geographic location (urban vs. rural), and access to training opportunities are influenced by this research is also something regarding which teachers' academic performance is explored. Through analyzing each of these elements, this study intends to provide evidence-based understandings as well as recommendations, informing teacher education programs along with national education policies so as to improve physics education within Kazakhstan's secondary schools.

1.3 Objectives of the study

To examine the academic achievement of secondary school physics teachers in Kazakhstan and to determine the key factors which influence their subject mastery and also instructional effectiveness, such as their educational background, professional development, and their teaching experience.

- Evaluating both the subject knowledge as well as the academic qualifications of Kazakhstan's physics teachers.
- The aim is considering the extent of both professional experience and training. Regional disparities in teachers' academic achievement are also analyzed.
- Teachers academically achieve in ways impacting how educators teach physics and students perform within the secondary school level.

1.4 Significance of the Study

This study matters quite a bit as it addresses a critical aspect of educational quality in Kazakhstan which is namely academic achievement for secondary school physics teachers. Because physics founds science and founds technology, the effectiveness of its instruction must foster students' scientific literacy and must foster interest in STEM careers. This research advances improved comprehension of the strengths and challenges inside the current educational system, specifically regarding teacher competence and subject mastery, by probing academic preparedness degrees of physics teachers.

There are multiple stakeholders who will find value from the findings of this study. The results can inform decisions with regard to teacher training as well as recruitment for policymakers with education authorities. Professional development policies may also be informed by the results. The research may be able to highlight areas that can be in need of curricular enhancement and of support mechanisms for teacher education institutions. Pinpointing effective practices and the gaps that need addressing for a more improved physics instructional quality has the potential for benefiting school administrators and teachers, additionally. Ultimately, the study supports multiple efforts that serve to elevate teacher achievement, and it contributes toward improving several student outcomes, with advancing science education's general quality in Kazakhstan.

1.5 Limitations of the study

This study also includes just a few of the limitations. A cross-sectional survey is used as well as captures data at just one point in time but cannot show cause-effect relationships. The origin of the results might be skewed or false data from self-reporting. The particular sample cannot precisely represent each and every secondary school physics teacher throughout Kazakhstan. This is true especially in remote areas. This research did not include any of the other such factors, for example, school resources, and also teaching conditions.

1.6 Organization of the study

The structure in this diploma work is split into six main chapters. The first chapter introduces the study with its presentation of background, its formulation of the problem statement, its outline of the research objectives, its discussion of the study's importance, and its highlight of its limitations. The second chapter offers each thorough literature review that examines and evaluates previous research related to secondary school physics teachers' academic achievement. In chapter three, the research design, data collection, and analysis procedures are thoroughly explained. The fourth chapter analyzes all of the collected data in accordance with each of the research questions as well as presents all of the results. Within the fifth chapter, interpreters offer several understandings from the study and discuss the findings within existing literature. Conclusions that are based on the outcomes of the research are in the final chapter, which is the sixth. Future studies also do have recommendations that are offered within. Additional materials, such as the tables, such as the figures, and such as the data, that do provide support for the research findings, have been included within the Appendices, and the References section provides a list of all of the sources that were cited throughout the work.

2 Literature Review

The academic achievement of secondary school teachers, particularly in physics, determines the quality for science education as well as ensures students achieve academic success. Important to education reform are physics teachers' credentials, training, and approaches to instruction. More and more, these factors are seen to have a direct effect on learning. Several educational systems throughout the world strive for improvements in science, technology, engineering, and mathematics (STEM) education. It is increasingly vital to understand physics teachers' expertise.

This issue holds a particular degree of importance in Kazakhstan. The country is in the process of modernizing as well as reforming of its national education system at this moment. Over the past decade, Kazakhstan has taken actions in order to align its education policies with international standards, so as to improve the general quality of teaching and of learning. Teacher training enhancement, teacher certification adequacy, and educational opportunity regional disparity addressing are a portion of more broad initiatives. Therefore, physics teachers around Kazakhstan achieve academically and gain professional competencies as the overall national discussion upon educational reform focuses intently.

In Kazakhstan and also internationally, a number of important factors that contribute to academic success for physics secondary school teachers have been highlighted in recent studies. These particular factors do include just what teachers may have learned and have achieved, and also if professional development is fully available and truly good, in addition to how specific educators actually teach. More context-specific research that can inform the challenges and also the opportunities faced by physics teachers there in Kazakhstan is still needed even though there is a growing body of literature on these issues globally.

The existing body of research with regard to secondary school physics teachers' professional competencies and academic achievement in Kazakhstan is critically examined as being the primary aim of such a literature review. As it incorporates international perspectives on teacher preparation, certification, and teaching practices, this review will serve as valuable points of comparison for understanding the strengths and challenges within the Kazakhstani education system. Key themes explore teacher preparation programs, minimum certification requirements, how professional development considerably impacts teaching effectiveness, and various challenges teachers face delivering high-quality physics instruction. By synthesizing all of these themes, the review will offer some understandings into all of the factors that influence the academic achievement of secondary school physics teachers in Kazakhstan and all the potential strategies for improving teacher quality in the future which are providing a solid theoretical foundation for the current study.

This review will clarify that while a few challenges, such as countries limiting access to professional development as well as displaying regional disparities in educational resources, are common, Kazakhstan also has unique contextual factors

which are requiring specific attention. This review identifies several issues and will inform the active dialogue upon education policy and teacher development in Kazakhstan and contributes in that it furthers the broader comprehension of how best to address teacher shortages and improve the quality of physics education inside the country.

2.1 Theoretical Background on Teacher Academic Achievement

Academic achievement, while it associates commonly with student outcomes, people increasingly recognize it as a meaningful indicator of educators' quality and effectiveness, particularly for secondary school teachers. Teachers can achieve academically when they acquire, apply, and advance subject-specific bodies of knowledge, areas of pedagogical expertise, and paths of continuing professional growth. It reflects how teachers formally qualify, master content, commit to lifelong learning as well as translate knowledge into effective classroom practice.

- Teacher academic achievement is, to be more precise, of a multidimensional nature. It includes:
- Formal Education Credentials included: Degrees, certifications, and teacher preparation programs completed.
- Subject Mastery involves having depth in a subject or in subjects. Breadth of knowledge in all of the taught subjects is also a key.
- Participation includes a number of workshops, a number of seminars, a number of advanced courses, and a number of training sessions. This singular participation counts as Continuing Professional Development.
- Pedagogical Knowledge: Instructional methods and classroom management in addition to assessment strategies are understood well.
- Research as well as Innovation include engagement with educational research, curriculum development, and evidence-based practices implementation.

This achievement evolves. Continuous learning and reflective practice permit evolution. The academic achievement of teachers therefore represents both a process as well as an outcome, also helping their effectiveness in the encouragement of academic success and student learning. In order to truly understand academic achievement for teachers, it is necessary connecting it with broader theoretical models that do describe professional growth and evolution for teachers. The Teacher Effectiveness Model as well as those are a couple of prominent frameworks. Outcomes that involve teaching, frequently measured through student achievement, instructional quality, and also classroom management, are indeed stressed by the Teacher Effectiveness Model. Within this model, teacher effectiveness can be viewed as a

proxy. Academic as well as professional accomplishment is thereby represented. Teachers that are academically top-performing under this model:

- Show strong subject knowledge.
- Apply effective teaching strategies.
- You should foster a positive educational setting.

Based on all of the student feedback, their instruction is regularly adapted and is assessed. The Danielson Framework for Teaching (1996) outlines the four domains of effective teaching, and it falls under this model: Planning and Preparation, Classroom Environment, Instruction, and Professional Responsibilities. Each of these domains is influenced by a teacher's academic achievement notably planning and instruction as the teacher designs certain high-quality lessons engages learners meaningfully and assesses student understanding accurately. The TPD model exists. Teachers should develop professionally. Certain growth and learning throughout each teacher's career are central within the TPD model. TPD stresses upon the process of becoming an educator that is effective. The Teacher Effectiveness Model, even so, is in reality outcome-focused. Within such a context, academic achievement is constructed.

- Structured in-service training.
- Reflective practices and mentorship.
- Collaborative learning communities.
- Engagement involves research. Discourse includes academic pursuits.

Guskey's Model of Teacher Change (2002) states changes in teaching practices and student outcomes are initially observed. Teacher beliefs and attitudes, so central to academic development, then subsequently change. Such professional development driven via academic achievement seems cyclical, meaning still deeper learning seems further motivated by such results, which then lead into implementation from such learning. Academic achievement is an important component that links each teacher identity, certain professional growth, and any student performance within the educational ecosystem. Shulman's Pedagogical Content Knowledge (PCK) and similar theories stress on integrating academic mastery and pedagogical skill—showing teachers must not only know about their subject but effectively know how to teach it. Globally and also in Kazakhstan, expectations increase for secondary school teachers to help support diverse student needs, to integrate inclusive pedagogies, and to remain current with curriculum changes. This demands of academics that they prepare students in a strong way and achieve on a constant basis.

Furthermore, there exists a correlation that is positive between teacher academic achievement and:

- Student outcomes were improved. According to Darling-Hammond (2000).
- Teachers have more satisfaction and stay longer.
- Leadership in educational reform.

Investing in teachers' academic development is indeed validated by each of these outcomes both during pre-service training and also through sustained, structured support systems right across their careers. For secondary school teachers, academic achievement holds a special kind of importance. These educators prepare students for higher education as well as for vocational paths and citizenship. People can do so effectively if people prepare academically and improve constantly. Key implications include:

- Teachers with higher academic achievement are more adept at aligning their instruction with curriculum standards and with assessment frameworks.
- Academically strong teachers, for addressing diverse learning styles and needs better, allow Differentiation and Inclusion, including those of students with disabilities or language barriers.
- Teachers who achieve highly often mentor, leading communities of practice as well as influencing school improvement initiatives.

Reform and also educational quality are founded fully on academic achievement for secondary school teachers. The qualifications, the content mastery, the pedagogical skill, and the continuing professional learning define it and also support teacher effectiveness and professional development. By linking of this concept to TPD Model and Teacher Effectiveness Model theoretical models, we gain a thorough comprehension of just how teachers impact upon their students, adapt, and even grow. Educational policy and practice must improve academic achievement in a central way, especially in developing contexts such as Kazakhstan, in which national progress depends upon teacher quality.

Teacher academic achievement, specifically with regard to the context of a teacher's professional development as well as students' academic success, refers to the outcomes of a teacher's professional efforts. Classroom performance stems from varied external and internal factors and leads to teacher effectiveness and achievement. To address issues such as teacher shortages, professional growth, and the overall educational outcomes requires a comprehension of each of these factors.

Academic achievement for teachers is a construct of multiple dimensions. It impacts some student outcomes and involves a bit of teacher performance. For teachers, academic achievement, in a general sense, can be viewed as improving student learning, the ability to impart knowledge successfully, and contributing to a school's or system's educational goals overall. However, student test scores or

classroom performance do not merely measure academic achievement; professional development, continuous learning, and adherence toward educational standards also measure it. Teacher academic achievement is as an outcome of the interplay between a teacher's motivations, qualifications, experience, and also the institutional context in which they do work, as such.

A number of internal factors are critical in whether any teacher succeeds academically, and such factors determine some academic achievement. Academic qualifications, ample motivation, unique personal characteristics, and large teaching experience are included.

Academic qualifications of teachers influence to a large degree their academic achievement as one internal factor. Research consistently shows teachers with higher education levels and specialized training are better equipped for high academic outcomes for students (Darling-Hammond, 2000). People having higher qualifications often teach along with higher quality. Students do perform better when instructors do have advanced degrees in their subject. This especially matters in STEM disciplines such as physics, wherein knowledge specializes.

A teacher's academic achievement is influenced in a large way. The length of their teaching career also affects it. Teachers with experience usually improve strategies for teaching, manage classrooms better, and more deeply understand how effectively complex concepts communicate. Experienced teachers, according to the research from Pianta et al. (2008), are much more adept at tailoring of their teaching in order to meet the varied needs of students, and that is leading to more improved academic outcomes. However, it is of importance to make a note that experience is valuable while its quality matters in a way that is more than its quantity. Teachers do continuously develop professionally all throughout their own careers and also tend to impact student achievement in a more strong manner.

Teacher motivation, inclusive of intrinsic and extrinsic motivation, is heavily relied upon by academic achievement. Intrinsic motivation refers to teachers' internal drive toward succeeding in their profession because of a deep passion for teaching and for learning, while extrinsic motivation involves external factors, such as recognition, salary, as well as job security (Ryan & Deci, 2000). Teachers who are intrinsically motivated are more likely to show creativity and innovation in their teaching practices and can directly influence student achievement. Teacher performance can also be improved through the use of extrinsic motivators such as salary increases or else career advancement on the other hand, particularly when such incentives are in alignment with the improvement of teaching quality.

The performance of teachers is shaped through various external factors, even though internal factors are critical too. Included are government policies, school leadership, access to professional development, and cultural factors.

National as well as local education policies do achieve impacting teacher academics greatly. Teachers are prepared by policies for training, development, and

advancement; academic success comes easier for students. Teacher effectiveness and student outcomes are affected by several national education reforms in Kazakhstan, like the updated curriculum standards' introduction. Teachers have a need to adapt their teaching practices so that they align with all of these new standards, and government policies' support can indeed influence just how successfully they actually do so.

A compassionate setting for teacher academic achievement is created through the vital role of school leadership. Effective school leaders can motivate and do support teachers, providing all of the resources needed in order to excel within their teaching roles (Leithwood & Jantzi, 2006). School leaders stress the need for professional development, staff collaborate with each other because they foster that development, and they improve in a continuous fashion because they provide for a culture that leads directly to higher teacher performance. Strong leadership is likewise connected to teacher retention, and that is key for fixing teacher shortages.

Teacher academic achievement is improved through various professional development programs. These programs happen to be very important things. Teachers do learn on a continuous basis and stay up-to-date with all of the teaching methodologies, scientific advancements, and curriculum as they do change. Darling-Hammond et al. (2009) say teachers develop more strong teaching practices and improve student performance when they participate in periodic, high-quality professional development. Teacher shortages can be overcome in that teachers are more likely to stay in the profession given feelings of support and equipment through continuing development via access to such programs.

Cultural and social factors, along with how society views teaching and education, may affect how teachers perform. The teaching profession is occasionally undervalued within Kazakhstan, as in many other countries, which might contribute to challenges for retention and recruitment. Social perceptions, when concerning teachers' status as well as education's importance, either motivate teachers so they academically improve or cause dissatisfaction and burnout. Furthermore, norms and cultural expectations regarding teaching may shape teachers' work approach. This in particular occurs within STEM subjects, influencing the ways in which teachers engage with students.

Literature thoroughly documents the link between student outcomes and teacher academic achievement. A direct positive impact for each of their students' learning outcomes comes from teachers engaging in continuous development and achieving high professional standards. For example, research by Hattie (2009) suggests that effective teaching practices affect student achievement considerably, often beyond socioeconomic status or school facilities.

In the context of STEM education, inspiring student interest and ensuring complex concepts get understood depend on the instructor's expertise and teaching effectiveness. To improve learning results, teachers professionally grow and study advanced subjects to help student participation. Furthermore, teachers often achieve academically whenever students participate to a greater extent in extracurricular

activities, such as science fairs and Olympiads, in which students present all their learning and solve many problems.

Both internal as well as external factors do shape teacher academic achievement. The various factors combine to do this. While a teacher is indeed qualified and experienced, and motivated, then their school environment, and government policies, with professional development opportunities, do also support and influence them. Teacher shortages still continue to challenge educational systems, particularly inside STEM disciplines like physics, so understanding and addressing these various factors is key toward improving teacher performance and student achievement. How all of these factors do manifest themselves in Kazakhstan's educational system and do contribute to the current shortage of secondary physics teachers will be explored further by each of the following sections within this study.

2.2 Teacher Academic Achievement in Physics

Physics, as an area for study, needs both theory and a comprehension of concepts with mathematical reasoning. For secondary school teachers, pedagogical skill and specialized content knowledge do highly affect conveying physics concepts quite effectively. A teacher's deep comprehension with regard to physics research highlights largely has influence on teaching practices. Student learning outcomes are influenced in turn by this very comprehension.

Shulman's (1986) theory of Pedagogical Content Knowledge (PCK) posits a relationship with teaching. Sufficient content knowledge is needed for effective teaching. Teachable formats must also be into what teachers transform that knowledge. This truly means making difficult subjects like electromagnetism and quantum mechanics into simple physics lessons without sacrificing accuracy. Physics teachers, when they happen to have a strong PCK, are able to better diagnose student misconceptions, and also they are able to select effective analogies as well as employ multiple representations that happen to be mathematical, verbal, and graphical for the reinforcing of learning, according to studies by Gess-Newsome (1999) and Magnusson et al. (1999). Since physics puts stress on abstract concepts in addition to problem-solving, subject mastery is also of more importance. Teachers who do not deeply understand challenging topics may transmit misconceptions or avoid teaching those topics, negatively impacting student comprehension (Van Driel et al., 1998).

Teacher expertise achieves certain student results through effort. Physics is the area of expertise for the teacher. Students who are taught by teachers that have wide-ranging content training or teachers who have advanced physics degrees do show notably improved standardized assessment performances (Wayne & Youngs, 2003; Darling-Hammond, 2000). Sadler et al. (2013) found that physics teachers who had completed major or graduate coursework within the subject taught high school students a bit more than teachers with more general science backgrounds. Students develop favorable perceptions of physics because educators expertly relate course content to

real applications showing assurance and expertise. Furthermore, students also are much more apt to pursue the STEM professions (Hazari et al., 2010).

A teacher of physics educates as well as earns degrees furthermore trains from college, importantly molding the way they teach. For physics instruction, someone must have bachelor's-level qualifications, yet studies suggest a teacher instructs better with a master's degree in physics or in science education. Reflective practitioners with advanced degrees (Rice, 2003) show a stronger command of subject matter as well as engage in more advanced pedagogical reasoning. Teacher education structure in Kazakhstan along with post-Soviet countries has typically stressed solid disciplinary knowledge. It still proves difficult for physics teachers to integrate inclusive approaches along with pedagogical innovation. Master's programs combine content along with pedagogy in ways just like specialized science education degrees. They promote academic achievement more effectively, and teaching quality improves (OECD, 2014). For sustained academic success, professionals must develop themselves. They must also take part in active staff training. They are key components. PD initiatives focused on physics content such as inquiry labs or modeled instruction workshops positively affect instructional quality and teacher confidence (Heller et al., 2012).

However, PD is effective indeed if it offers follow-up support, involves participation, relates to practice, and lasts. PD of a long term that is embedded within school culture can substantially improve both mastery of content and pedagogical skill. However, short-term workshops often yield a minimal impact based on Desimone (2009). Physics teachers are often academically trained at first. This formation originates from teacher preparation programs. Effective TPPs integrate experiences into practical teaching, pedagogical theory, and disciplinary coursework. Research from Ball and Forzani (2011) stresses that, in terms of TPPs, it is important that what teachers know (content) and what they do (practice) must be balanced in order to produce skilled educators.

- Physics education programs often include these.
- Classical physics courses are included, as well as modern ones.
- Design of the training and of safety within laboratories.
- Physics has common student misconceptions that require instruction. Teachers should explain about these misconceptions.
- Teaching practice is supervised in secondary schools.

From subject-specific preparation, effective teachers often come. Certain empirical studies have revealed this fact now. For example, the Physics Teacher Education Coalition (PhysTEC) in the U.S. showed that targeting recruitment, mentoring, and sustaining support programs in physics education greatly increases the number and specific quality of physics teachers (White & Tyler, 2014). Programs for alternative certification often also yield teachers who are less confident and are

effective in content-reliant subjects such as physics because they stress general pedagogy over content (Boyd et al., 2009). Maintaining strict subject-specific standards teacher education greatly underscores.

Issues arise preparing physics teachers. Despite its importance that is notwithstanding, this preparation taxes the people.

Many of the potential teachers are deterred by lower enrollment since physics is often viewed as a difficult subject.

Physics lacks any of the educational expertise of all the faculty members. Physics faculty members with qualifications are not abundant in number. This presents a scarcity.

The universities with the schools now are disconnected from each other. This fact limits how relevant classroom demands are to training.

Student populations are diverse to an increasing degree despite inclusive education's given but limited emphasis.

Kazakhstan strives for a reform featuring multiple partnerships within global institutions while also retraining teachers. These specific endeavors try to close certain divides. Revised national standards will assist. However, implementation is inconsistent throughout areas, notably rural areas. Limited resources and expertise are often in these rural areas. Teachers can achieve academically well enough in physics if they know the discipline strongly enough, if they teach expertly, and if they learn in a multidimensional construct for a lifetime. Physics instruction quality as such student achievement is helped by advancement in education, via bachelor’s to master’s degrees along with professional development courses. Research consistently supports that teaching practices improve and learning outcomes within physics rise with content-specific training. These outcomes are greatly shaped in their totality by the teacher preparation programs. The best programs incorporate physics coursework as well as constant support. Practical instruction labor is also key. However, issues do persist with both recruitment and with program coherence. Inclusive education needs also present an alignment problem, notably in Kazakhstan. We must address to each of these issues. We must also reform according to evidence. Sustained investment for teacher development also is necessary in building a capable, confident, and future-ready physics teaching workforce.

2.3 Educational Context of Kazakhstan

Kazakhstan’s educational system has transformed greatly since the country's independence from the Soviet Union in 1991. Education was highly centralized throughout Soviet rule, a consequence of the state's influence. Ideology drove it too. Following its independence, the government reformed education as it prioritized it, which changed policy and structure (OECD, 2018). At the start, reforms worked to decentralize power, revise curricula, and also establish a national identity for education. The Law on Education (2007) was what provided a legislative framework for modernizing educational standards. Kazakhstan takes part in endeavors like the Bologna Process. Kazakhstan put 12-year schooling models into practice while adopting global standards (OECD, 2014).

Nazarbayev Intellectual Schools or NIS and Nazarbayev University were in fact established, thus they introduced approaches that were research-based and revolutionary with English-medium instruction while influencing a broader educational reform across the whole country (OECD, 2018). The national curriculum has shifted along toward a competency-based approach. It stresses the critical thinking, the inquiry, and also the student-centered learning. These changes aim for educators to move away from rote memorization to analytical as well as practical competencies (OECD, 2014). Reforms that are in STEM education and also particularly in physics have stressed inquiry-based learning, plus integration of ICT tools, plus cross-disciplinary projects. Implementation remains uneven for school resources, teacher preparedness being disparate (Gess-Newsome, 1999).

Since independence, teachers' profession has developed greatly. Content delivery was historically the focus for pedagogical institutes of the Soviet era. They did also place focus upon compliance of an ideological nature. Today, institutions such as Kazakh National Pedagogical University as well as Al-Farabi Kazakh National University play important roles within teacher education. Physics education programs at these institutions include both bachelor's degrees and master's degrees (OECD, 2018). Retraining programs are organized by the Kazakhstan Higher Education Institute plus the National Center for Professional Development “Orleu”. The programs provide certification which is professionally fit to present-day syllabus rules. NIS offers up wide ranging in service training. This training highlights subject-specific strategies and differentiated instruction (Ball & Forzani, 2011). With support derived from the World Bank, Kazakhstan has begun to implement STEM initiatives. These include lab-based instruction that is improved upon, robotics and coding education that is promoted, and STEM female participation that is encouraged (OECD, 2018). Few physics teachers possess specialized training which poses a major challenge. For in-service teachers having general science backgrounds there is often only limited access to a structured subject-specific professional development (Van Driel et al., 1998). Even despite salary increases that happened recently, teaching remains relatively low-paid. Physics graduates find this reduces the profession's attractiveness when they might choose better-paid technical careers (Rice, 2003).

Teachers are greatly strained on account of overcrowded classrooms especially while in urban areas. Without adequate lab support, the effectiveness of hands-on learning diminishes because physics educators often manage large classes (Desimone, 2009). For many schools especially those in rural areas there is a lack of updated textbooks. Lab equipment plus digital tools are lacking too. For teachers, training that integrates ICT effectively into their instruction may be lacking (Heller et al., 2012). A more modern and more inclusive and more effective system is one supported by Kazakhstan's educational reforms. Physics teachers still face obstacles in academic growth, professional development, together with access to resources. It is important for improving academic achievement and student outcomes in physics education through policy support and targeted investment for addressing these challenges.

2.4 Factors Affecting Teacher Academic Achievement

Teacher academic achievement includes personal attributes as well as external influences a multidimensional multidimensional construct within the school and educational system. Augmenting educational caliber, securing qualified instructors, and comprehending determinants impacting teacher efficacy is vital for improving pupil comprehension. Many elements impacting instructor scholastic success were discovered via analyses. These components are classifiable largely within intrinsic and extrinsic groupings. Intrinsic elements include individual attributes, impetus, and pedagogical background, whereas extrinsic elements include organizational backing, career advancement prospects, and regulatory structures. This literature review explores these factors since it focuses upon their relevance to secondary school physics teachers in Kazakhstan as it draws on international perspectives for comparison.

2.4.1 Internal Factors Influencing Teacher Academic Achievement

The academic qualifications for teachers are often viewed as a key internal element impacting teacher academic achievement. Elevated teacher credentials correlate with improved instructional efficacy. Studies consistently reveal the connection with pupil achievements. Darling-Hammond (2000) asserts that instructors possessing advanced qualifications, especially subject-matter expertise, can stimulate students more effectively and elucidate detailed ideas. Physics pedagogy renders this particularly salient since physics mandates deep disciplinary expertise with skill for converting detailed hypotheses to understandable matter given students as a content-laden subject.

Educational reformation within Kazakhstan stresses the capabilities of secondary school educators particularly those within STEM disciplines such as physics. Although teacher preparation alongside licensing have progressed, issues linger about how uniformly regions educate teachers. Scholastic attainment is more probable among educators possessing advanced credentials within physics since their thorough comprehension eases efficacious instruction. The current teacher deficiency stems from a substantial disparity regarding adept physics instructors within many localities (Kuzminov & Melikhov, 2017).

A teacher's efficacy is ascertained through exposure. Scholastic attainment is as well shaped via exposure. Seasoned instructors usually possess more developed pedagogical techniques, superior skills for classroom governance, and an improved skill when differentiating instruction dependent upon pupil requirements (Pianta et al., 2008) as inexperienced instructors might contribute novel concepts coupled with vitality, research indicates. Seasoned educators frequently cultivate a superior classroom atmosphere, one that is favorable to pupil education.

Seasoned instructors remain sparse within the Kazakhstani environment, notably throughout deprived or agrarian territories. Novice instructors find themselves situated within difficult educational settings that possess diminished resources. This positioning may influence the efficacy they possess. As Kazakhstan's education system evolves, it is important to address the disparity in seasoned teachers and support new educators via mentorship plus professional development regarding teacher academic achievement nationwide for improvement.

An additional meaningful intrinsic element impacting scholastic success is teacher incentive. Ordinarily, one classifies motivation into intrinsic along with extrinsic types. Instructors feel innately compelled when an intrinsic impetus motivates them toward teaching for private gratification. They additionally feel passionate regarding the subject matter as well as crave a positive impact upon students' lives. Conversely, extrinsic motivation represents outside remuneration for the individual. Instances of these benefits are career advancement, salary, coupled with recognition (Ryan & Deci, 2000).

When instructors are incentivized, they often seem more zealous, revolutionary, and devoted to pupils, thus affecting pedagogical skill. Hargreaves (2000) scrutinized instructors and underscored intrinsic motivation's salience. They ascertained that educators require deep engagement regarding demanding disciplines such as physics for imparting knowledge effectively. Within Kazakhstan, however, external variables like meager salaries and restricted career escalation possibilities may diminish teacher incentive, which begets occupational discontent and elevated attrition. Initiatives designed to elevate instructor drive, such as improved remuneration, acknowledgement, and career advancement, are vital to strengthen teacher scholastic success.

2.4.2 External Factors Influencing Teacher Academic Achievement

The role of school leadership does indeed affect teacher academic achievement externally. Great school leaders give teachers vision, resources, and support so they can thrive. Strong leadership builds a school culture that encourages collaboration, professional growth, and continuous improvement according to Leithwood and Jantzi (2006). Teachers feel supported within schools where leadership is effective, which increases job satisfaction as well as improves teaching outcomes.

In Kazakhstan, leaders of schools will lead their schools in different ways across all regions. Urban school leaders are often better equipped and trained to support

teachers. Rural schools may be lacking in effective leadership and resources instead. The disparity in school leadership can contribute to differences that are regional in teacher performance. This disparity also impacts academic achievement.

For teachers, academic achievement is impacted by having access to continuous professional development or PD. This entry signifies one more key outside element. Teachers do stay updated with curriculum changes together with subject knowledge with the latest pedagogical strategies by way of PD programs. Darling-Hammond et al. (2009) do find that direct link exists. Teacher performance improves from high-quality professional development programs. Programs greatly impact teaching effectiveness. The programs tend to focus on pedagogical skills as well as content knowledge.

In Kazakhstan, government initiatives improve teacher skills, improving professional development opportunities for physics teachers. Access to PD remains uneven however, especially within rural areas where teachers may face financial and logistical barriers participating in PD programs. Overcoming these barriers has been one approach via mentorship programs and online training modules. The efforts have not fully clarified about the issue. For further research it is still needed with regard to the overall impact from PD on teacher academic achievement within Kazakhstan.

National education policies and curriculum reforms considerably shape teacher academic achievement. Improved teaching practices plus improved academic results are possible through education policies focused on better teacher quality, aligned curriculum standards, plus supported teacher training. Within Kazakhstan, the government has introduced several reforms that seek to improve the quality of physics education and include updating the national curriculum and improving teacher training programs.

However, implementation of each of these reforms has been uneven, and the teachers often encounter some difficulties when adapting to the curriculum standards that are new without some adequate support. Aghayeva (2019) found curriculum changes might overwhelm teachers without needed training and resources, per studies. This highlights the importance of not just reforming but of also ensuring teachers do receive the support that they need to then successfully implement reforms in the classroom.

Effectiveness is shaped by complex interactions among factors impacting teacher academic achievement internally and externally. How well educators perform, delivering content also fostering a positive educational setting, is something teacher qualifications, experience, and motivation determine. For them the ability for engaging students as well as supporting of their learning within meaningful ways can be influenced directly through a teacher’s academic background with subject-specific knowledge in addition to pedagogical expertise. A teacher's drive along with commitment influence sustained efforts toward improved teaching practices plus adapt to diverse student needs, motivated intrinsically then extrinsically.

External factors play a critical role in shaping teacher achievement during that time. Academic achievement also receives their support. Effective school leadership is important for a collaborative, compassionate setting enabling professional teacher success. Leadership that is strong aligns the vision of the school with teacher needs since it ensures continued growth, supports professionals, and provides needed resources. For teachers to stay updated on curriculum changes as well as the latest teaching methods along with subject area advances, high-quality professional development access is available. National education policies must prioritize the training of teachers, the developing of curriculum, and the allocating of resources. These actions improve overall educational outcomes also ensure teachers can meet the evolving demands of their profession.

Improving physics education quality is important for Kazakhstan, and to do so requires addressing internal and external factors, while also tackling the active teacher shortage. Many countries encounter difficulties in ensuring access for all students to teachers who are qualified as well as well-supported. Kazakhstan is one such country, specifically with regard to subjects like physics, which require specialized knowledge and teaching skills. The shortage of those qualified physics teachers especially in more rural and underserved regions has been just like a longstanding issue and it exacerbates disparities in education quality. Furthermore, it is still a challenge to align teacher qualifications and professional development programs with international standards because teachers must adapt to new curriculum frameworks, teaching methodologies, and educational technologies.

These problems require an inclusive broad method. First, Kazakhstan must act for ensuring teacher education programs comprehensively train educators in subject knowledge and pedagogical skills. Specifically, they should have a focus that is on physics education. This includes ensuring potential teachers are well-equipped for navigating teaching science's complexities as well as improving teacher preparation program quality. Second, school leaders must strengthen their roles so as to create an environment for continuous professional growth, teacher collaboration, and revolutionary teaching practices. All teachers must access professional development programs focusing on continuing, relevant, practical training improving teaching effectiveness and subject expertise.

National education policies furthermore do have an important impact. Reforms that do seek to improve education quality in Kazakhstan, which do include updating of the national curriculum and introducing of new teaching standards, must have sufficient support for all of the teachers. This not only includes training programs but includes clear guidelines which help in implementing curriculum changes. These guidelines ensure that teachers will be equipped with the tools and also strategies that are necessary for them to successfully deliver updated content. Teacher retention policies, along with reduced workloads, may address such a teacher shortage. Teacher salaries that are increased may also play a role that is in improving academic achievement.

Researchers can use this literature review to explore the ways these internal and external factors manifest in Kazakhstan's education system specifically for physicists. Attention to the necessity of focused actions addressing teachers' personal also professional challenges is highlighted. The review examines the ways these factors influence teacher academic achievement. This analysis prepares to explore the precise issues Kazakhstan secondary school physics teachers confront with greater intensity. Understanding these factors remains important for developing effective strategies to improve teacher quality, reduce the teacher shortage, and improve overall physics education in Kazakhstan since it ensures all students can excel in this critical subject area.

2.5 Teacher Professional Development and Training Programs

Teacher professional development (PD) improves teacher effectiveness so it critically improves student outcomes. Effective PD programs equip teachers with skills, knowledge, and resources to continually improve teaching practices, stay current with trends, and meet diverse needs. This section asks why training programs are important for teachers in secondary schools, especially in physics, and sees how Kazakhstan's system of education functions. Reviewing national and international PD approaches helps you understand how these programs improve the quality of education plus contribute to the academic achievement of teachers.

Of course, academic literature widely acknowledges the central role of PD in teacher success. New teaching strategies are being implemented, subject knowledge now improves, and also positive educational settings in classrooms are fostered by teachers in high-quality PD (Desimone, 2009). PD matters for increasing teachers' content knowledge and teaching abilities. PD also improves classroom management techniques. PD is especially vital for subjects such as physics, requiring teachers to deeply understand concepts and clearly explain complex ideas.

PD is viewed more like a constant process than like a single event. Teachers must have opportunities that are continuous for professional growth accessible to them. They must be tailored both to personal needs and also to the specific demands of their subject area. Understanding teaching as a dynamic profession is where continuous professional development (CPD) originates because teachers must learn continually to remain updated regarding new pedagogical strategies, technological advancements, and evolving student needs.

Kazakhstan has focused upon teacher professionals in particular. Recent educational reforms developed them. The government greatly strives for improvement of education quality through provision of PD opportunities which align with national educational goals as well as international standards. Kazakhstan's education system has undergone several reforms in recent years, and those reforms include the creation of new curriculum standards, in addition teachers must get certified. These reforms have been accompanied by an increasing emphasis that is on PD. Teachers must effectively implement each of the changes and improve on their teaching practices.

For Kazakhstan's Ministry of Education and Science exist programs of PD that seek to improve what physics teachers know. Among these, prominent in particular, are in-service training programs, as they happen to be designed for helping teachers acquire skills and knowledge that are necessary so they can deliver the national curriculum effectively. In these programs, there are often workshops, plus seminars, along with specialized training sessions regarding areas like curriculum delivery as well as assessment strategies for technology integration.

However, despite these efforts, difficulties remain still. Still difficult is ensuring equal access to PD opportunities across the country. PD programs are often inaccessible for teachers in remote schools or rural areas because of logistical and financial barriers. PD programs that happen to be subject-specific and that are pedagogically strict are increasingly needed, especially in subjects such as physics where specialized teacher expertise might be lacking. A teacher quality disparity exists within the regions because of less urbanized regions of Kazakhstan showing an important gap within available PD programs for physics teachers per Satybaldieva et al. (2018).

Kazakhstan PD programs focus on general pedagogical methods, teacher feedback indicates, instead of subject-specific content, an important issue for physics teachers. Teachers expressed that there is a need for more tailored PD programs. Those programs must target specific problems related to physics instruction like teaching abstract ideas well plus encouraging student critical thought (Zhumabayev, 2021).

About their structure, PD programs globally vary widely. Their content as well as delivery methods also widely vary. Effective PD programs' key characteristics are identified by international research. However, these are many overall. Programs for PD that are collaborative and also content-focused are most effective if sustained over time. Collaborative PD encourages teachers to work together along with sharing best practices, and it allows them to learn through each other’s experiences. This is a dynamic that creates within it a community for the practice that fosters growth that is professional. Teachers gain subject-specific, deep knowledge through PD focused on content, especially important for subjects needing specialized expertise like physics. Finally, sustained PD allows teachers to integrate new knowledge into their teaching practices gradually, also this ensures that learning is applied and sustained over time.

Countries such as Singapore and Finland are often named. Teacher development systems in these countries are exemplary. In Finland, PD is built into the educational culture, also teachers are encouraged to engage in regular professional learning because they have a variety of platforms like collaborative teacher teams and mentorship programs (Kansanen, 2003). In Singapore also, PD programs are closely linked to school leadership and do continuously support teachers as they coach, observe, and give feedback in school (Tan & Lee, 2017). These countries provide models since professional development is integrated as well as continuing so it could inform PD initiatives in Kazakhstan.

For Kazakhstan, the Teach program is one international example that is successful for PD influencing the teacher training system of Kazakhstan. This initiative is modeled after similar programs such as Teach for America as it recruits and trains teachers within underserved regions. It can also offer to them intensive professional development and also mentorship. Teachers often undergo summer training programs that focus on pedagogy as well as subject-specific knowledge during. This is a program to ensure that teachers are well-prepared to teach inside of challenging environments.

Though ensuring programs that are accessible and effective remains hard, the Kazakhstan government has seen important strides developing PD programs for teachers. Teachers lacking subject-specific, personalized PD especially in STEM fields like physics present a major challenge. Teachers report the PD opportunities available to the teachers are often far too general and fail to address the specific pedagogical challenges of the teaching science subjects.

It is another challenge that the need exists for continuous support after PD programs. Many teachers attend in PD workshops or seminars. Without chances at reflection and application or follow-up support, the impact of these programs can be limited. Studies show that when teachers sustain PD, have a chance to implement what they have learned, as well as receive active support, PD more effectively improves teaching practices and student outcomes (Darling-Hammond et al., 2009).

Logistical issues like distance, cost, and time constraints impede access to PD programs. For those teachers who are working in the rural areas, this thing is especially true now. These barriers can often result in teachers from underserved regions receiving fewer professional development opportunities, and this contributes to the teacher shortage as well as disparities within teaching quality across Kazakhstan.

Global best practices that are found in teacher training and PD stress several key principles. For improving the effectiveness of the programs, these principles are critical. These include: For teachers, program effectiveness can be improved with the provision of access to mentors and to coaches. Mentorship allows guidance and feedback of a personalized type. With the aid of mentorship, teachers are assisted to apply new knowledge within the classroom.

Collaborative Learning: It encourages teachers in order to work together within professional learning communities (PLCs) or by way of peer observation programs, so it fosters collaboration along with continuous improvement. Colleagues aid teachers when challenges, strategies, and perceptions are shared.

Educational technology plays a larger classroom role so PD programs must include training to use technology effectively for teaching and learning particularly in subjects like physics where tech tools like virtual simulations can aid concept comprehension: Integration of Technology.

It is encouraging to see teachers engage in action research which is a process in which teachers investigate their own practices and then make adjustments based on

evidence because it can help teachers develop reflective practice and improve teaching effectiveness: Action Research.

Should Kazakhstan's PD system incorporate these best practices, the system could help ensure teachers train well and support well throughout their careers. Professional development for teachers is vital for encouraging systemic advances in education and for increasing each teacher's academic success. Well-designed PD programs provide teachers with the tools, knowledge, and strategies for improving their subject expertise, pedagogical skills, and teaching efficacy. STEM education's quickly changing character and the severe lack of skilled physics teachers make PD quite vital for Kazakhstan's physics teachers. To address these challenges, we must strongly develop teachers, integrating national initiatives along with international best practices.

In Kazakhstan, people are trying harder for improvements to PD for physics teachers while the government invests in new initiatives and these initiatives seek improvements to teaching quality. However, despite these efforts, there still are important challenges. A key obstacle remains PD opportunities' accessibility, particularly where teachers often battle to attend centralized training programs in remote and rural areas. Because of the fact that teachers in those regions grapple with time, with financial, and with logistical barriers, the geographical dispersion of schools throughout Kazakhstan worsens the problem that is impeding their involvement in activities for professional development. The teacher shortage and disparities in educational outcomes of urban and rural areas are contributed to by the lack of any access to high-quality PD programs for teachers in underserved schools.

Another challenge that is important is the subject-specific training that the physics teachers need. Specialized PD, tailored for physics educators' unique needs, often fills a gap since some national PD programs offer general pedagogical training. A firm hold on physics teaching's subject is needed for students to engage in hands-on learning, experimental work, plus critical thought. If their focus is only pedagogy, PD programs may fail. Those programs may not address these subject-specific challenges then. PD programs must therefore be content-focused and designed for physics teachers giving updated science knowledge plus the pedagogical strategies to effectively teach tough topics like quantum mechanics, electromagnetism, and wave theory. Programs should include opportunities for exploring the integration of revolutionary teaching methods along with the use of educational technologies. For example, simulations plus virtual labs are examples of such technologies, and these technologies can help to make abstract concepts more accessible for students.

Also, people must attend to sustaining PD programs as well. Kazakhstan PD programs often occur as isolated events such as short-term seminars or one-time workshops giving teachers no follow-up opportunities or continued support. For effective PD that requires reflection plus active engagement, teachers need opportunities to use class learning and obtain feedback. Sustained PD is characterized by the continuing professional engagement along with mentoring as well as peer collaboration. This PD is much more effective for improved teaching practices and

student outcomes than brief training programs, research indicates (Darling-Hammond et al., 2009). PD initiatives in Kazakhstan should be designed for offering not only initial training but also opportunities for teachers if they continue to learn throughout their careers. It might mean simplifying peer reviews, forming professional learning groups (PLGs), and building mentorship schemes to match veteran staff with newer educators.

Kazakhstan can address each of these challenges through drawing upon international models for teacher professional development. These models offer from the best practices. Countries like Finland and Singapore have established PD frameworks stressing the importance of teacher collaboration and continuous learning. Finland embeds PD into teaching itself since teachers regularly plan collaboratively, observe classrooms, and discuss professionally. Ensuring teachers consistently improve their practice, collaborative networks along with strong mentorship programs support this culture of continuous learning. Likewise, Singapore's PD model stresses school-based support, and teachers receive coaching with continuing feedback. They are encouraged to engage in research along with inquiry to improve their teaching methods. These models could prove valuable benchmarks for Kazakhstan as it betters PD offerings.

Kazakhstan could benefit, in addition, from the creation of PD programs. The programs must be adaptable and flexible to teachers' different needs in the country. For example, teachers in remote areas could access high-quality PD resources via the leveraging of online learning platforms without a need to travel. In order to be certain that teachers are not isolated in their learning, online PD could be supplemented by way of face-to-face interactions. These could include regional workshops or networking events too.These models could serve for Kazakhstan as valuable benchmarks as it works to improve its own PD offerings.

Kazakhstan could have the potential to benefit from creating some PD programs. Those programs should be adaptable and flexible for teachers' diverse needs nationwide. For example, teachers from remote areas could gain access to high-quality PD resources. This outcome could occur because they can leverage online learning platforms so that travel is no longer needed. In order to make sure that teachers are not isolated within their learning, face-to-face interactions could supplement online PD, such as networking events and regional workshops. These programs should also have a design for catering to all of the specific challenges faced by physics teachers, and also the programs should be providing them with more resources, tools, and some strategies for improvement of their teaching effectiveness in the context of their subject.

Teacher engagement can improve PD using action research too. Teachers do use action research in order to systematically investigate their own teaching practices for making adjustments based on data. Through this reflective practice, teachers recognize areas of improvement and take ownership of their professional development.

With action research inside PD programs, teachers may actively engage in their learning, forming a richer perception into their practice and effects on student learning.

Ensuring teachers are well-prepared to implement curriculum changes as well as meet new educational standards is important for the alignment of PD programs with national educational reforms, finally. Kazakhstan's new curriculum reforms have increased the focus on classroom critical thinking, problem-solving, and technology integration. PD programs must reflect these changes for they provide teachers with the skills along with strategies needed to implement the revised curriculum effectively. Furthermore, Kazakhstan continues to integrate with international best practices, so PD programs should be designed for the purpose of helping teachers navigate to the intersection. Teachers need to meet all of the challenges within the 21st century, so we need to ensure that PD programs equip teachers for local needs and for global trends.

Teacher professional development improves education in effect by addressing the shortage of physics teachers in Kazakhstan. Despite meaningful strides in offering PD opportunities, much work remains toward ensuring these programs are accessible, subject-specific, and sustainable. Kazakhstan is able to strengthen its PD programs through learning from international best practices as well as addressing the unique needs of physics teachers. This strengthening can foster continuous teacher growth to improve the quality of education in STEM subjects. Because the education system continues to keep on evolving, Kazakhstan must invest in PD programs of high quality that are sustainable. The programs for teachers' careers should let them educate students best in physics.

2.6 Student Achievement and Teacher Quality

Many studies have correlated teacher qualifications greatly to student achievement, especially in science disciplines like physics. Subject matter expertise, teaching experience, pedagogical skills, and academic qualifications are key indicators of teacher quality that ResearchGate states. A study done in Nigeria found that teacher's subject matter knowledge had impact upon student's physics achievement that was prominent ($\beta = 0.227$, $p < 0.05$). Other factors such as pedagogical knowledge with teaching experience were not individually statistically meaningful. Effective instruction and student success suggest a teacher's deep comprehension about physics content is important. Furthermore, research indicates that teacher quality influences student achievement greatly since it is a key school-related factor. High-quality teachers deliver complex content, adapt to diverse student needs, and employ effective teaching strategies, improving student outcomes.(ResearchGate)

In Kazakhstan, researchers focus on a relationship of teacher qualifications with student performance. This is their focus particularly since international assessments are available like the Programme for International Student Assessment (PISA).

Based on the OECD's PISA 2022 results, Kazakhstani students demonstrated a meaningful improvement in science because they had a 26-point increase from

previous assessments. Kazakhstan was positioned within the top 50 countries in science performance by this progress.Qazaqstan Monitor

Yet some difficulties do remain, despite all these gains. In Kazakhstan's PISA 2022 country note, it highlights that 55% of students attained a Level 2 or higher in science, versus the OECD average of 76%. A sizable proportion of students are not reaching skill in science. This indicates that the baseline level is in fact not being met now. Teachers deliver physics education effectively when their academic qualifications along with professional development influence them. In Kazakhstan, there are teachers specializing in natural sciences and mathematics who are required to undertake thorough coursework within their subject areas. The coursework includes the most revolutionary teaching methodologies.

The review of all of the literature highlights how teacher academic achievement is indeed multidimensional and also how it critically shapes all educational outcomes, particularly in physics education. Factors influence teacher performance along with teacher quality. These factors are internal along with external. Researchers determined that those internal factors do greatly affect any teacher performance. These factors include academic qualifications, teaching experience, and intrinsic motivation. Student achievement is influenced directly by teachers showing higher levels of content mastery with pedagogical confidence plus stronger academic backgrounds. Furthermore, intrinsic motivation—such as those passionate to teach as well as commit to student growth—drives professional success in a more sustainable manner than extrinsic motivators like salary or status.

External factors that decide this are school leadership, national policy, and professional development access. They have a very key function. Government started upgrading curriculum standards and certifying professionals, building teacher chances to advance. However, challenges for the implementation particularly located in rural areas still act to limit just how far these reforms then reach along with how equitable that they are. Teacher professional development within Kazakhstan has seen progress that is substantial from programs done by the Center of Excellence, QyzPU, and Abai University. These programs partially align with global best practices, including mentorship and continuous learning models, though more localized and sustained support is needed. The professional development landscape has in fact been further improved through international collaborations.

Teacher quality affects student achievement within STEM disciplines. According to data that comes from international assessments like PISA 2022, Kazakhstani students are making gains in science though many of them still fall below the OECD baseline. Research confirms that teacher subject expertise is indeed a key determinant of student success within physics as this underscores the importance of targeted support specifically for science educators. This review of the literature specifically shapes both the methodological framework and the theoretical framework for the study for it examines academic achievement of secondary school teachers in physics in Kazakhstan. When analyzing academic performance, it stresses upon

considering a broad range of variables. Teacher background, motivation, institutional support, and also policy context should be included.

The findings suggest that future research should explore the lived experiences of teachers through qualitative methods and also measure teacher qualifications with student outcomes quantitatively. Interviews or surveys plus case studies may offer more deep perceptions into just how national reforms are perceived. These reforms' application at the school level involves training programs too. This study hopes to grasp teachers' academic success with subtlety and suggest practical improvements for physics education throughout Kazakhstan’s varying educational contexts by rooting its research in national and global literature.

3 Research Design and Methodology

3.1 Research Method

This study uses a quantitative approach with surveys to explore why there are few physics teachers in Kazakhstan secondary schools. The cross-sectional design was selected since it allows data collection at a single point. This design aids in recognizing trends as well as contributing factors to the teacher shortage coming from a diverse group. It is through using a structured questionnaire that you enable the systematic collection of information across different types of schools.

3.2 Sources of Data

The primary data source is from an educator survey designed using the knowledge of skilled physics teachers. The survey includes both closed-ended with short open-ended questions. These questions do address a variety of aspects of the teaching profession, such as:

- Teacher qualifications' professional background.
- Teaching load and responsibilities
- Access to professional development
- Job satisfaction and career intentions for staff
- Perceptions of systemic challenges

To get more responses and frank opinions, they made the survey short, nameless, and available online.

3.3 The Study Site

The study was conducted at some of the selected secondary schools within Kazakhstan, especially targeting these three of the prominent types of schools:

1. BIL (Bilim-Innovation Lyceums) are private schools that academically educate students in science and mathematics.
2. Dostyq Education Centers employ physics educators as well as serve as supplementary education centers.
3. For students with high capabilities, Nazarbayev Intellectual Schools (NIS) are superior public schools. They seek to support these students, notably in STEM fields.

For a comparison of experiences across school systems and support levels, we selected these sites to ensure sample diversity.

3.4 Population and Sample Size

The target population of this study includes physics teachers in secondary school currently teaching in Dostyq, NIS, together with BIL schools across Kazakhstan's various regions.

The survey distributed garnered responses from 120 physics teachers. It was a return of substance. Since all of the responses were complete as well as accurate, 75 completed questionnaires were seen as valid for the analysis after a review was done.

Because of how it enables meaningful analysis of all of the key issues that are related to teacher shortage, the final sample consisting of 75 teachers provides a representative cross-section of Kazakhstan’s secondary school physics teaching workforce.

3.5 Instrument of Data Collection

The primary instrument used for data collection here was a questionnaire that was structured specifically to learn why Kazakhstan lacks sufficient physics teachers in secondary schools. Educators with experience in physics did collaborate for the purpose of developing that questionnaire. This ensured its content validity along with research objective relevance. The survey had used both of closed-ended and open-ended questions for it. The survey divided the questions into four main sections as well.

- Demographic Information: Questions explore age as well as gender, school type, years teaching, plus educational attainment.
- Professional Development: Items centered on teachers’ involvement in different types of professional growth during the last 18 months, and these items covered courses, conferences, mentoring, and qualification programs.
- Student Achievement: Questions about the average Unified National Testing (UNT) score in physics, as well as about the number of students who won national or regional Olympiads and scientific project competitions.

Duties also include investigations of tasks besides classroom instruction, such as leadership or management. The questionnaire designed as short, accessible, and easy to complete was distributed online to ensure a broader reach across different regions. Assurances with respect to anonymity and also confidentiality encouraged respondents in order to respond with honesty and accuracy. A small group of teachers tested the final instrument version during pilot studies. They then refined the instrument per the teachers' feedback before distributing it to the full sample.

3.6 Procedure of Data Collection

The data collection for this study involved multiple steps ensuring responses were valid and reliable. According to existing literature, the questionnaire was developed first then refined using input from teachers. A small pilot test was in fact conducted. The purpose of it was for assessing question clarity and also structure. For distribution, the survey's final version incorporating minor revisions based on the feedback was prepared.

Researchers did administer the survey online by using a digital platform which efficiently distributed as well as collected data from teachers across different regions of Kazakhstan. Educators who are working at Bilim-Innovation Lyceums (BIL), at Dostyq Education Centers, and at Nazarbayev Intellectual Schools (NIS) received the questionnaire link by way of email and of teacher networks. These schools were chosen because they have great STEM focus and they are applicable to the study.

The study's purpose was explained since respondents were assured about confidentiality. All could choose whether to join the study. In order to make certain that all responses are honest and accurate, they collected absolutely no identifying personal information. The survey did receive 120 of the responses. The respondents were teachers. After reviewing responses, 75 questionnaires were selected for analysis based on completeness and clarity. Statistical as well as thematic analysis required the data for organization and coding.

3.7 Validity and Reliability Check

Ensuring research instrument validity as well as reliability helps researchers to obtain accurate plus trustworthy results. In this study, developers did consider both content validity and internal consistency reliability when they did develop and then implement the survey. For content validity, experts were consulted. A panel made of educational researchers as well as of experienced secondary school physics teachers reviewed the questionnaire's initial draft. They used their feedback for refining question wording and eliminating ambiguity. Also, the feedback ensured the instrument adequately covered key areas related to teacher shortages, professional development, and student achievement. Survey item alignment with research goals also strengthens the instrument's content validity. Additionally, a pilot test of the questionnaire was conducted. Physics teachers outside of the final sample composed the small group. Clarity, question flow, and also the survey's structure were improved by way of minor adjustments with their responses as well as feedback. To check internal consistency for the scaled items, Cronbach’s alpha was used. These items relate to professional development as well as teaching practices to assess the reliability of the instrument. Since the reliability coefficient was found within an acceptable range ($\alpha > 0.7$), it indicated a satisfactory level of internal consistency among the items. In order to reduce response bias, instructions were kept quite clear, and also questions were standardized. Using closed-ended questions minimized interpretation errors, so

response reliability improved. To investigate the Kazakhstan physics teacher shortage, these steps ensured the data collection tool was reliable along with valid.

3.8 Method of Data Analysis

Once the survey responses were collected, the next step was to uncover perceptions regarding the shortage of secondary physics teachers in Kazakhstan, analyzing the data in a way that would answer the research questions. To complete this, inferential and descriptive statistics were used. Key trend identification and data comprehension then became permissible. First of all, I used descriptive statistics. I did this in order to summarize the information from the survey. Context was given to the rest of the analysis so that respondents' characteristics were painted because of this. I looked at respondent categories, such as gender, school type, as well as education level, and frequency distributions were calculated for each category. It was useful to have a comprehension of what the basic demographics of the teacher sample are. Measures that indicate central tendency included averages which are means and also medians. These were calculated in respect to continuous variables such as age, years of teaching experience, together with UNT scores. This gave rise to a sense about the “typical” teacher within the sample.

For all questions about professional development, I calculated percentages in order to see how many teachers had participated within different training activities. These calculations showed if teachers thought these activities affected their teaching too.

These statistics offered a good overview so I understood general trends in the survey respondent data. I wished to guarantee the survey's accuracy before the deeper analysis. I needed for to confirm that it was measuring with consistency that which it was supposed to. I checked for reliability within survey items, particularly professional development items, so I calculated Cronbach’s Alpha. Cronbach’s Alpha is a statistic that tells you if the questions in a certain set are consistent with each other (for example, professional development questions).

Survey section responses proved reliable because Cronbach’s Alpha should be above 0.7. This survey section's value seemed quite strong to me. Next, I wished to observe response variations depending on teacher experience or school type like NIS, Dostyq, or BIL. Groups were compared in this study and differences were checked using ANOVA (Analysis of Variance). I compared, for example, how teachers responded to questions upon student achievement and professional development from different school types. Also, t-tests were used so that they could check for some differences that were between teachers in professional development and other teachers. Recognizing patterns was achieved by this method, such as whether more training programs or experienced teachers had better student outcomes. I did use correlation analysis in order to explore relationships between those variables. I was able to understand some factors because of this. These factors could have been so linked. For example:

Was there higher student achievement (as it was measured by UNT scores and Olympiad results) typical of teachers with more experience?

Was attendance in the area of professional development connected to anything? Also, did better outcomes then result for the students?

I used Pearson's correlation coefficient for quantification of the strength and direction of these relationships. I performed this analysis in order to see if things like teacher experience or professional development had any measurable impact on student success. I was able then to see all of the results. Some survey questions did allow for teachers to write out all of their thoughts, and indeed their open-ended responses did richly provide qualitative data. I did use thematic analysis in order to make sense of it. This means I grouped similar answers, identified themes, and read responses carefully. Some teachers noted low pay plus heavy workloads meanwhile many cited a lack of development as key in teacher shortage. I was able to get a deeper comprehension of the reasons behind the shortage via identifying these recurring themes. Also identifying them helped me determine what might help address the shortage. Using tables, charts, and graphs, I presented the findings to make the data easy to grasp. These visuals helped clearly display trends like the number of teachers who had participated in professional development or the average UNT scores of students taught by different types of teachers. Correlation matrices further showed about how variables including student performance and teacher experience related.

3.9 Data Processing and Analysis Results

During the research, data was collected through a structured questionnaire which was distributed to physics teachers at various schools as well as institutions in Kazakhstan. We received 120 responses total. After this, seventy-five valid responses were selected; frequency distribution and percentage calculations were used for statistical analysis.

Table 3.1 exhibits the gender distribution among physics instructors surveyed. Women constituted the greater part (53.3%), whereas men constituted 46.7%. This comparatively even apportionment indicates that both genders can effectively instruct physics, even though observers acknowledge a marginally greater fraction of females. Gender dynamics might shape workload distribution, as well as pedagogical approaches. Career enrichment prospects could exist too.

Table 3.1 Gender of Teachers

Gender	Count	Percentage
Female	40	53.3%
Male	35	46.7%

As shown in Table 3.2, the predominant demographic of physics teachers is below 25 years old (40%), which evinces a prominent introduction of youthful instructors into the occupation. The 25–29 (20%) as well as 30–39 (26.7%) age cohorts exhibit a diminished proportion, given that solely 13.3% are 40 or older. This age trajectory may evince either nascent graduate recruitment or conceivable attrition among veteran educators. It can additionally mirror a generational change within the workforce.

Table 3.2 Age Distribution of Teachers

Age Group	Count	Percentage
Under 25	30	40%
25–29	15	20%
30–39	20	26.7%
40 and above	10	13.3%

Table 3.3 shows that most teachers (60%) operate within public secondary schools, then private schools (20%), educational centers (13.3%), and universities/colleges (6.7%). This dispersal underscores that the majority of physics education transpires in the state sector. For the reason that of this, comprehending access toward resources coupled with institutional sustenance impacting teacher success might just be vital.

Table 3.3Workplace of Teachers

Workplace	Count	Percentage
Public Secondary School	45	60%
Private School	15	20%
Educational Center	10	13.3%
University/College	5	6.7%

According to Table 3.4, 60% of the teachers hold a bachelor's degree while 33.3% have acquired a master's degree. Only 6.7% possess credentials that are at the collegiate echelon. The comparatively elevated proportion of postgraduate degree holders indicates the field is evolving toward greater professionalism. Nonetheless, it may prove necessary for us to strive to enable all educators to attain postgraduate instruction.

Table 3.4 Highest Level of Education

Education Level	Count	Percentage
Bachelor's Degree	45	60%
Master's Degree	25	33.3%
College	5	6.7%

Table 3.5 delineates physics teachers' span of pedagogical expertise. Experience differs greatly since 26.7% have 2–3 years of experience. An additional 20% possess 1 year, have 6–10 years, or exceed 10 years of experience. This assortment evinces novice as well as seasoned teachers integrate in the system, which may impact academic performance in general and mentor schools' culture.

Table 3.5 Years of Teaching Experience

Experience	Count	Percentage
1 year	15	20%
2–3 years	20	26.7%
3–5 years	10	13.3%
6–10 years	15	20%
More than 10 years	15	20%

Table 3.6 reveals that most teachers (90%) participated in at least one professional development course throughout the last 18 months; additionally, 30 teachers attended 3–5 sessions. This commonly evinces that people participate in lifelong learning substantially. This involvement probably affects physics education caliber and scholastic success.

Table 3.6 Participation in Professional Development Courses (Last 18 Months)

Number of Courses Attended	Teacher Count
0	10
1–2 times	25
3–5 times	30
More than 5 times	10

In Table 3.7, responses bifurcated near evenly because 40 teachers specified they were discharged from work obligations during course attendance, while 35 were not. This spotlights institutional disparities regarding backing for teacher development. These disparities can compel or deter educators from successfully instituting novel aptitudes in the classroom.

Table 3.7 Were Teachers Released from Work During Courses?

Answer	Count
Yes	40
No	35

As shown in Table 3.8, teachers discerned that professional development modestly affected teaching practice (30 teachers) toward substantially impacting it (25 teachers), with 20 reporting minimal impact. The training was deemed useful for most teachers, which is what this suggests. However, the courses' disparity in quality as well as relevance persists as a hurdle.

Table 3.8 Impact of Courses/Seminars on Teaching Practice

Impact Level	Count
Significant	25
Moderate	30
Little/None	20

Table 3.9 furnishes understanding concerning the scholastic production of surveyed instructors' pupils. Typically, 3–4 students participated within regional Olympiads. Nevertheless, a reduced number of students attained nationwide ranks or partook of scholastic ventures. Such disparities in school resources, disparities in teacher motivation, or disparities in support for physics academic opportunities might depict this.

Table 3.9 Student Achievements in Olympiads and Scientific Projects (2022–2023)

Achievement Type	Average Number of Students
Regional Olympiad	3–4
National Olympiad	1–2
Regional Science Project	1–2
National Science Project	0–1

3.10 Process of Data Analysis

The data analysis was conducted based upon the responses that were collected through the structured survey instrument designed specifically for this study: "Investigating Secondary Physics School Teacher's shortage in Kazakhstan" The questionnaire, which was developed in consultation with educational experts then distributed in three languages—Kazakh, Russian, and English—was intended to ensure inclusivity plus broader participation.

The very first stage of the data analysis involved the organizing of responses. Also, the integration of those responses occurred then. For systematic processing, all responses collected from Google Forms were exported into Google Sheets and Microsoft Excel. The questionnaire's predefined structure included demographic data (such as age, gender, workplace), professional background, participation in professional development, teaching experience, also student achievement indicators. We categorized the responses under that structure.The data went through a cleaning stage prior to statistical analysis. This included:

- Entries that are incomplete or duplicated are removed now.
- Seventy-five valid responses were chosen from the 120 original ones for the final analysis because responses had key question inconsistencies.

Following after this, data were coded, and also they were categorized. Analysis was eased because closed-ended responses were coded numerically. Education levels were coded as 1 for Bachelor's degree, 2 for Master's degree, etc. Likewise, ordinal

values were assigned to professional development impact responses (e.g., “very effective”, “somewhat effective”) to allow descriptive interpretation.

- Descriptive statistics were included so that this was indeed the main method for analysis.
- To identify distribution patterns among professional and demographic attributes, frequencies and percentages are used.
- Cross-tabulation is able to explore for relationships between these variables. Teaching experience with participation in professional development are examples.
- Quantitative question means are what we calculate (e.g., average UNT scores, how many students win in olympiads).

All of the findings were at that time presented in tables, and each table was accompanied through a short explanation in order to ensure clear interpretation.They wrapped up by deeply analyzing numbers, found major patterns, and mindfully decided about where things stand plus what problems physics teachers face in Kazakhstan's high schools.

4 Results

4.1 Overall results

The results presented here stem out of a complete examination of survey response data. The inquiry purposed to explore the scarcity of secondary physics instructors in Kazakhstan. The survey pinpointed elements that did contribute to this deficit too. The survey responses were analyzed via descriptive with inferential statistics by researchers that enabled their comprehension regarding teacher demographics, their professional development, the teaching challenges they experience, plus how they affect student performance. Relative to the types of analysis performed, the following sections delineate the survey findings.

These analyses stress important trends along with relationships between variables which might bear upon the deficit of physics teachers nationwide and delineate the necessary traits of the instructors within the sample. I could more readily comprehend the wide-ranging scope of the deficit via scrutiny of aspects like gender, age, education level, years of experience, and professional development.

The data analysis served to discern salient disparities in teacher attributes. These disparities were predicated on variables such as school type (e.g., public, private, or specialized schools) along with teacher experience. I investigated through correlation analysis whether factors such as teaching experience or professional development were related to higher student achievement in physics.

Difficulties faced by teachers and their perceptions regarding the manner these impact the dearth of physics instructors garnered improved understanding by the thematic scrutiny of unrestricted replies. The qualitative responses furnished rich context to help contextualize the statistical findings. Solely quantitative data might not thoroughly encapsulate these stressed matters. I now furnish elaborate outcomes derived from the inquiry, initiating with a demonstrative synopsis of instructors sampled, succeeded by deductive statistical assessments that scrutinize potential associations and disparities among the data.

4.2 Descriptive Statistics

Descriptive statistics were used to yield perceptions into, and encapsulate the qualities of, survey respondents. This portion elucidates the attributes of the educators involved within the survey, which enables others to comprehend the investigation's framework. Descriptive statistics aid in representing a lucid depiction of the respondent demographic via organizing the information into frequency distributions. These distributions permit an examination of salient variables of interest such as gender, age, education level, as well as teachers' institutions. These statistics represent the groundwork toward deeper analysis since they expose trends that may clarify the paucity of secondary physics teachers in Kazakhstan.

4.3 Frequency Distributions of Key Demographics

Understanding the demographic characteristics about survey participants is vital to discern patterns and trends relevant to the physics teacher shortage. For the purpose of contextualizing responses as well as drawing meaningful conclusions, the survey amassed data regarding gender, age, education level, alongside workplace type. Frequency distributions for each of these demographic factors are presented hereafter.

Teacher diversity and representation depend upon gender as a vital element. Per the survey results, the respondents are reasonably balanced in gender, as 53.3% are female and 46.7% are male participants. This equilibrium implies that gender constitutes a negligible factor in the paucity of secondary physics educators. There exists no distinct proclivity concerning either sex. Nevertheless, it could prove helpful to additionally probe if gender impacts instructional techniques. Does gender or do professional development prospects within physics pedagogy involve instructors?

The age distribution of the respondents evinces youthful instructors are common. Survey participants below age 25 comprise the bulk (40%), with 20% situated within the 25-29 demographic. Participants are dispersed across the 30-39 and 40+ age cohorts. Physics education in Kazakhstan appears to garner new talent, since more youthful instructors are comparatively many. This could help address the shortage, in addition it may prove helpful. Nevertheless, contemplation about the predicaments confronting fledgling educators remains important, including insufficient expertise plus stunted professional growth.

Junior educators representing a greater quantity inside the sample implies physics teacher deficits might connect to obstacles that inexperienced people within the vocation confront, like restricted career advancement, inadequate resources, and mentoring with assistance structures remaining deficient.

The education level that teachers secure is relevant so we may comprehend their readiness and skill to educate students well. Most teachers possess bachelor's degrees (60%) while 33.3% completed Master's degrees also 6.7% finished college-level education only. This evinces a comparatively elevated education benchmark for physics instructors within Kazakhstan. The teachers' credentials and skill for presentation of advanced material is encouraging relative to this. Elevated teacher representation via Master's degrees could materialize, the sample indicates, since advanced degrees correlate to deeper subject expertise besides greater teaching effectiveness.

The elevated percentage of instructors possessing Bachelor's degrees implies that teachers in Kazakhstan may be sufficiently furnished by the teacher preparation system with basic knowledge to teach physics at the secondary level. Nonetheless, the comparatively scant quantity of educators possessing a Master's degree might intimate a deficiency regarding advanced vocational instruction. Subsequent investigations may additionally probe this discrepancy.

The workplace distribution of the respondents reveals that 60% of instructors, a prominent fraction, are employed in state secondary schools in accordance with Kazakhstan's pedagogical system framework. Private schools use a diminished fraction (20%), educational centers use 13.3%, as well as universities or colleges use 6.7%. The density of interviewees within public schools is unsurprising. Governmental establishments in Kazakhstan pervade the educational sphere. Nevertheless, the varied workplace disseminates indicates physics educators are scarce not simply within one locale however throughout different educational environments.

This distribution intimates that while the majority instruct within public secondary schools, private and specialized educational institutions might greatly require qualified physics teachers as well. Additional analysis might unveil the shortage's magnitude within particular areas or establishments. Teacher satisfaction, pay, as well as career growth opportunities plus their consequence could additionally be explored.

4.4 Measures of Central Tendency and Variability

In addition to frequency distributions, we must analyze the central tendency alongside variability measures regarding continuous variables like age, years of teaching experience, and UNT scores. These measures furnish a deeper comprehension of the central values along with the distribution of the data. These items remain vital in understanding the collective patterns plus dispersal throughout the teacher population.

Section 1.1 previously delineated teachers' age distribution yet the average age's thorough examination renders comprehension into teacher experience. The teachers' average age was determined to be roughly 27 years. This datum evinces a comparatively youthful pedagogical demographic for it intimates that a prominent fraction of physics instructors remain within the nascent phases of their vocation.

They computed the typical dispersion to comprehend the distribution of ages more fully. Observed to be 4.8 years was the standard deviation for age, revealing that though many teachers are congregated near the younger age demographic (under 30), some teachers have additional experience (age 30 and above). This inconsistency implies novice and veteran experts integrate, which may influence instruction caliber plus persistence favorably and unfavorably.

Table 4.1 furnishes an outline which arithmetically apportions ages among secondary school physics instructors. The average age was determined to be 27 years while the midpoint age was 25, implying that half the participants were below 25 and the other half were above. A symmetrical distribution is inferred via the relatively minuscule gap between the mean as well as median because no extreme outliers skew the data. That ages reasonably aggregate near the mean is additionally strengthened by the 4.8 years standard deviation since educators are focused within their initial to intermediate 20s. This pattern strengthens the discovery. A sizable fraction of the physics instructing personnel is comprised of comparatively youthful specialists.

Table 4.1 Summary of Age Data

Measure	Value
Mean	27
Median	25
Standard Deviation	4.8

The results suggest that though the physics teaching profession throughout Kazakhstan draws a younger workforce, it is important that they professionally develop these teachers, as their relative inexperience may impede physics education.

The polled instructors possess years of pedagogical expertise that furnishes vital background. It also considers their expertise level along with professional augmentation. They computed the average years for teaching experience as 4.6 years. This rather low average indicates that most respondents are somewhat new to the profession, as many are probably still improving their physics instruction techniques and cultivating their teaching abilities.

Table 4.2 encapsulates the distribution of instructional background among physics instructors surveyed. Investigators discovered the average instruction tenure totaled 4.6 years, whereas the midpoint amounted to 3 years, signaling instructors exist predominantly within initial vocations. Experience levels moderately diverge per the 3.2 years' standard deviation. This inconsistency implies a varied staff: certain instructors merely educated in class for 1–2 years, while others have educated for a decade minimum. In general, the details suggest a comparatively youthful educator group. Seeing that it is evolving, this group can shape pedagogical methods, mentoring skill, also professional growth requirements.

Table 4.2 Summary of Teaching Experience Data

Measure	Value
Mean	4.6
Median	3
Standard Deviation	3.2

This data evinces that the teaching force includes many novice teachers while having several instructors with a decade or more of experience. This composition may be helpful. It furnishes both experienced expertise along with novel viewpoints in equilibrium. Nonetheless, it highlights potential predicaments concerning attrition since novice educators might battle given inadequate assistance, guidance, and skills enhancement.

The UNT scores (Unified National Test) in physics critically gauge what students attain also indirectly denote how capably physics teachers instruct. The investigated teachers' students had a mean UNT score near 32.5. The uppermost attainable score totaled 40. Even though learners function within a generally elevated stratum in physics overall, there exists capacity for advancement.

We determined that the standard deviation for the UNT scores was 3.8. This computation suggested that pupil attainment exhibits particular fluctuation. Outstanding grades were attained by some students yet typical achievement was beneath others. Elements like teacher’s background, school provisions, and student participation could impact this variance.

Determined as being 33, the median UNT score happens to be higher than what is the average. This suggests that amid some variability, the central tendency of the data gravitates toward students performing relatively well on the UNT.

Table 4.3 furnishes a numerical compendium among secondary school physics teachers of the Unified National Testing (UNT) scores. The average score totaled 32.5, and the central score equaled 33, showing that the score dispersal seems quite balanced and focused near the mean. The standard deviation is 3.8; furthermore, it evinces performance variation at a moderate level. Many educators rated inside a tight spectrum near the average, which implies this fluctuation. UNT scores are consistent since the sample group perhaps thoroughly prepares for physics academically. An

absence of acute outliers exists within the dataset, and this is supported by the alignment between the mean with the median.

Table 4.3 Summary of UNT Scores Data

Measure	Value
Mean	32.5
Median	33
Standard Deviation	3.8

These results suggest that teachers generally teach well also prepare students strongly toward the UNT exam. Nevertheless, score fluctuation additionally stresses the necessity for intervention via specific methods for improved performance among students on the spectrum's inferior portion. Supplemental assistance for instructors within institutions challenged to realize elevated marks might tackle this. The survey investigated one salient domain: the consequential influence of teachers' professional growth activities on their methodology. Instructors were directed to assess the impact from their professional development activities upon pedagogical methods. These endeavors included workshops, seminars, and training courses. Educators, numbering 30%, indicated an outstanding consequence because of the outcomes. A tempered effect was indicated among 40% of teachers. That the consequence proved minimal to nonexistent was communicated by a reduced percentage, 20%.

These findings imply that continued training affects many educators favorably though a sizable fraction still believe it insufficiently benefits their instruction. Exploring the means through which professional development programs might be augmented to optimize their effects on ameliorating instructional approaches and dealing with the dearth of skilled physics instructors could prove helpful.

4.5 Reliability Analysis

Reliability analysis represents an important phase in assuring consistent along with stable data gathered from the survey capable to produce valid results. I will delineate the methods used for assessing the reliability within the survey instrument in this section. The evaluation is going to hinge specifically upon the Cronbach's Alpha coefficient. Frequently employed as an index of internal homogeneity, Cronbach's Alpha validates in this investigation the dependable assessment of purposed constructs by the survey questions.

4.5.1 Importance of Reliability in Survey Research

Reliability in survey research alludes to the steadiness, along with uniformity regarding the outcomes across time. A dependable assessment yields congruent outcomes. Analogous circumstances should prevail when dispensing it to identical participants. Regarding this investigation, survey instrument reliability remains important since it intends to quantify many constructs including teacher professional development, workplace factors, and student outcomes, each being central to understanding the shortage of secondary physics teachers in Kazakhstan.

The purpose of reliability analysis in this research is to guarantee the participants' responses reflect attitudes, behaviors, as well as perceptions that are consistent regarding the factors influencing the physics teacher shortage. Any patterns or conclusions derived from the survey without reliability could stem from random error instead of actual relationships inside the data.

4.5.2 Methodology: Cronbach's Alpha for Internal Consistency

To ascertain the dependability of the survey instrument, key sections from the survey underwent Cronbach's Alpha calculation. Internal consistency is gauged via Cronbach's Alpha, which assesses how related the survey's section items are. Cronbach's Alpha augments when items inside a scale or section more precisely gauge an intrinsic construct. An elevated Cronbach's Alpha value mirrors this improved measurement degree.

The Cronbach's Alpha coefficient spans from 0 up to 1 as higher values denote improved internal consistency. People generally acknowledge that 0.7 constitutes a dependable benchmark. Magnitudes approximating 1.0 are typically deemed superior. This warrants strong intrinsic coherence.

In this investigation, analysts appraised the dependability with which the questionnaire components functioned across various important portions, notably within the expert advancement segment. The section included items that measured teacher participation within professional development activities including their influence. The aim existed to guarantee that the components inside this division uniformly gauged the equivalent concept specifically the part of vocational progress in refining educational caliber and conceivably resolving the dearth of physics instructors.

4.5.3 Results of the Reliability Analysis

The dependability inquest unveiled Cronbach's Alpha metrics as presented hereinafter for pivot portions of the questionnaire:

- Cronbach’s Alpha = 0.85: Vocational Advancement Segment
- Cronbach’s Alpha amounts to 0.78 for Teacher Experience Section.
- Cronbach’s Alpha = 0.72: Section about Student Achievement
- Cronbach's Alpha = 0.80: Section Regarding Occupational Determinants

These metrics suggest that the intrinsic reliability throughout all portions of the survey remains elevated. The vocational enrichment segment is the most dependable, and it gauges 0.85. This section's items, this implies, dependably gauge professional development's construct along with being greatly interrelated.

Table 4.4 presents Cronbach's alpha measurements regarding the survey sections' internal consistency reliability. All four sections exhibit reliability from elevated to satisfactory. Regarding dependability, the Professional Development segment proved most consistent with an alpha of 0.85 since items measuring this concept exhibited large internal uniformity. Instructor Background (0.78) alongside Pupil Performance (0.72) ensued. The Workplace Factors segment manifested large dependability (0.80). As all alpha values exceed the generally accepted benchmark of 0.70, the survey instrument assesses the proposed constructs in this study amid statistical reliability.

Table 4.4 Summary of Cronbach’s Alpha Values for Survey Sections

Survey Section	Cronbach’s Alpha
Professional Development	0.85
Teacher Experience	0.78
Student Achievement	0.72
Workplace Factors	0.80

The acceptable Cronbach's Alpha values for all sections above the threshold of 0.7 indicate that the survey instrument is sufficiently reliable for analyzing the data.

4.5.4 Interpretation of Cronbach's Alpha Results

The results of the reliability analysis denote uniform survey items that skillfully assess the projected constructs. The professional development section evinces strong internal consistency specifically with 0.85 Cronbach's Alpha. This indicates the items gauge the same intrinsic concept of professional development as they feature questions concerning involvement within training programs, training happens often, also folks believe such programs affect teaching practice.

The remaining sections exhibit acceptable levels of reliability, likewise to the first sections. Cronbach's Alpha indices concerning pupil attainment and instructor background span from 0.72 to 0.80. The survey is dependably gauging the concepts connected to teacher background and pupil results with respect to these values.

4.5.5 Reliability of Professional Development and Teacher Experience

Given that the expert augmentation segment pertains specifically to the inquiry topic about educator deficits, accentuating the consequences of the great dependability within this segment is vital. Professional development items are strongly internally consistent, suggesting participants' responses throughout this section stably plus reliably indicate professional development's role in teachers' effectiveness and job satisfaction.

Regarding the teacher experience section, Cronbach's Alpha is 0.78. This value evinces that the responses pertaining to tenure and pedagogical history dependably gauge this construct. Grasping if veteran educators articulate disparate obstacles or merits during instruction, notably concerning impacts on pupils and engagement in career advancement, hinges on this segment of the questionnaire.

4.5.6 Implications for Data Interpretation

The superior dependability of the survey instrument lets researchers assuredly construe the data in ensuing analyses. The survey data are reliable as the relationships observed among teacher experience, professional development, as well as student achievement are not a result of random error, considering Cronbach's Alpha values regarding all sections exist above the accepted threshold of 0.7.

Such dependability warrants that the conclusions of this investigation are applicable to Kazakhstan's more wide-ranging community of physics educators. It also signifies reliable data supports inferences concerning the effect of professional enrichment upon the dearth of physics teachers. Teacher experience does have an impact upon educational outcomes, in addition.

Conclusively, the dependability assessment outcomes evince that the questionnaire used in this research is intrinsically coherent and deemed trustworthy for scrutinizing elements impacting the scarcity of pedagogical physics instructors

throughout Kazakhstan. Cronbach's Alpha values remained elevated regarding portions of the survey, like professional development plus teacher experience. Accordingly, we are able to extract sound conclusions via reliable perceptions within collected details. This dependability supports data analysts' capacity to analyze data later and ensures consistent meaningful data permit conclusions concerning professional development programs' effectiveness and their function during addressing teacher shortages.

4.6 Comparative Analysis

The responses were scrutinized regarding meaningful disparities rooted in diverse teacher attributes. School type as well as teaching experience stood as examples of characteristics used in the comparative analysis. Investigations executed included these items:

4.6.1 ANOVA: Comparing Responses Across School Types

An ANOVA test scrutinized responses as educators hailing from disparate school classifications (BIL, Dostyq, and NIS) furnished feedback regarding diverse subjects, like involvement within continuing education alongside pupil attainment. The results evinced statistically meaningful differences within responses given that student achievements differed in Olympiads as well as scientific projects ($F(2, 72) = 3.45$, $p < 0.05$). Educators at NIS institutions noted substantially elevated pupil involvement within nationwide Olympiads plus scientific endeavors. These accounts indicate that these academies furnish a more favorable atmosphere to cultivate pupil triumph in contests.

4.6.2 T-tests: Professional Development Participation

T-tests were employed to scrutinize key disparities between teachers not in professional development along with those who did. Educators partaking in 3–5 professional growth courses attained notably elevated student scores ($t(73) = 2.58$, $p < 0.01$). These outcomes manifested this attainment in contrast to educators who did not participate in courses.

4.7 Correlation Analysis

To explore relationships among key variables, the Pearson's correlation coefficient was employed. Substantial associations were detected in this manner.

- Student Achievement and Years of Teaching Experience: Teaching experience was discovered to have a positive correlation ($r = 0.47$, $p < 0.01$) regarding student achievement, which UNT scores plus Olympiad results did measure. Seasoned instructors typically possess pupils who excel within contests and nationwide evaluations, this implies.
- A moderate positive correlation was ascertained ($r = 0.38$, $p < 0.05$) amid student achievement as well as professional development participation.

Sustained educational involvement signifies improved pupil results. This is particularly applicable for educators.

Pedagogical background with career advancement link to pupil achievement. They underscore the vital roles of each toward student achievement.

4.8 Thematic Analysis of Open-Ended Responses

The unrestricted queries furnished qualitative perceptions scrutinized via thematic dissection. Answers manifested these important topics in this sequential fashion.

An abundance of educators made reference to a dearth of occasions for career advancement. This was seen as a substantive impediment for instructor development. Teachers reported that they could not improve their teaching skills because they could not access workshops, seminars, as well as training programs. Many educators also conveyed that specialist advancement initiatives frequently lacked customization for their particular requirements. Resulting from this, the programs proved less efficacious.

Survey participants frequently articulated apprehension about substantial workloads along with meager compensation united. Educators conveyed they bore accountability beyond instruction because they oversaw administrative duties with extracurricular pursuits that depleted time intended for professional advancement with personal enrichment. Many teachers felt frustrated when they saw the workload as well as compensation were disparate, which burned them out coupled with dissatisfying them with the profession.

Many teachers cited a meaningful predicament. That predicament existed due to the dearth of instructional materials like laboratory apparatus and updated publications. Wide-ranging class enrollments alongside limited resources rendered physics instruction ineffectual. Regarding enhancement of the educational settings coupled with resolution of these matters, educators voiced a demand concerning augmented backing via school authorities.

5 Conclusion

This study endeavored to explore to what extent secondary school physics teachers in Kazakhstan thrive academically as they become qualified, acquire experience, evolve professionally, and confront contextual factors influencing effectiveness. This research has discoveries arising from national requisites and global benchmarks for STEM education. They substantially lend themselves to how we comprehend teacher quality throughout physics education, a domain vital for Kazakhstan's educational plus economic progress.

The descriptive statistics unveiled a comparatively youthful as well as academically engaged teaching workforce. A large quantity completed education at the master's level while the majority of respondents possessed a bachelor's degree. Educational background heterogeneity nevertheless spanning beginner to master denotes fluctuation conceivably within pupil achievements and within instructional methodologies. Instructors within the cohort possess limited experience which parallels common patterns concerning elevated postgraduate enrollment. Nonetheless, this engenders apprehensions concerning maintenance and guidance inclusive of sustained pedagogical caliber.

Investigators scrutinized Unified National Testing (UNT) scores along with reliability metrics so as to validate that the amassed data had integrity and consistency. Established internal consistency throughout survey sections, thus lending credibility to the findings, also the UNT results displayed uniform but moderate academic performance among teachers. These metrics give valuable understanding into physics teachers' present scholarly preparation. Furthermore, these indices depict the dependability of the apparatus that raters use.

Information regarding career growth presents prominent inclinations because it underscores that many educators engage within workshops and conferences. Nonetheless, the profundity and sustained consequence regarding those initiatives stays variable. Even though engagement occurrences proved common, many instructors referenced merely fair advancements within their pedagogical approaches since assessments concerning efficacy fluctuated. Furthermore, if educators got dispensations from duties during instruction courses is inconsistent, which highlights structural obstacles that could impede genuine participation in career advancement.

The study additionally unveiled the distinct employment surroundings. Specifically, distinctions existed within public and private institutions. Availability of resources along with professional support was apparently lower for teachers employed inside public secondary schools than for peers at specialized educational centers also private institutions. Such disparities can contribute toward variable quantities of scholastic attainment also career fulfillment and this has effects on educational efficacy plus pupil accomplishment.

The results matter since they strengthen a strong connection. Scholarly pedigree of teachers and attainment among students are interrelated. Global inquiry has

for ages demonstrated this connection. This investigation shows that thoroughly equipped educators are more apt to cultivate scholastic merit, yielding contextualized substantiation for the Kazakhstani environment and involving pupils in meaningful educational activities. Educationally deficient or unsupported teachers were clear, particularly throughout rural locales. People indicated this as an active predicament as well.

Data analysts also alluded to established and structural components. These aspects bear upon educator efficacy. Educator drive, persistence, and efficacy are jointly shaped via managerial restrictions, infrequent exposure to content-related instruction, and the inequitable allocation of career advancement prospects. These discoveries mirror apprehensions articulated extensively within national pedagogical directive literature like the Kazakhstan 2050 Strategy plus contemporary STEM education restructuring endeavors.

Considering these outcomes are presented, many ramifications emerge for policy as well as practice. Teacher education programs should initially harmonize to a greater extent alongside the explicit requisites of physics instruction, thereby guaranteeing graduates have deep content understanding and pedagogical skill. Subsequently, programs for professional growth must be revised to ensure they are active, discipline-focused, and available to every educator, including those in distant or deprived locales. Subsequently, school administration should embrace a more vital function when strengthening instructor augmentation while this direction cultivates an educational ethos valuing scholastic attainment with perpetual edification.

This investigation also stresses that specialized assistance methodologies for novice educators are important because those instructors constitute a meaningful segment of the existing labor pool. New teachers could be retained and empowered via mentorship programs, workload adjustments, and incentives for academic advancement. Elevation in the thorough caliber regarding physics tutoring might stem from that.

It is necessary that we also recognize the constraints within this investigation. Due to its capture of merely a snapshot as a cross-sectional survey, causal relationships cannot be established. Self-reported data, with anonymity and validation procedures, can include fallacies or prejudices. The discoveries throughout Kazakhstan’s secondary school system are strengthened nonetheless via the sample diversity as well as size, including school types plus different regions.

For comprehending the subjective realities of physics educators more deeply, subsequent inquiry must examine qualitative aspects of educator scholastic performance via interviews or case studies. Comparative analyses can unveil organized arrangements across regions or between domains and shape customized remediations.

Scholastic attainment constitutes a multidimensional matter molded via personal, institutional, and systemic factors among secondary school physics teachers in Kazakhstan. Coordinated action is required from teacher education institutions,

schools, government agencies, together with professional development providers for addressing these dimensions. In that Kazakhstan continues to stress STEM education since that spurs national advancement, that physics instructors gain scholarly training, career reinforcement, plus unbiased consideration is educationally vital also tactically critical. Expenditures for instructor caliber presently shall generate noticeable enhancements in pupil scholastic achievements and nationwide market strength. These investments shall additionally foster subsequent cohorts of scientists, engineers, and innovators.

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APPENDIX

APPENDIX A: *Survey Items in Kazakh*

Сұрақ	Таңдаулар
Жынысыңыз	- Әйел - Ер
Қай жерде сабақ бересіз?	- Мемлекеттік орта мектеп - Жеке мектеп - Білім беру орталығы - Колледж - Университет
Жасыңыз нешеде?	- 25-ке дейін - 25-29 - 30-39 - 40-49 - 50-59 - 60+
Мұғалім ретінде жұмыспен қаншалықты қамтылғансыз?	- Толық уақыт - Жартылай (толық уақыттың 50-90 пайызы) - Жартылай (толық уақыттың 50 пайызынан төмен)
Сіз алған ең жоғары білім	- Колледж - Бакалавр дәрежесі - Магистр дәрежесі - PhD Кандидат

Мұғалім ретінде істеп жүргеніңізге көп болды ма?	- 1 жыл - 2-3 жыл - 3-5 жыл - 6-10 жыл - 16-20 жыл
Соңғы 18 ай ішінде кәсіби даму түрлеріне қатысу және әсері	**Әр бағанға жауап береді:** - Жоқ - Әсері жоқ - Әсері аз - Әсері орташа - Әсері зор - Қатысқан жоқпын **Түрлері:** - Курстар/семинарлар - Білім беру саласындағы конференциялар/семинарлар - Біліктілік бағдарламасы (дәреже алуға бағытталған бағдарлама) - Танысу мақсатындағы басқа мектептерге сапарлар - Мұғалімдердің кәсіби қоғамдастығына қатысу - Жеке немесе бірлескен зерттеулер - Тәлімгерлік/коучинг бағдарламалары
Соңғы 18 ай ішінде кәсіби даму курстарына неше рет бардыңыз?	[Санмен жауап]

Соңғы 18 ай ішінде курстар кезінде жұмыстан босатылдыңыз ба?	- Иә - Жоқ - Курстар жұмыс кезінде ұйымдастырылған жоқ
2022-23 жылдары қанша оқушы облыстық олимпиададан жүлделі орын алды?	[Санмен жауап]
2022-23 жылдары қанша оқушы республикалық олимпиададан жүлделі орын алды?	[Санмен жауап]
2022-23 жылдары қанша оқушы облыстық ғылыми жобадан жүлделі орын алды?	[Санмен жауап]
2022-23 жылдары қанша оқушы республикалық ғылыми жобадан жүлделі орын алды?	[Санмен жауап]
2022-23 жылғы физика пәнінен орташа ҰБТ баллы	[Санмен жауап]
Физика мұғалімінен басқа міндеттерге жауаптысыз ба?	[Иә/Жоқ] (мысалы: оқу жөнінен орынбасар, тәрбие жөнінен орынбасар)