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STRENGTHENING EDUCATIONAL FOUNDATIONS AND PRINCIPLES FOR 21ST-CENTURY MATHEMATICS TEACHER PROFESSIONALISM DEVELOPMENT

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ABSTRACT

Twenty-first century education demands mathematics teachers to possess professionalism grounded in philosophical, psychological, sociological foundations and educational principles to effectively address the dynamics of digital-based and character-oriented learning. This study aims to analyze the urgency of strengthening educational foundations and principles in developing the professionalism of mathematics teachers in the 21st century. This research employed a qualitative approach with a library research method. Data were obtained through systematic literature reviews, journal articles, reference books, and educational policy documents, then analyzed using content analysis techniques. The results indicate that strengthening educational foundations encompassing philosophical, psychological, sociological, historical, and juridical aspects serves as a conceptual basis in determining educational policy directions, objectives, and practices that are humanistic, contextual, and aligned with contemporary demands. Meanwhile, educational principles function as normative guidelines in educational practice, such as the principles of humanism, democracy, justice, freedom, activeness, and relevance. The integration of these two elements significantly contributes to enhancing mathematics teachers' adaptive abilities in facing classroom dynamics, technological developments, and shifts in educational policy. Strategies for strengthening teacher professionalism can be optimized through value-based training, MGMP-based lesson study, digital learning communities, and the Teacher Professional Education (PPG) program. These findings recommend the importance of designing systematic, collaborative, and value-oriented teacher professionalism development programs to build a national education system that is adaptive, competitive, and character-driven

Keywords: Educational Foundations; Educational Principles; Teacher Professionalism.

INTRODUCTION

Education is a strategic foundation in building the quality of a nation's human resources. In the context of globalization and the rapidly developing industrial revolution 4.0, education is required to not only educate the nation's life, but also prepare an adaptive, creative, and competitive generation at the national and international levels. One of the fundamental aspects of education is the existence of teachers as the spearhead of the learning process in schools (Abidah et al., 2022). Therefore, strengthening teacher professionalism is an urgent need to achieve sustainable national education goals.

Teachers as part of the educational staff, play an important role in building student competencies. In the 21st century, learning challenges are increasingly complex along with technological advances, changes in student mindsets, and demands for digital-based learning (Irani & Mahmudi, 2024). This condition requires teachers to not only master teaching materials, but also be able to apply modern pedagogical principles, utilize learning technology, and instill character values according to the demands of the Merdeka Curriculum.

In developing teacher professionalism, strengthening the foundation and principles of education is a fundamental aspect that must be considered. The foundation of education includes various philosophical, historical, sociological, psychological, and cultural perspectives that form the basis for formulating educational policies and practices. Meanwhile, the principles of education are general principles that direct the educational process to run in accordance with applicable goals and norms (Astri, 2025). These two aspects are important frames of reference in building the personality, competence, and professional ethics of teachers.

The development of the educational paradigm in the 21st century encourages a redefinition of the role of teachers, including mathematics teachers. Teachers are no longer merely conveyors of information, but also facilitators, motivators, and inspirators for students in the learning process (Etistika YW et al., 2016). To fulfill this role, strengthening the understanding of the foundations and principles of education is absolutely necessary so that every pedagogical action carried out by teachers has a clear philosophical basis and values and can be accounted for.

The philosophical foundation of education helps teachers understand the meaning, purpose, and values contained in the learning process. In the context of mathematics, this philosophical approach is needed to provide meaning that mathematics is not just a counting tool, but also a means of forming logical, systematic, and critical thinking patterns (Isnaintri et al., 2023). Thus, the professionalism of mathematics teachers is not only measured by mastery of the material alone, but also by the ability to instill meaningful learning values for students.

The historical foundation of education plays a role in providing an overview of the development of the education system, especially mathematics education from time to time. Understanding the historical journey of education allows teachers to reflect on past educational values and adapt them to the current context without losing their basic essence (Ristanti et al., 2020). This is important so that teachers are able to build learning practices that remain relevant and contextual in facing the challenges of the 21st century.

The sociological basis of education directs teachers in understanding the role of education as a social instrument that shapes the character of individuals and society. In this context, mathematics teachers must be able to design learning that not only hones cognitive abilities, but also instills social values, collaboration, and academic ethics (Santika Virdi et al., 2023). Thus, teacher professionalism will be reflected through their ability to integrate social aspects in mathematics learning.

The psychological foundation of education provides an understanding of the characteristics of student development, learning styles, motivation, and emotional aspects that influence the learning process. Mathematics teachers need to have psychological sensitivity in designing learning strategies that are appropriate to the needs and abilities of students (Azzahra & Darmiyanti, 2024). This will increase the effectiveness of learning and support the creation of a conducive and participatory classroom atmosphere.

The basis of education, the principles of education become normative guidelines in organizing the learning process. Principles such as the principle of awareness, the principle of activity, the principle of freedom, the principle of equal rights, and the principle of sustainability must be internalized in the learning practices of mathematics teachers (Ulfah et al., 2021). The application of these principles aims to create a learning atmosphere that is humanistic, democratic, and oriented towards the development of students' potential optimally.

Strengthening the principles of education also serves to ensure that the learning process does not only focus on achieving academic results, but also on the formation of students' personalities. Mathematics teachers are expected to be role models in implementing the values of honesty, discipline, hard work, and responsibility in every learning process, in accordance with the values of Pancasila as the nation's ideology(Saputra & Lubis, 2025).

In the context of the Independent Curriculum, the professionalism of mathematics teachers is increasingly emphasized on critical, creative, collaborative, and communicative thinking skills (Etistika YW et al., 2016). Therefore, strengthening the foundations and principles of education is an absolute prerequisite for equipping teachers with a systematic, adaptive, and ethical framework for dealing with various dynamics of learning in the 21st century.

Efforts to strengthen the professionalism of mathematics teachers also need to be supported by educational policies that support the development of teacher capacity in a sustainable manner. Training programs, workshops, development of learning communities, and provision of access to digital learning resources must be in line with the philosophical, historical, sociological, and psychological values of education so that they are not merely technical, but also substantial and visionary(Ramadhani et al., 2025).

Research on the professionalism of mathematics teachers based on strengthening the foundations and principles of education needs to be continuously conducted to enrich scientific references and become the basis for making educational policies (Ramadhani et al., 2025). The academic study is expected to broaden the perspective of teachers in understanding the complexity of their roles while improving the quality of classroom learning practices.

Based on the description above, the researcher is interested in conducting a study entitled "Strengthening the Foundations and Principles of Education in Developing the Professionalism of Mathematics Teachers in the 21st Century". This study aims to respond to the complexity of the challenges of 21st-century education which require teachers to have not only academic competence, but also professional character, moral integrity, digital literacy skills, and awareness of national and humanitarian values in educational practices in schools.

RESEARCH METHODS

This study uses a qualitative approach with a library research method as the basis for data collection and analysis. The library research method was chosen because it is in accordance with the objectives of the study which focuses on conceptual and theoretical studies regarding strengthening the foundations and principles of education in efforts to develop the professionalism of mathematics teachers in the 21st century (Sofiah et al., 2020). Through this method, the study seeks to explore, analyze, and synthesize various theories, concepts, research results, and relevant documents related to the topic of study. Data sources in this study were obtained from primary and secondary literature, including reference books, national journal articles, seminar proceedings, and education policy documents such as the Merdeka Curriculum, Law Number 20 of 2003 concerning the National Education System, and related Regulations of the Minister of Education.

Data collection techniques were carried out by systematic searches through online databases such as Google Scholar, DOAJ, ResearchGate, and SINTA-accredited national journal databases. The search was carried out using relevant keywords, including "educational foundations," "educational principles," "teacher professionalism," "mathematics teachers," and "21st century education." All selected literature was then analyzed descriptively-qualitatively to find patterns, relationships between concepts, and trends in scientific development related to the focus of the research. The collected data was analyzed using content analysis techniques, namely by classifying and interpreting the contents of the literature. The results of the analysis were then presented systematically in the form of a structured narrative description in accordance with the research discussion framework(Ramadani et al., 2023).

RESULTS AND DISCUSSION

The Urgency of Strengthening the Foundations and Principles of Education in the 21st Century

The development of the era of globalization, digitalization, and the industrial revolution 4.0 demands a significant transformation in the world of education, especially in the teaching profession. 21st century education does not only emphasize cognitive aspects, but also 21st century skills such as critical thinking, creativity, communication, and collaboration(Parhan et al., 2022). Mathematics teachers, as educational actors, play a strategic role in forming adaptive and competent human

resources. Strengthening the foundations and principles of education is an urgent need to ensure the relevance of education to the dynamics of the times. According to(Nasir & Sunardi, 2025), without a strong educational foundation, teacher professional development tends to be pragmatic and less sustainable. This reinforces the urgency that every effort to improve the capacity of mathematics teachers must begin with strengthening the basic concept of education so that the direction of learning is not only oriented towards academic targets, but also builds character and 21st century competencies.

The Concept of Educational Foundations and Its Implications in the Mathematics Teaching Profession

The foundations of education include philosophical, psychological, sociological, historical and legal aspects which form the basis for formulating educational policies, strategies and practices.(Junaid, 2012). Mathematics teachers need to understand the philosophical dimension to form a humanistic outlook on life and educational values. From a psychological perspective, understanding the learning characteristics of students greatly determines the effectiveness of abstract mathematics learning. The sociological aspect requires teachers to understand the socio-cultural conditions of students, while the historical aspect reflects the development of mathematics education from time to time. Juridical, as a legal basis, provides guidance on norms that must be adhered to. In line with research(Brother, 2022), the integration of these five foundations has been proven to improve the quality of pedagogical decision-making in the classroom. A comprehensive understanding of the five foundations not only supports the accuracy of abstract mathematics learning strategies, but also strengthens teachers' ability to anticipate increasingly complex classroom dynamics.

Principles of Education from the Perspective of the Teaching Profession

The principles of education are basic principles that serve as a reference in the implementation of education, such as the principles of humanism, democracy, justice, freedom, activity and relevance(Amiruddin, 2015). Mathematics teachers are required to apply the principle of humanism through fair treatment of students, the principle of democracy through participatory learning, and the principle of relevance by adjusting teaching materials to the needs and developments of the times. The results of the study from(Nurhaedah & Kadir, 2024)shows that teachers who consistently apply educational principles are able to create a conducive learning atmosphere, increase learning motivation, and develop students' potential optimally. According to researchers, these principles are not just normative concepts, but practical principles that must be internalized in the planning and implementation of mathematics learning in order to create a learning process that is adaptive and responsive to the needs of students.

Characteristics of Professionalism of Mathematics Teachers in the 21st Century

The professionalism of mathematics teachers in the 21st century includes pedagogical, professional, social, personality, digital literacy, and continuous self-development competencies(Wardani & Budiadnya, 2023). Teachers are not only required to master teaching materials and learning methods, but also have digital skills in designing interactive learning media. According to(Sedana, 2019), digital competence is one of the important indicators in assessing the professionalism of today's teachers. In addition, professional ethics, social responsibility, and the willingness to continue learning are the main characteristics that distinguish professional teachers from conventional teachers. Researchers assess that mastery of digital technology for today's mathematics teachers is no longer an option, but a demand. Digital literacy must be an integral part of the teacher's professional profile so that they can utilize technology to improve the quality of interesting and meaningful mathematics learning.

The Role of Educational Foundations and Principles in Shaping Teacher Professionalism

Strengthening the foundation and principles of education plays a fundamental role in shaping the professionalism of mathematics teachers in the 21st century. The foundation of education, which includes philosophical, psychological, sociological, historical, and legal aspects, functions as a conceptual foundation in arranging the direction, goals, and policies of education that are humanistic, relevant, and contextual. The philosophical dimension, for example, shapes the teacher's perspective on the nature of humans, education, and science, so that mathematics teachers are not

only oriented towards academic achievement, but also prioritize moral values, humanity, and the character of students(Rokhanah, 2025).

Psychological aspects in the foundation of education help teachers understand the characteristics of student development, learning styles, and emotional and cognitive needs of students in the abstract mathematics learning process. This understanding is important because the teacher's ability to design learning that is in accordance with the psychological conditions of students will have implications for the effectiveness of learning, learning motivation, and student learning outcomes.(Azzahra & Darmiyanti, 2024).

The principles of education serve as normative and practical guidelines in carrying out teaching duties. The principles of humanism, democracy, justice, freedom, activeness, and relevance are the main principles that teachers need to apply in mathematics learning. Mathematics teachers who prioritize the principle of humanism will treat students fairly and respect their individual potential, while the application of the principle of democracy encourages the creation of dialogical, participatory, and collaborative spaces in the classroom. Likewise, the principle of relevance requires teachers to always adjust learning materials, methods, and media to technological developments and the needs of students in the digital era(Rokhanah, 2025).

Study by(Astri, 2025)revealed that teachers who have a comprehensive understanding of the foundations and principles of education show better adaptability in dealing with class dynamics, such as the diversity of student characters, technological developments, and changes in education policies. These teachers tend to be more reflective, innovative, and able to improvise learning that is appropriate to the class situation without ignoring the basic principles of education. Furthermore, teacher professionalism formed through strengthening the foundations and principles of education is reflected in moral integrity, social responsibility, pedagogical competence, class managerial skills, and adequate digital literacy.

The foundation and principles of education are not just theoretical concepts, but strategic instruments that can guide mathematics teachers in carrying out their roles professionally and ethically. This strategic role also has implications for improving the quality of student learning processes and outcomes, creating a conducive learning climate, and producing graduates who are adaptive, creative, and have character according to the demands of the 21st century (Rokhanah, 2025). Strengthening the understanding and implementation of the foundation and principles of education in teaching practice needs to be a priority in every teacher professional development program, whether through Teacher Professional Education (PPG), ongoing training, or learning communities based on basic educational values.

Strategy for Strengthening the Professionalism of Mathematics Teachers Based on Educational Foundations and Principles

Strategies to strengthen the professionalism of mathematics teachers can be carried out through ongoing training, integrative workshops, MGMP-based lesson study, and the Teacher Professional Education (PPG) program which emphasizes the integration of educational foundations and principles. The results of the literature review from(Saerang et al., 2023)shows that educational foundation-based professional development programs are more effective in improving teachers' pedagogical and professional competence than conventional training models. A digital learning community-based approach is also recommended to improve teachers' digital literacy in the post-pandemic era. This approach is highly recommended nationally because in addition to improving pedagogical competence, it also strengthens the basic values of the teaching profession in mathematics teachers, which have often been ignored in purely technical training.

Obstacles and Challenges in Strengthening the Professionalism of Mathematics Teachers

Some obstacles in strengthening the professionalism of mathematics teachers include low motivation for independent learning, limited digital facilities, suboptimal education policies, and low teacher participation in professional communities.(F et al., 2025). In addition, the lack of integration of educational foundations in training programs causes teachers to tend to be pragmatic in improving competence. Comparative study of(Nurpadillah et al., 2024)emphasizes the importance of designing training based on basic educational values in order to create teachers who are not only competent, but also visionary and adaptive. This challenge must be addressed immediately by building a culture of lifelong learning among mathematics teachers and providing facilities and training that touch on aspects of values, not just technical skills.

Model for Strengthening Mathematics Teacher Professionalism Based on Educational Foundations

Professional development models based on blended learning, lesson study based on pedagogical values, and digital learning communities based on the principles of humanism have proven to be effective in various schools.(F et al., 2025). This best practice combines strengthening the educational foundation with digital and pedagogical skills training. The results of the model evaluation by(Nurpadillah et al., 2024)showed a significant increase in the pedagogical and professional competence of mathematics teachers after participating in a training program based on educational principles. This model is worthy of being widely replicated, because in addition to improving technical skills, it also builds professional integrity, reflective abilities, and digital literacy of teachers, according to the demands of learning in the 21st century.

The Impact of Strengthening the Foundations and Principles of Education on the Quality of Mathematics Learning

Strengthening the foundation and principles of education has a positive impact on the quality of mathematics learning, both in terms of planning, implementation, and evaluation of learning. According to the results of the study(Rokhanah, 2025), teachers who apply basic principles of education tend to be more innovative in designing problem-based learning and higher order thinking skills (HOTS). This has implications for increasing student motivation and learning outcomes.

Based on the results of the literature review, it is recommended that the government and educational institutions develop a mathematics teacher professional development program based on the integration of educational foundations and principles. The program needs to be designed collaboratively between universities, the Education Office, and professional communities to ensure sustainability. In addition, strengthening a culture of lifelong learning and digital literacy needs to be a top priority in teacher development in the digital era(Rokhanah, 2025).

CONCLUSIONS

Strengthening the foundations and principles of education has a strategic role in developing the professionalism of mathematics teachers in the 21st century. The foundations of education, which include philosophical, psychological, sociological, historical, and legal aspects, are the conceptual basis for determining the direction, values, and policies of education. Meanwhile, the principles of education function as normative principles in implementing humanistic, democratic, fair, and relevant learning. The integration of these two aspects has been proven to increase teachers' ability to adapt to classroom dynamics, technological developments, and changes in education policy. Strategies for strengthening professionalism can be carried out through training based on educational values, lesson study, digital learning communities, and PPG programs based on educational foundations. Obstacles such as low teacher motivation, limited digital facilities, and minimal participation in professional communities are challenges that need to be overcome through systematic and sustainable professional development policies and programs. The integration of the foundations and principles of education in the teaching profession is an important key in building a national education system that is adaptive, competitive, and remains rooted in the nation's cultural values.

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