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Research Article

Developing A Guide For A Mathematics Teacher Preparation Program: An Evaluation Study

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ABSTRACT

This study critically assesses and enhances the mathematics teacher preparation program at the College of Education in Sohag, aligning it with national and international standards. Objectives include diagnosing the current program, establishing clear goals and standards, and identifying strengths and weaknesses. While strengths include experienced faculty and positive attitudes towards teaching, weaknesses encompass a traditionalist approach and vague program objectives. The study emphasizes the need for specificity in skills and competencies, improved course descriptions, integration of educational innovations, and a stronger connection between scientific content and practical teaching applications. The evaluation methods are identified for development, emphasizing deeper understanding over rote memorization. A meticulously developed guide for the "Mathematics Teacher Preparation Program" fills internal regulatory gaps, offering a valuable resource for all involved in the preparation of Mathematics Division students. This guide, rooted in systemic thinking, ensures a cohesive and comprehensive approach to training future mathematics educators, addressing critical aspects to enhance the effectiveness of the program in preparing students for successful careers as mathematics teachers.

Keywords: mathematics education, teacher preparation program, evaluation study, curriculum development, standards, skills, weaknesses, strengths

Introduction

Mathematics holds a significant position within the realm of general education, and there has been a growing focus on reforming mathematics teaching in recent years. The aim is to cultivate a generation capable of critical thinking, problem-solving, and creativity. In this endeavor, the mathematics teacher plays a crucial role in shaping students' mathematical education. The teacher's mastery of the subject matter and their ability to present it effectively have a profound impact on students' comprehension and learning outcomes. Students' experiences in the classroom greatly influence their understanding and acquisition of mathematical knowledge (Khasawneh et al., 2023; Saleh et al., 2023; Schoenfeld, 2016; Al-Astal, 2003; Ajman University of Science and Technology, 2002).
The principles outlined in the School Mathematics Standards (NCTM) underscore the significance of the mathematics teacher in the domain of general education. Consequently, it is imperative to prioritize the preparation of mathematics teachers and the continuous development of teacher preparation programs. This emphasis ensures the cultivation of competent and qualified teachers capable of effectively fulfilling their responsibilities. The experiences and effective teaching methods acquired by teachers during their preparation period significantly impact their instructional approach with students (Shirawia et al., 2023; AlAli & Ghafar, 2015; Ministry of Education, 2003).
The present study, titled "Evaluation and Development of the Mathematics Teacher Preparation Program at the College of Education in Sohag," is motivated by the inherent importance of the evaluation process itself. It serves as a fundamental step towards achieving desired quality and potential academic accreditation for the Mathematics Teacher Preparation Program. The study aims to ensure that the College effectively attains its objectives and instills confidence in community institutions regarding the competence of its graduates.

The primary objective of the current research project is to conduct a comprehensive evaluation and development of the mathematics teacher preparation program at the College of Education in Sohag, in accordance with a set of national and international standards. This evaluation process draws upon the work of scholars such as Zahran (2023), Mohamed, Khalil & Awaji (2023), Elsayed & Al-Abbad (2023), Ahmed Endris (2022), AlAli (2021), CBMS (2001), CCTC (2003), Clark (2005). The research project encompasses two main aspects:

- Diagnosing the actual state of the current mathematics teacher preparation program: This involves a thorough assessment to identify the program's strengths and weaknesses. Various aspects will be examined, including but not limited to the number and qualifications of faculty members, the structure and content of academic courses, the availability and adequacy of laboratories, classrooms, libraries, and educational technology resources. By conducting this diagnosis, the research project aims to gain a comprehensive understanding of the program's existing resources and areas that require improvement.
- Establishing clear goals, standards, and skills for the mathematics teacher preparation program: Based on the evaluation and diagnosis, the research project will set forth specific and measurable goals, standards, and skills that should be integrated into the mathematics teacher preparation program. These objectives will align with recognized national and international standards in mathematics education. By establishing these benchmarks, the research project aims to enhance the program's effectiveness and ensure that future mathematics teachers at the College of Education in Sohag possess the necessary knowledge, competencies, and pedagogical skills to excel in their profession.

The significance of this project is two-fold:

Establishing a model for evaluating teacher preparation programs: This research project provides a valuable framework for evaluating the different facets of the mathematics teacher preparation program at the College of Education in Sohag. The model developed through this project can serve as a guide and be replicated in the evaluation of teacher preparation programs in other specializations within the same college or even in other colleges. By offering a systematic and comprehensive approach to program evaluation, this project contributes to the enhancement of teacher education programs on a broader scale.

Contributing to the pursuit of academic accreditation: The Mathematics Teacher Preparation Program at the College of Education in Sohag is in its early stages toward achieving academic accreditation, a priority within the national project to enhance higher education. The national project aims to improve and ensure the quality of educational programs in Egyptian universities. By evaluating and developing the mathematics teacher preparation program, this research project aligns with the objectives of the national project, supporting the improvement and quality assurance of educational programs in higher education institutions. The findings and recommendations from this project will play a vital role in strengthening the program's alignment with accreditation standards, promoting excellence in teacher education, and instilling confidence in stakeholders, including students, faculty, and the wider community.

The current research project aims to accomplish its objectives through a series of key activities, drawing on the works of Al-Barakat et al. (2022), AlAli & Abu Naser (2021), Darling-Hammond, & Johnson (2012), Chung & Kim (2010), Graham and Fennel (2001), Jeane and Bright (2001), and Moustafa (2005):

1. Preparation and design of evaluation forms: The project involves the development and design of ten comprehensive evaluation forms that cover various aspects of the mathematics teacher preparation program. These forms serve as essential tools for assessing elements such as curriculum content, instructional strategies, faculty qualifications, resources, and educational technology integration. The design of these evaluation forms ensures a systematic and thorough examination of the program's components.
2. Validation and reliability assessment of evaluation tools: The research project places great emphasis on ensuring the validity and reliability of the evaluation tools. Rigorous procedures are employed to validate the evaluation forms, ensuring they accurately measure the intended constructs. Additionally, reliability tests are conducted to establish the consistency and stability of the evaluation tools, enabling reliable and consistent data collection.
3. Selection of a study sample and implementation of evaluation tools: A representative study sample is carefully chosen to participate in the evaluation process. The evaluation tools, including the designed evaluation forms, are administered to the selected sample. The data collected through these instruments capture essential information regarding the strengths and weaknesses of the mathematics teacher preparation program.
4. Analysis and interpretation of results: The collected data undergoes rigorous analysis using appropriate statistical techniques and qualitative methods. The research project entails a comprehensive analysis of the evaluation results, allowing for meaningful interpretations. This analysis provides insights into the current state of the program, highlighting areas of excellence and areas that require improvement.
5. Identification of strengths and weaknesses: Through the analysis of evaluation results, the research project identifies the strengths and weaknesses of the current mathematics teacher preparation program. This

assessment offers a holistic view of the program's effectiveness, shedding light on aspects that can be further developed and areas where enhancements are needed.

6. Setting goals and standards: Building upon the evaluation findings and in alignment with national and international standards, the research project establishes clear and measurable goals and standards for the mathematics teacher preparation program. These goals and standards serve as benchmarks for program improvement, ensuring that the program aligns with recognized educational standards and produces highly competent mathematics teachers.

In order to ensure the high quality of the research project's outputs, valuable input and insights were sought from renowned experts in the fields of specialized science and education. The perspectives of these distinguished experts were considered invaluable in shaping the project's direction and ensuring its credibility. Additionally, collaboration was established with esteemed university centers known for their expertise in educational development and research. These centers included: Center for the Development of University Education at the Faculty of Education, Ain Shams University: This center, renowned for its expertise in enhancing university education, provided valuable guidance and recommendations to ensure the project's alignment with best practices in teacher preparation programs. Center for Future Science Studies at Assiut University: Recognized for its research and studies in interdisciplinary sciences, this center contributed valuable insights and perspectives to the project, enriching the evaluation and development of the mathematics teacher preparation program. English Language Center at the university branch in Sohag: As language proficiency is a crucial aspect of teacher education programs, collaboration with the English Language Center facilitated the integration of language skills development within the mathematics teacher preparation program. Their expertise in language instruction and assessment was instrumental in ensuring the program's effectiveness. Directorate of Education: The involvement of the Directorate of Education allowed for a broader perspective on the relevance and alignment of the mathematics teacher preparation program with the needs and requirements of educational institutions. Their input provided valuable insights into the practical aspects and real-world applicability of the program's goals and standards.

The evaluation component of the research project encompassed multiple dimensions to comprehensively assess the mathematics teacher preparation program. These dimensions included:

- Evaluation of intangible components: This aspect involved a thorough examination of the program's objectives, standards, and content. The research project evaluated the alignment of the program's objectives with the broader goals of mathematics education. The standards and benchmarks set for the program were scrutinized to ensure their relevance and effectiveness. Additionally, the content of the program was evaluated to determine its comprehensiveness, depth, and alignment with current research and best practices in mathematics education.
- Evaluation from the perspective of beneficiaries: The research project sought the perspectives of various beneficiaries, including students, graduates, and mentors. Their viewpoints and experiences were sought to assess the program's impact on their learning, professional development, and teaching practices. Through surveys, interviews, and focus groups, the project gathered valuable feedback to understand the strengths and weaknesses of the program from the beneficiaries' viewpoint.
- Evaluation of physical components: In addition to the intangible aspects, the research project also evaluated the physical components of the mathematics teacher preparation program. This assessment included an examination of the program's physical resources, such as classrooms, laboratories, and the library. The adequacy, accessibility, and suitability of these resources were assessed to ensure they effectively support the teaching and learning process.

The evaluation of the current mathematics teacher preparation program yielded valuable insights into its strengths and weaknesses. The strengths identified in the program encompassed the following aspects:

- Faculty members with diverse experiences: The program demonstrated the availability of an appropriate number of faculty members who possess diverse experiences in teaching academic, educational, and cultural courses. This diversity enriches the learning environment and provides students with a well-rounded educational experience.
- Interconnected course topics and strong professor-student relationships: The evaluation highlighted that most courses in the program have interconnections, allowing for a coherent and integrated learning experience. Moreover, professors were found to possess a strong mastery of the scientific material, fostering a positive relationship with students. This conducive professor-student dynamic enhances the learning process and promotes effective knowledge transfer.
- Positive attitudes and teaching skills: The current program was found to cultivate positive attitudes towards the teaching profession among students. Graduates were equipped with the ability to employ effective teaching methods and demonstrate skills in managing student interactions and accommodating individual differences. This emphasis on pedagogical skills enhances the graduates' preparedness for the teaching profession.

- Educational component strength: Compared to the academic and cultural components, the educational aspect of the program was identified as a particular strength. The program effectively emphasizes educational principles, theories, and practices, ensuring that graduates possess a solid foundation in the field of education.
- Quality of university books: Most university books utilized in the program were found to be free of scientific errors, and their content was deemed suitable in relation to the allotted teaching hours. This quality assurance in the selection of educational materials contributes to the students' learning experience and ensures accuracy and relevance in their studies.
- Adequate library resources: The program was supported by a library that provided students with an appropriate number of books necessary for their studies. Additionally, the availability of an external loan service further enhanced students' access to supplementary resources, promoting independent learning and research.
- Diverse laboratory facilities: The program boasted a variety of laboratories that cater to the academic and professional needs of students. These diverse laboratory facilities contribute to the students' practical understanding of mathematics and support their overall preparation for their future teaching roles.

The evaluation of the current teacher preparation program revealed several weaknesses that require attention and improvement. These weaknesses include:

1. Lack of alignment with current developments: The program was found to be traditional and not keeping pace with the latest advancements in the field of education. It lacked innovation and failed to incorporate emerging educational practices and methodologies.
2. Unclear objectives and standards: The evaluation highlighted that the current program lacked clarity and specificity in its objectives and standards. The desired skills and competencies for teacher preparation were not clearly defined, leading to a lack of focus and direction in the curriculum.
3. Insufficient course descriptions: The program lacked comprehensive descriptions of its courses, including objectives, content elements, and learning outcomes. This lack of information hindered students' understanding of what to expect from each course and compromised the transparency of the curriculum.
4. Disconnect between theory and practice: The evaluation identified a significant gap between theoretical knowledge and practical application within the program. The practical aspects of the courses were not adequately specified, and there was a scarcity of educational media usage. This gap hindered students' ability to bridge theory with real-world teaching practices.
5. Inadequate preparation for educational innovations: The current program was found to be inadequate in preparing graduates to effectively engage with educational innovations. Graduates lacked the necessary skills to apply their knowledge in innovative and creative teaching practices. Furthermore, the program did not sufficiently align the scientific content with the actual teaching practices in schools.
6. Limited and outdated assessment methods: The evaluation revealed that the assessment methods used in the current program were in need of development and diversification. The focus on exam questions primarily measuring memorization skills undermined the development of critical thinking and problem-solving abilities among students.
7. Low quality of university textbooks: The evaluation identified poor writing and production standards of university textbooks used in the program. The quality of the content, accuracy, and relevance of these textbooks were found to be lacking, which adversely impacted students' learning experience.
8. Inadequate library facilities: The library associated with the program exhibited several deficiencies. These included a scarcity of specialists, inadequate cataloguing practices, poor ventilation and lighting, insufficient budget allocation, and a lack of contemporary technology, particularly electronic resources, which limited students' access to relevant and up-to-date materials.
9. Unsuitable classrooms: The evaluation revealed that classrooms were generally ill-suited for effective teaching and learning experiences. They suffered from overcrowding, lacked safety precautions, exhibited poor conditions of blackboards and speakers, and were not equipped to accommodate multimedia resources.
10. Deficiencies in laboratory capabilities: The laboratories within the program were found to have various deficiencies that hindered their functionality. These included the absence of an appropriate physical environment, the lack of a specialized technician, inadequate provision of computers and internet access, and insufficient resources required for conducting experiments and practical activities.
11. Absence of a student database: The program lacked a centralized database for student records and information. Student interactions with different departments relied heavily on paper records and notebooks, impeding efficient administrative processes and hindering access to accurate and up-to-date information.

The second component of the proposed program is the model guide (Abu Nasser & AlAli, 2022, Polotskaia & Savard, 2021, Mullis et al., 2017; Schoenfeld, 2016; Smith, 2009; NCATE, 2002; NCATE, 2003a; NCATE, 2003b; NCTM, 1989; NCTM, 1991; NCTM, 1998; NCTM, 2000; Wies & Leibbrand, 2001). The development of this guide for the "Mathematics Teacher Preparation Program" aims to emphasize the crucial role of teachers as fundamental elements in the educational process. The guide addresses the deficiencies in the internal regulations of the College of Education in Sohag, as the previous regulations from 1995 only mentioned course names, hours, and exam grade distribution (written, practical, and oral). The updated regulations in 2005 added course symbols and numbers. However, these regulations lacked comprehensive guidelines for the program.

The preparation of the guide followed a series of successive and parallel phases. The initial phase involved evaluating the existing guide and identifying its shortcomings. This assessment provided valuable insights into areas that needed improvement. The subsequent phase focused on establishing goals and standards for the mathematics teacher preparation program. These goals and standards were developed based on both Egyptian and international experiences in mathematics teacher preparation. The aim was to align the program with best practices and incorporate successful approaches from around the world. Once the goals and standards were established, the next stage involved identifying the specific skills necessary to prepare competent mathematics teachers. These skills encompassed a broad range of pedagogical, subject-specific, and cultural competencies that are essential for effective teaching in the mathematics discipline.

Concurrently, the development of specialized, educational, and cultural courses began. A total of 48 courses were designed to cover these different domains. Each course was carefully crafted to address specific knowledge areas and pedagogical methods relevant to mathematics education. The specifications for these courses were meticulously developed, ensuring that they align with the objectives and standards of the program.

This guide serves as a comprehensive resource for individuals involved in teacher preparation, particularly those within colleges of education and students specializing in Mathematics at the College of Education in Sohag. Its primary focus is to equip students who will graduate as mathematics teachers for the preparatory cycle (grades 7-9) and the secondary stage (grades 10-12) with the necessary knowledge and skills. The guide emphasizes the methodological aspects of teacher preparation in Mathematics, promoting systemic thinking.

Various stakeholders, including university faculty members, teaching assistants, mathematics teachers, education mentors, and students within the mathematics department, are encouraged to refer to this guide. It outlines the objectives of the mathematics teacher preparation program, providing essential guidelines for implementing the program effectively. The guide also highlights the standards against which the program is assessed, ensuring its alignment with established benchmarks. Moreover, the guide articulates the expected educational outcomes for students upon completion of the program. It delineates the academic (specialized), educational, and cultural courses that students will undertake, shaping their overall learning experience. However, the guide goes beyond course content; it addresses teaching methods and evaluation strategies necessary for successful program implementation. It includes a skills matrix that outlines the specific competencies that students are expected to acquire or develop throughout their studies. Faculty members are encouraged to internalize and emphasize these skills throughout their teaching, ensuring that students not only acquire them but also can effectively apply them in future educational contexts.

Program Overview:

First, Program Name: "Mathematics Teacher Preparation Program for the General Section in the Preparatory Cycle (Grades 7-9) and the Secondary Stage (Grades 10-12)"

Second, Departments Involved in the Program:

- Department of Curriculum and Teaching Methods
- Department of Mental Health
- Department of Educational Psychology
- Department of Comparative Education and Educational Administration
- Department of Educational Fundamentals
- Department of Mathematics, College of Science
- Department of Chemistry, College of Science
- Department of Physics, College of Science
- Department of English Language, College of Arts

Third, Program Structure and Components:

Program Duration: 4 years

The Mathematics Teacher Preparation Program for the General Section in the Preparatory Cycle (Grades 7-9) and the Secondary Stage (Grades 10-12) is designed to provide a comprehensive education for aspiring mathematics teachers. The program involves collaboration between multiple departments within the university. The program has a duration of four years, during which students engage in a structured curriculum that encompasses theoretical and practical components. The curriculum is designed to provide students with a strong foundation in mathematics, pedagogy, and relevant interdisciplinary subjects. Through a combination of coursework, practical training, and supervised teaching experiences, students develop the necessary skills and knowledge to become competent mathematics teachers.

Table 1: Distribution of Theoretical and Practical Hours in the Program

The number of hours	Theoretical	Practical	Total	%
Educational sciences courses	43	9	52	%19
Specialized science courses	111	80	191	%70
Other science courses (computer,........)	12	2	14	%5
Field Training	-	16	16	%6
Total	166	107	273	%100

Fourth, Registration Conditions:

First, In order for a student to enroll in the bachelor's degree program, several conditions must be met in addition to the general requirements outlined in the executive regulations of the Universities Organization Law. These conditions are specified to ensure the suitability of the student for pursuing a career in teaching. The following requirements must be fulfilled:

A) General Conditions: The student must meet the academic prerequisites and qualifications established by the executive regulations of the Universities Organization Law. The student must satisfy any other specific criteria as determined by the college.

B) Fitness for Teaching Tests: The college conducts tests to assess the student's suitability for the teaching profession and their aptitude for the program. These tests are decided upon by the college council and serve as a measure of the student's readiness to pursue a career in teaching. The specific requirements and criteria for these tests are outlined in Table 2.

No.	method	Measuring the Targeted Outcomes of the Program
1	Oral exams	Awareness and understanding of concepts, fluency and ability to communicate
2	Written tests	The ability to solve problems, organize steps, think logically, and comprehend scientific material
3	Field observation	The ability to plan and move within the framework of a teaching strategy, and interest in student learning
4	Writing reports on projects	Originality, ability to investigate and collect information, use various library and electronic learning resources, creative abilities
5	Producing collaborative work	The ability to work in a team, accept the opinion of others and engage in constructive dialogue to achieve a specific goal
6	Measure trends	The inclination towards studying and teaching mathematics, the role of mathematics, the role of its scientists, and methods of working in it
7	Self-evaluation	Self-awareness and different thinking skills

Second, Admission of Students with Prior Bachelor's Degrees:

The college has the authority to consider the admission of students at the bachelor's level who possess a bachelor's degree or an equivalent qualification from colleges or institutes that are officially recognized by the Supreme Council of Universities. The specific band (academic level) and department in which the student will be enrolled, as well as the courses from which they may be exempted, are determined by a decision of the college council. In making the decision, the college council takes into account the recommendations and opinions provided by the relevant departments. However, it is essential that the student demonstrates a strong commitment to devoting themselves to studying and actively engaging in the program. The admission process for students with prior bachelor's degrees involves a thorough evaluation of their academic records, qualifications, and relevant experience. Based on this assessment, the college council determines the appropriate band and department for the student's enrollment. Additionally, the council may grant exemptions for certain courses based on the student's previous academic achievements and compatibility with the program's curriculum. It is important to note that each case is evaluated individually, taking into consideration the student's academic background and the requirements of the program. The college council ensures that the admission decision aligns with the college's standards and regulations, while also considering the student's potential for academic success and their commitment to their studies.

Fifth, Study and Examination System:

- Duration of Study: The duration required to obtain a bachelor's degree is four academic years or eight semesters.
- University Year and Semester Enrollment: The university year is divided into two semesters: the first semester and the second semester. A student enrolled in the first semester is eligible to enroll in the second

semester of the same university year and within the same academic band, on the condition that they have completed all the first semester exams, in accordance with the rules established by the University Council.

- Advancement and Course Retakes: A student progresses to the next academic band if they have successfully completed all the courses of both semesters within the current band. If a student fails in a maximum of two courses, they are allowed to advance to the next band with the failed courses marked as retakes. However, if a student fails in more than two courses, they are required to repeat the entire band.
- Mid-Semester Examinations: The college may administer mid-semester exams for certain courses. The grades obtained in these exams may be considered as part of the semester work or as part of the end-of-semester examinations, based on proposals put forth by the department councils and approved by the college council.
- Semester Work Grade: The rules governing the assessment of the semester work grade are proposed by the department councils and approved by the college council.
- Student Training in Schools: The college organizes student training in suitable schools for students from various academic groups within the college. This organization is based on proposals made by the department councils and approved by the college council.
- Grade Assessment for Student Training: The grade for the student training course in schools is determined out of one hundred points, with fifty marks allocated for each semester. The student's success in the course is determined by the total sum of their student training grades in both semesters. The College Council may establish rules regarding the assessment and distribution of grades among the different student training supervisors.
- Retakes for Student Training Course: A student who fails the student training course is eligible for a retake, even if they have been successful in all other courses. If a student fails the student training course, they may take the second round exam for the courses in which they failed during the fourth year exams.
- Duration and Supervision of Student Training: The student training course consists of four practical hours per day. Each student training group may have two supervisors, one representing the educational aspect and the other representing the specialized aspect.
- Supervision and Rewards for Student Training: The administrative and technical supervision of students during the student training period is the responsibility of the educational faculty members. They are assisted by subject instructors, directors, or principals of the schools where students are undergoing training. These supervisors are rewarded with four practical hours per week during the separate training period and eight practical hours per week during the continuous training period. The College Council may increase the reward if the number of students exceeds thirty in a single school.
- Grading System: Student success is evaluated based on the following grading scale, whether for an individual subject, the total number of academic subjects within a group, or the four groups for graduates:

1. Excellent: 85% or more of the total grades.
2. Very Good: 75% to less than 85% of the total grades.
3. Good: 65% to less than 75% of the total grades.
4. Acceptable: 50% to less than 65% of the total grades.

Student failure is categorized as follows:
1. Weak: 30% to less than 50% of the total score.
2. Very Weak: Less than 30% of the total score.

- Semester Work Grade Allocation: The College Council, based on the proposal of the relevant department, may assign a percentage of the final grade for any educational course to be determined by semester work. The rules governing the assessment of the semester work grade are established by the College Council, based on the proposal of the relevant department council.
- Attendance Requirements and Exam Eligibility: The College Council, upon the request of the department councils, may prohibit a student from sitting for exams in some or all courses if their attendance at lectures, discussions, practical lessons, or student training falls below 75% of the allocated time for each. In such cases, the student is considered to have failed in the courses for which they were denied exam eligibility, unless they provide an excuse accepted by the College Council. In the case of an accepted excuse, the student is considered absent from the course with an acceptable excuse.

General Objectives of the Program:
The program aims to achieve the following objectives in order to prepare students with a high school diploma/mathematics degree and graduates of colleges of science (mathematics major) to work as mathematics teachers in the preparatory cycle (grades 7-9) of basic education and the secondary stage (grades 10-12) in the Arab Republic of Egypt, in accordance with national and international standards. These objectives include:
1. Comprehensive Understanding of Mathematics: The program seeks to provide students with a deep understanding of mathematical thinking and concepts. It equips them with the necessary knowledge to recognize that mathematics is an interconnected science with unified elements, emphasizing that the whole is greater than the sum of its parts.

2. Versatile Teaching Methods: Students will be exposed to various teaching methods and approaches, and they will be trained to employ these methods with comprehension and expertise. This includes classroom organization and management, effective utilization of educational and technological resources, and the use of appropriate evaluation methods to assess learning outcomes when teaching mathematics to middle school and high school students.
3. Professional Skills through Practical Training: The program aims to equip students with professional and performance skills in teaching mathematics through extensive field training and practical education at the preparatory and secondary levels. This practical experience will allow them to develop the necessary competencies and adapt their knowledge to real-life teaching scenarios.
4. Emphasis on Contemporary Approaches: The program will emphasize contemporary directions in teaching and learning mathematics, seeking to enhance the performance of general education students in pre-university education. By incorporating innovative and effective teaching practices, students will be equipped to address the evolving needs and challenges in mathematics education.
5. Development of Mathematical Sense: The program recognizes the significance of developing two essential aspects of mathematical sense: numerical and spatial. Students will be encouraged to enhance their numerical reasoning skills, enabling them to effectively analyze and interpret numerical data. Additionally, they will develop spatial reasoning abilities, which are crucial for understanding geometric concepts and solving spatial problems.

Targeted Educational Outcomes of the Program:

1. Knowledge and Concepts:

A) Comprehensive Mathematical Knowledge: The program aims to provide students with a solid foundation in various mathematical sciences. This includes equipping them with essential knowledge and concepts in advanced mathematics, such as algebra (all types), geometry (all types), numerical analysis, complex analysis, topology, continuous mathematics, discrete mathematics, statistics and probability, mechanics (including neutrons, relativity, and quantum mechanics), complexity phenomena (chaos, fractal geometry), abstract mathematical structures, programming, and mathematical modeling in real-world applications.

B) Development of Mathematical Thought: The program seeks to foster the development of mathematical thinking through practical applications, rigorous theory, experimentalism, and the study of significant mathematical figures from Arab, Muslim, and Western traditions. This approach encourages students to engage with mathematics from different perspectives, enhancing their problem-solving abilities and analytical skills.

C) General Mathematical Culture: The program aims to cultivate a comprehensive mathematical culture among students, highlighting the practical role of mathematics as a tool for other sciences. Students will explore the practical applications of mathematics in disciplines such as physics, chemistry, and others. This will enable them to:

- Apply mathematical reasoning to social, political, and economic situations.
- Analyze and interpret number patterns through observation, representation, and identification of patterns in various social and physical phenomena.
- Understand the historical development of mathematics, the interconnectedness of mathematical topics, and the significant mathematical discoveries that have shaped society and human thought.

D) Perceiving Mathematical Connections: The program emphasizes the ability to establish connections between abstract mathematical concepts and their real-life applications. Students will develop skills in conducting exploratory mathematical reasoning and clearly articulating the relationships between different branches of mathematics. They will also demonstrate an understanding of the historical development of mathematics, the interconnections among mathematical topics, and the profound impact of mathematical discoveries on society and human thought.

Furthermore, students will be able to:

- Apply mathematical principles to social, political, and economic scenarios.
- Analyze and interpret number patterns in diverse ways, including observation, representation, and identification of patterns in social and physical phenomena.

2. Mental Skills:

Students are anticipated to develop the following mental skills:

A) Proficiency in mathematical and symbolic thinking, encompassing skills in reasoning, deduction, induction, contemplation, analysis, and demonstration. This includes fostering scientific and creative thinking alongside symbolic reasoning.

B) Application and evaluation of intuition through inductive reasoning, providing analogous examples, and assessing the efficacy of discussions.

C) Presentation of systematic and non-systematic proofs, both in written and oral formats, across various mathematical branches aligned with content requirements.

D) Utilization and demonstration of mathematical theories, emphasizing both proving and practical application.

E) Analysis of solutions to equations employing diverse mathematical theories.
F) Application of mathematical thinking to problem-solving within various academic domains.
G) Proficiency in reading and organizing data, utilizing contemporary electronic tools for data analysis, engaging in approximate estimation, and comprehending concepts related to probability and chance in real-life situations.

3. Professional and Practical Competencies:

A) Equipping students with pedagogical proficiency in teaching mathematics, ensuring that the prospective teacher can:

- Analyze course content comprehensively, facilitating a nuanced understanding and organization of material for effective teaching that emphasizes both conceptual comprehension and procedural knowledge.
- Assess learner characteristics to actively contribute to determining educational activities, methods, strategies, and experiences.
- Plan teaching endeavors by developing a comprehensive vision for instructional positions and processes, aligning them with pedagogical and educational objectives.
- Employ diverse, engaging, and interactive teaching methodologies, fostering the development and reinforcement of skills and concepts through activities such as direct learning, discussions, individual and group applications, as well as remedial and enrichment teaching.
- Apply fundamental ideas within subject topics that underpin the middle school and high school curriculum.
- Utilize educational techniques and methods to process information, solve problems, analyze data, and effectively present information.
- Adequately prepare for lessons, deliver them with varied motivation and reinforcement, and successfully conclude them.
- Implement methods for organizing the classroom environment, extracurricular activities, and classroom dynamics to foster a positive socio-emotional atmosphere and establish an effective and productive social system within the classroom.
- Formulate and pose a diverse range of classroom questions that reflect both convergent and divergent thinking.
- Employ multiple assessment measures, including performance evaluations, presentations, research projects, field experiences, observation, personal interviews, and written and oral examinations.
- Utilize formative and summative assessments in accordance with subject requirements and performance standards.
- Implement appropriate methods for collecting information to assess strengths, weaknesses, and areas requiring improvement.
- Communicate effectively with students, colleagues, and parents.

B) Problem-Solving, Decision-Making, and Time Management Skills: The student teacher should demonstrate the following competencies:

- Proficiency in the scientific investigation and exploration process.
- Ability to contextualize mathematical problems, discerning their connections with other problems.
- Problem-solving aptitude in both theoretical mathematics and real-world applications.
- Mastery of various methods for solving problems in physical and industrial engineering.

C) Mathematical Modeling in Problem Solving: The student teacher is adept at:

- Modeling verbal problems using mathematical relationships.
- Interpreting mathematical equations and functions, showcasing versatility in problem-solving approaches.

D) Error Detection and Accuracy Verification: The student teacher possesses the skills to:

- Detect errors in calculations and methodologies.
- Verify the accuracy of findings and work performed.

4. General Skills:

A) Communication and Mathematical Expression Skills (Oral and Written):

- Articulating mathematical ideas, concepts, generalizations, and thought processes clearly and consistently using the language of mathematics.
- Crafting mathematical explanations suitable for various grade levels.
- Analyzing and evaluating others' mathematical ideas and strategies.
- Employing effective techniques to present mathematical ideas and concepts.
- Describing and representing information, data, and various coordinate systems.

B) Identifying General Patterns from Diverse Situations.
C) Adaptability to Changing Situations.
D) Proficiency in Using Mathematical Language and Terminology for Mathematical Proof.

E) Strategic Planning and Intelligent Guesswork for Task or Project Advancement.

The Mathematics Teacher Preparation Program at the Faculty of Education in Sohag aims to cultivate these skills in the student teacher, as illustrated in the following matrix:

Table 3: Mathematics teacher preparation program skills matrix

Field / Skills		Teaching Methods	Curriculum and educational	Principles of education and	Psychology and mental health	Pure mathematics	Applied Mathematics	Nature and chemistry	computer	Practical education	a foreign language	human rights
Mental skills	Mathematical, symbolic and deductive thinking skills	✓				✓	✓					
	The skill of using intuition	✓				✓	✓	✓			✓	
	The skill of using mathematical thinking	✓				✓	✓	✓			✓	
	The skill of presenting systematic and non-systematic evidence	✓				✓	✓					
	Skill in reading and tabulating data	✓				✓	✓	✓			✓	
Professional and Practical Competencies	Technical skills in teaching mathematics	✓								✓		
	Problem solving, decision making and time management skills	✓	✓	✓	✓	✓	✓	✓		✓	✓	
	Mathematical modeling	✓				✓	✓	✓		✓	✓	
	Detect the error and validate the solution					✓	✓	✓		✓	✓	
General Skills	Communication and sports communication skills	✓	✓	✓	✓	✓	✓			✓	✓	✓
	Use the language and terminology of mathematics	✓				✓	✓			✓		
	Pre-planning a task	✓	✓	✓	✓	✓	✓			✓		✓

Criteria for Selecting Program Courses:

1. Emphasis on Specialized Mathematics Courses: The foundational structure of the program revolves around specialized mathematics courses offered by the Department of Mathematics at the Faculty of Science in Sohag. These courses should encompass various mathematical sciences, providing students with comprehensive mathematical knowledge and a deep understanding of mathematical principles. Despite diverse specializations, the program aims to instill a unified philosophy of mathematical thought.

- Realizing the significance of mathematical thought and its historical and scientific evolution.
- Understanding proof methods across different mathematical sciences (algebra, geometry, differentiation, etc.).

2. Development of Mathematical Communication Skills: Cultivating skills in oral and written expression of mathematical thoughts.
3. Utilizing Mathematical Language and Terminology: Proficient use of mathematical language to articulate ideas effectively.
4. Analysis and Evaluation: Developing the ability to analyze and evaluate various methods of proof or mathematical solutions.
5. Problem-Solving Skills: Enhancing problem-solving capabilities.

6. Interdisciplinary Understanding: Recognizing the role and importance of mathematical sciences in other fields such as physics and chemistry.
7. Technological Integration: Training students in mathematics courses to use advanced technology, including computer programs, programming languages, and relevant computer sciences.
8. Comprehensive Learning: Covering a range of subjects, including algebra, various branches of engineering sciences, calculus, number theory, statistics, probability, mathematical logic, computer science, philosophy, history of mathematics, and applied mathematics.
9. Characteristics of Educational Courses in the Program:

A) Alignment with Program Philosophy and Objectives:

- Each course should incorporate aspects of the program's philosophy and objectives, with faculty members explicitly detailing these objectives.

B) Integration of Technological Developments:

- Courses must address contemporary technological advancements, encompassing electronic data collection and analysis methods, classification of scientific programs and packages, instruction on ethical and legal considerations in advanced technology use, and exploration of social and societal implications associated with teaching advanced technology.

C) Varied Presentation Methods in Mathematical Education:

- The program incorporates diverse approaches to presenting mathematical scientific material across middle and high school levels.
- Faculty members emphasize curriculum construction, class organization strategies, classroom management, educational activities, and applied studies and research in their courses. These topics aim to instill precision in observation, methods of data recording and analysis, and result interpretation.
- Educational courses focus on implementing methods that empower students to engage actively in work and teaching through hands-on training activities, research, and various learning methods (individual, group, cooperative learning, etc.).
- Emphasis on the importance of employing diverse evaluation methods, with faculty members practicing these methods on students in educational courses. Evaluation methods include observation, oral tests, research projects, and written tests.

10. Duration and Frequency of Courses:

- Any course within the program should span a minimum of 15 weeks per semester, with a minimum of 2 hours per week dedicated to instruction.

Field Training Standards:

The field training and practical practice component of the program are guided by specific standards and criteria, with an emphasis on practical education in both general education schools (middle and secondary). Key sub-criteria for this type of activity include:

1. Integration of Practical Field Training:

- Practical field training, or practical education, should be a fundamental and integral element of the students' academic program.

2. Alignment with Academic Courses:

- There must be a seamless connection between field training activities and the academic courses offered within the program.

3. Collaboration with Education Department:

- The education department in the region should actively participate alongside college administrations in coordinating and engaging in practical training activities. Direct supervision should be a collaborative effort involving the highest authorities from both sides.

4. Faculty-Teacher Collaboration:

- Effective communication and cooperation are essential between faculty members teaching in the program and the cooperating teachers in the schools where students undergo training.

5. Selection of Training Schools:

- The faculty members and education administration should jointly participate in the selection of schools where practical training will be conducted.

6. Performance Improvement Tools:

- The program should incorporate tools and mechanisms designed to enhance students' performance. Additionally, strategies and methods for improvement should be implemented if students do not achieve the minimum acceptable teaching performance.

7. Comprehensive Field Training Activities:

- Field training activities must encompass the following: A) Training in organized observation through planned presentations. B) Training on teaching performance before the commencement of actual field training. C) Analysis of the curricula that students will teach in schools. D) Integration of specialized university courses in the program with the school curriculum courses. E) Each student is required to document their work throughout the academic year by creating a comprehensive portfolio. This portfolio should detail the student's activities, methods implemented during practical field training, and serve as evidence of their practical and field achievements.

Evaluation Criteria in the Program:

1. **Comprehensive Assessment Approach:**
- An effective teacher preparation program should incorporate both formative and summative evaluation methodologies for each course. Evaluation methods must be diverse, encompassing performance measures, research projects, presentations, oral and written examinations, discussions, personal interviews, observations, among others.

2. **Alignment with Knowledge Specifications:**
- There must be a congruence between the content knowledge specifications and the aspects evaluated in the program. Evaluation criteria should directly relate to the prescribed content.

3. **Scientific Foundation for Evaluation Tools:**
- All evaluation tools utilized must adhere to the scientifically approved course description, covering a substantial portion, ideally 75% or more, of the outlined content.

4. **Diverse Final Evaluation Measures:**
- The final evaluation of courses should employ a variety of measures to assess student performance comprehensively, reflecting the experiences and skills acquired during the course.

5. **Transparent Grading System:**
- Students should be well-informed about the evaluation and grading system, including the types of tests, grade distribution, criteria for grading, and overall grading standards at the commencement of each course.

6. **Continuous Evaluation System Review:**
- Faculty members are obligated to assess and revisit the evaluation systems utilized, scrutinizing each testing method across different semesters for validity, accuracy, and its ability to measure educational outcomes in line with program standards.

7. **Preparation of Evaluation Tools:**
- The departments responsible for program implementation must develop tools and materials that encompass faculty members' adherence to course requirements. This should include the preparation of methods, tests, and criteria for soliciting student feedback on the courses.

8. **Program Enhancement through Evaluation:**
- The program should undergo continuous improvement based on evaluation results. This entails incorporating new academic subjects, addressing student needs within the program, and staying attuned to developments in general education in schools.

Conclusion and Recommendations:

Colleges of education play a crucial role in preparing and improving mathematics teachers, enabling them to achieve high levels of competence and teaching effectiveness. Therefore, evaluating the mathematics teacher preparation program in these colleges is essential to ensure the adoption of best international practices and standards in mathematics education. In this context, the present study aimed to conduct a comprehensive evaluation of the mathematics teacher preparation program at the College of Education in Sohag. The evaluation focused on analyzing and assessing the program's content, teaching methods employed, and their impact on students' achievement and engagement in mathematics.

The evaluation results revealed several strengths in the current program. The presence of a sufficient number of faculty members with diverse experiences was identified as a significant advantage. Additionally, the program has successfully fostered positive attitudes towards the teaching profession and equipped graduates with effective teaching methods. The availability of various types of laboratories that support students' academic and professional development was also acknowledged as a strength. However, the evaluation also identified certain weaknesses in the current program. Traditionalism and a lack of alignment with current developments in the field were highlighted as primary concerns. The goals and standards of the program were found to be unclear and general, and the skills and competencies required for teacher preparation were not clearly specified.

Based on the valuable information and practical guidance obtained from the evaluation, it is recommended that the college administration and faculty members undertake updates and improvements to the mathematics teacher preparation program. The aim should be to achieve high-quality mathematics education, enhance teaching capabilities, and improve the learning experiences of students. To accomplish this, the following recommendations are proposed: Continuous Updating and Development of Educational Curricula: The program should incorporate diverse and innovative teaching strategies and utilize appropriate educational materials to enhance students' understanding and engagement in mathematics. Training Opportunities and Workshops for Teachers: Providing regular training opportunities and workshops for teachers will allow them to enhance their teaching skills specifically in the field of mathematics. This continuous professional development will ensure that teachers are equipped with the latest pedagogical approaches and instructional techniques. Enhanced Use of Technology: The program should emphasize the integration of technology in the qualification of mathematics teachers. Utilizing educational technology tools and resources will facilitate effective teaching and learning, as well as promote students' digital literacy skills. Comprehensive Evaluation Mechanisms: The program should implement comprehensive evaluation mechanisms to measure the progress of trainee teachers throughout their training. Regular assessments and feedback will enable continuous monitoring and improvement of the program's effectiveness.

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