

## The role of Pre-service teacher's preparation programs in improving the teaching performance of early career mathematics teachers

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### Abstract

This study aimed to investigate the necessary teaching competencies for early career mathematics teachers and identify the degree to which these competencies are represented in pre-service teachers' preparation programs. The study also aimed to identify the most effective teaching strategies that should be included in preparation programs. The study was applied to (142) early career mathematics teachers in Jordanian public schools with no more than three years of experience. The study relied on a mixed methodology based on quantitative and qualitative approaches. A questionnaire and semi-structured interviews were used to collect the data. The study concluded that teaching competencies fall within four areas: namely, knowledge competencies, implementation competencies, assessment competencies, and personal competencies. The pre-service preparation programs succeeded in preparing mathematics teachers well by acquiring these competencies and providing them with personal skills that provide them with effective and continuous communication with their students. Mathematics teachers find that the most effective teaching strategies are those that focus on students' interests and that the infrastructure and capacity of the classrooms have a major role in limiting the ability of mathematics teachers to apply what they have learned in the preparation programs. Mathematics teachers recommend that graduates who enter the teaching profession should pay attention to continuous improvement by enrolling in courses that enable them to keep pace with cognitive, professional, and technical developments in mathematics.

**Keywords:** pre-service preparation programs, early career mathematics teachers, teaching competencies, teaching performance.

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## 1. Introduction

Teacher preparation programs are the most important programs that universities and institutions responsible for graduating teachers should prioritize. The theoretical, practical, and professional preparation of teachers achieves the state and society's educational goals (Yin et al., 2019). Teachers who have been well prepared can avoid confusion and mistakes during their first year of teaching (Braksiek, 2022). Furthermore, it boosts their motivation and self-esteem, gives them a strong start, and prepares them for continuous professional development by accumulating appropriate teaching experiences based on the principle of achieving the necessary competencies to successfully practice the teaching process (Hassanein et al., 2021).

Teacher preparation programs help to give them a complete understanding of the school's environment, activities, and tasks, allowing them to deal with problems wisely and lowering their rates of frustration and failure when engaged in the teaching process (Noben et al., 2021).

Pre-service teacher preparation programs provide mathematics teachers with knowledge about curricula, classroom management, teaching strategies, and teaching-learning situation planning. They allow them to practice teaching steps during the preparation period, allowing teachers to have a conscious understanding and actual realization of what is expected of them. Their beginning would be more powerful if they combined theoretical concepts with practical experiences required in the classroom (Ryan et al., 2017).

One of the biggest challenges for a novice mathematics teacher is classroom success. As a result, before serving, the teacher must receive adequate preparation to possess the necessary competencies to face these challenges, such as educational situation and classroom management, teaching skills, and other competencies that serve as the foundation for student involvement in the learning process (Simonsen et al., 2014).

Teaching competencies are also necessary for maintaining the development of the education sector (Yang et al., 2021). As a result, it has become important to work on the teacher's competencies, which include knowledge, skills, attitudes, and values (Selvi, 2010). Mathematics teachers' possession of teaching competencies would positively affect students' access to deep and continuous learning and improve students' mathematical outcomes, leading to higher achievement (Gokalp, 2016).

As a result, the quality of teacher preparation programs is reflected in the quality and competencies of mathematics teachers. Different programs must work together to develop a well-qualified mathematics teacher with all the necessary teaching competencies and fundamentals (Ricketts et al., 2006). The relationship between the quality of preparation programs and the success of mathematics teachers in their profession highlights the need to identify the teaching competencies required for mathematics teachers before they begin working (Peterson-Ahmad et al., 2018).

### 1.1. Study Problem and Question

Teachers of mathematics must teach students problem-solving and critical thinking skills (Toibazarov et al., 2021). According to the European Commission, this requires a mathematics teacher with specific and targeted competencies (Queen Rania Foundation, 2015). According to the Jordanian Ministry of

Education, there are no unified teaching competencies for mathematics teachers in Jordanian teacher preparation programs (Ministry of Jordan, 2018).

Those in charge of such programs failed to provide mechanisms for identifying missing competencies as well as those available in teacher preparation programs (Toibazarov et al., 2021). As a result, this study investigated the necessary teaching competencies for early career mathematics teachers, allowing them to perform their tasks more effectively, and then determining the degree to which the programs represent these competencies. To achieve the current study's goal, the researchers attempted to answer the following questions:

- What is the pre-service teacher preparation program's role in providing the early career mathematics teachers with the necessary teaching competencies?
- Are there significant differences in the availability degree of the teaching competencies in the preparation programs of early career mathematics teachers due to experience?
- What are the most used teaching strategies that should be addressed in teacher preparation programs for early career mathematics teachers?
- What challenges do early career mathematics teachers face in applying what they have learned in the pre-service preparation programs in teaching?
- What are the recommendations of early career mathematics teachers for students in the last year of university (graduates) in mathematics who are about to enter the teaching profession?
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## **1.2. Background**

### ***Pre-service Mathematics Teacher Preparation Programs***

The pre-service teacher preparation programs are the first important step in preparing a qualified mathematics teacher for the teaching process (Wang et al., 2021). they provide them with mathematical knowledge and concepts and develop positive attitudes that enable them to practice their work from the first moment in a professional manner which leads to the development of the educational process and the enhancement of its outputs (Ariff et al., 2017).

The most important program in pre-service preparation is those dealing with the educational stages, namely, programs for preparing pre-junior mathematics teachers, for example, kindergarten teachers, and those preparing teachers of primary education. The programs are divided into two types. The first is during the undergraduate study period for students of faculties of educational sciences, in the specialization of curricula and methods of teaching mathematics, where the study plan contains the theoretical and practical courses necessary for preparation. In contrast, the second depends on additional years of study after graduation for professional or educational preparation. These programs and mechanisms prepare students to teach mathematics (Braaten et al., 2022) since their outputs aim to graduate qualified teachers capable of practicing the profession (Ries et al., 2016; Abu Naba'h et al., 2009).

The Jordanian Ministry of Education embraced the Strategic Plan for Education Reform (Ministry of Jordan, 2018) and became interested in preparing general pre-service teachers and mathematics teachers. The Queen Rania Foundation (2015) has been created to provide them with professional pre-

service preparation by enrolling them in the Teacher Education Professional Diploma (TEPD) offered by the Queen Rania Teacher Academy (QRTA) to provide them with the teaching competencies necessary to start the teaching profession in the schools of the Ministry of Education and to be able to develop and reform education in Jordan according to its strategic plan for the period (2018-2022).

### Mathematics Teaching Competencies

The competencies for teaching mathematics consist of all the mathematical theoretical knowledge, practical skills, and attitudes that a mathematics teacher must possess to handle the responsibility of working as a specialized teacher capable of achieving the required outputs (Maba et al., 2018; Selvi, 2010).

Tanguihan (2016) mentioned that the most important competencies a mathematics teacher should possess after qualification are educational needs, learning environment, the content of the mathematics curriculum, planning, assessment, reporting, networking with the community, and self-development.

Shekhawat and Thakur (2014) summarized the teaching competencies in the areas of planning, defining strategies for teaching, communicating knowledge and science, conveying learning impact, creating long-term learning, guiding students to their curriculum content, and evaluating students.

Prezi (2016) believes that the teaching competencies of a mathematics teacher are twelve procedural competencies represented in: the awareness of the necessary mathematical knowledge and continuous openness to it, which enables the mathematics teacher to use it in the classroom, taking into account individual differences; the possession of oral and written communication skills with classroom and school learning communities; the ability to lead students during different activities, and the skill of solving problems that appear during the educational process; the ability to plan for education and the ability to activate planned strategies in the classroom; the skills of formative and summative assessment that are closely related to the planning outcomes.

Based on the teaching competencies of the mathematics teacher stated in the previous studies, the researchers came up with a list of teaching competencies that should be available in a mathematics teacher. They classified them into four areas and identified the competencies needed in each, as shown in Table 1.

Table 1. Teaching Competencies Necessary to Prepare Early Career Mathematics Teachers

Area	Competencies
Mathematics Knowledge and Planning Competencies	Possessing general mathematical knowledge and updating it and having knowledge of the contents of the educational curricula.
	Planning learning based on mathematical content, strategies, and learner styles.
Implementation Competencies	Acquiring oral and written communication skills in learning communities
	Managing students' behavior and leadership while implementing different activities and solving urgent problems.
	It employs educational technology and teaching methods that engage students in long-term enjoyable learning.

Achieving inclusive learning by considering students with special needs.

Assessment  
Competencies

Acquiring pre-assessment skills that are consistent with the planned learning outcomes and based on the approved foundations of success.

Acquiring formative assessment skills that are consistent with the planned learning outcomes and based on the approved foundations of success.

Acquiring summative assessment skills that are consistent with the planned learning outcomes and based on the approved foundations of success.

Personal  
Competencies

Embracing professional ethics in the classroom and within the school environment.

Activating teamwork within the learning environment and through internal and external participation.

Self-development and continuous professional growth.

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**Early Career Mathematics Teachers**

Early career mathematics teachers are qualified and prepared by various preparation programs and - for the first time - practice the profession of teaching mathematics, relying on their teaching competencies obtained through these programs (Bledsoe et al., 2016).

Schuck et al. (2018) stated that novice mathematics teachers face many problems and challenges at the beginning of their careers. Thus, they need a lot of good preparation and continuous support to be qualified teachers and reach professionalism without negatively impacting the educational process and learners.

The current study was applied to early career mathematics teachers in Jordan with no more than three years of experience. The mathematics teachers graduated from faculties of education specializing in curricula and methods of teaching mathematics in different universities or have joined special programs for preparation and qualification after graduating from the Faculty of Science with a specialization in pure mathematics.

**2. Literature Review**

Atmaca (2017) compared English language teachers' perspectives on teaching competencies before and after enlisting in service. The Turkish Ministry of Education approved the studied competencies and accredited them in the preparation programs. This study included 366 students in preparation programs and 84 newly enlisted teachers. Their responses were compared. The findings revealed that half of the English language teachers had positive opinions about the correlation of competencies with their professional needs, while a few had negative opinions. Teachers proposed improving the teaching competencies taught in pre-service preparation programs.

Bledsoe et al. (2016) investigated the effectiveness and contribution of early career teachers. The design was explanatory, and sequential mixed methods were used. The sample included 57 teachers with no more than three years of experience who graduated from the Texas Association of Colleges for Teacher Education (TACTE). The effectiveness of teachers' contributions was measured in these colleges using seven approved teaching competencies. It was noted that they were well prepared for these competencies, particularly knowledge competencies, learning transfer, and long-term learning creation.

The least of them appeared in the communication skills with parents and colleagues. The study suggests that teachers' preparation can be improved based on their first year of experience.

Yuksel and Saglam (2018) determined the extent to which students of preparation programs developed teaching competencies during the stages of their studies in the accredited program in Turkey English Language Teaching (ELT). A cross-section of 132 students in preparation programs in various years of study was used, and the Turkish Ministry of Education approved the investigated Education competencies. A Likert scale questionnaire with indicators reflecting these competencies was used. According to the study, students in the second year had the fewest of these competencies, and students in the fourth year did not have all of them. These competencies also develop during over the course of a student's education.

Balyer (2017) discovered how teacher preparation programs help students acquire teaching competencies and become ready to practice the profession. The survey method was used in this study, and the sample consisted of 993 students in preparation programs. Data were collected using a questionnaire designed on the Likert scale. Students in the preparation programs have acquired the necessary competencies and are prepared to work in education.

Tang et al. (2016) assessed the extent to which the experiences required for teachers at the start of their careers relate to the teaching competencies acquired during preparation programs. This study was conducted using in-depth interviews with 12 students in Hong Kong and concluded that deep learning is used to develop teaching competencies for students in the program.

Koca (2016) evaluated the competence of teachers in music preparation programs in Turkish middle universities. A criterion sampling method was used, and a questionnaire with personal data and opinions was created. Students in the preparation programs are qualified to implement the special steps for teaching music. The competencies found in the weakest students are related to planning and preparing the material, organizing the learning environment, and managing the time allotted.

Gokalp (2016) concentrated on mathematics to answer two important questions. The first question is, what is the current state of mathematics teacher preparation programs at the basic level of classroom teaching competencies? The second question is, to what extent do these competencies exist in the preparation programs? The study included 202 graduate students enrolled in mathematics teacher preparation programs at Turkish universities. The findings revealed a positive correlation between reality and competencies and a difference in the appropriateness of competencies across stages, with sixth-grade competencies being more appropriate than eighth-grade competencies.

Nzilano (2013) investigated the teaching competencies of secondary school teachers and faculties of education in preparation programs at the University of Tanzania in Dar es Salam. The study included 30 students in preparation programs and eight administrators from secondary schools and colleges of education. A questionnaire, semi-structured interviews, a review of the achievement file, and class observations were used. The study defines the competencies required for student teachers in classroom education. The study recommended reforming teacher preparation and development programs, developing education policies, and collaborating between the Education Department in schools and colleges.

### **3. Method and Procedures**

The study followed a Mixed Method approach to answer its questions. A quantitative approach was used to measure the extent to which the teaching competencies are represented in the preparation programs. A qualitative approach was used through the semi-structured interview instrument to

explore the most commonly used teaching strategies in teacher preparation programs, the challenges that early career mathematics teachers face in applying what they have learned in the pre-service preparation programs and their recommendations for graduates students in mathematics who are about to enter the teaching profession.

### 3.1. Participants

The study population represents all mathematics teachers who graduated from Jordanian universities, joined one of the teacher qualifications programs, and were appointed to work in public schools. Their experience does not exceed three years. The convenience sampling method was used to choose the participation, which amounted to (142) mathematics teachers working in Amman with experience of (3) years at most. They attended preparation programs before being appointed teachers. The distribution of participants by years of experience is shown in Table 2:

Table 2. Distribution of participants by years of experience Instruments

Experience	One Year	45
	2-3 Years	97

### 3.2. A Questionnaire of Teaching Competencies in Pre-service Preparation Programs

To answer the first question, the researchers looked at the study of (Abu Naba'h et al., 2009; Ariza & Poole, 2018; Prezi, 2016; Theeb et al., 2013), as well as the teaching competencies approved by the Jordanian Education Council, and with the help of some education experts. a four-level scale questionnaire was developed, as shown in table 3, consisting of (12) teaching competencies divided into four areas: knowledge and planning competencies, which included two teaching competencies; implementation competencies, which contained four teaching competencies; assessment competencies, which have three competencies; and personal competencies, which are expressed by three learning competencies. The questionnaire was applied to all members of the study sample.

Table 3. The four-level scale of a Teaching Competencies Questionnaire

Preparation Level	Representation
1	Pre-service preparation programs did not succeed in acquiring teaching competencies
2	Pre-service preparation programs have been somewhat successful in acquiring teaching competencies
3	Pre-service preparation programs have been greatly successful in acquiring teaching competencies
4	Pre-service preparation programs perfectly successful in acquiring teaching competencies

### 3.3. Semi-structured interview to measure early career mathematics teachers' perceptions

The researchers developed a semi-structured interview with early career mathematics teachers consisting of five closed-ended questions, as shown in table 4, aimed at identifying the most important

teaching strategies used by early career mathematics teachers and providing more in-depth conclusions about the gap between reality and what they learn in preparation programs.

Table 4. The open-ended question of semi-structured interview

Q. N	Open ended question
1	What teaching strategies do you use as a teacher in the teaching process. List the three strategies you believe are most important from your perspective and rank them accordingly.
2	Show, using examples and situations from your teaching experience, how your teaching method led to students learning (please describe each situation as an action and a statement made or submitted by the student to indicate his learning).
3	Through your experience as a teacher in the field, what role did the pre-service teacher preparation programs play in your teaching performance? (Is your teaching performance affected by the training you received in your pre-service teacher preparation program? Explain that.)

### 3.4. Validity and Reliability of the Instruments

The content validity of the questionnaire was measured by presenting it to (10) experts specializing in mathematics curricula from Jordanian universities who work in the Ministry of Education in different preparation programs. The instrument was modified according to these observations. In addition, it was applied to a pilot sample of (30) mathematics teachers to examine its constructive validity as shown in table 5.

Table 5. Correlation Coefficients between Teaching Competencies domains. and overall

Teaching Competencies	Correlation Coefficient	Sig
Knowledge and Planning Competencies	0.891	0.000*
Implementation Competencies	0.944	0.000*
Assessment Competencies	0.917	0.000*
Personal Competencies	0.931	0.000*

Considering the reliability of the questionnaire, the coefficient of Cronbach Alpha is (0.975), which indicates a high level of reliability.

A semi-structured interview instrument was developed with three mathematical curriculum experts in teacher preparation programs. Next, the instrument was presented in its initial form to two coordinators of teacher preparation programs for review, and their comments were considered. Afterward, the instrument was presented to a group of experts with more than (10) years of experience in pre-service teacher preparation programs. The modification was done according to their observations. The instrument was presented to a group of experts in measurement and evaluation to examine the extent to which the individual interview questions relate to the study questions. The amendment was made by formulating some questions within the instrument according to their opinions and directions. Then it has been presented to language specialists to refine the questions and measure the clarity of the wording. Finally, the instrument was tested by applying it to (5) early career mathematics teachers with an experience of no more than three years, and based on their responses,

the clarity of the formulation of the questions was verified to provide answers to the study questions. Accordingly, the tool has been modified to become its final form.

#### 4. finding

##### 4.1. Quantitative Results

The availability degree of Teaching Competencies in the Pre-service Mathematics Teacher Preparation Programs

Table 6. Means and Standard Deviations of availability degree of Teaching Competencies in Preparation Programs

Teaching Competencies	M	SD	Rank	Availability Degree*
Mathematics Knowledge and Planning Competencies	3.14	0.70	2	greatly successful
Implementation Competencies	2.99	0.67	4	greatly successful
Assessment Competencies	3.10	0.77	3	greatly successful
Personal Competencies	3.32	0.64	1	perfectly successful
Overall	3.13	0.57		greatly successful

\*(1 - 1.75: failed in acquiring teaching competencies / 1.76 - 2.50: somewhat successful in acquiring teaching competencies / 2.51 - 3.25: greatly successful in acquiring teaching competencies / 3.26 - 4: perfectly successful in acquiring teaching competencies)

We note from Table 6 that pre-service teacher preparation programs succeeded in providing early career mathematics teachers with the most important teaching competencies necessary for them. The overall mean of the availability degree of teaching competencies in the preparation programs was (3.13). The table also shows that the most representative teaching competencies in the preparation programs are the personal competencies, where the degree of representation reached (3.32), which indicates that the programs have provided teachers with personal competencies perfectly. The early career mathematics teachers agreed that the preparation programs had greatly provided them with the rest of the teaching competencies in knowledge, planning, implementation, and assessment, with means of 3.14, 3.10, and 2.99, respectively.

On the other hand, the personal competency of “embracing professional ethics in the classroom and within the school environment” obtained the highest degree of representation (M=3.48), which indicates that the preparation programs succeeded very well in promoting professional ethics in the classroom. However, the implementation competency “achieving inclusive learning by considering special needs students” obtained the lowest degree of representation (M=2.73), which indicates that special needs are not considered a priority in preparation programs; yet, still.

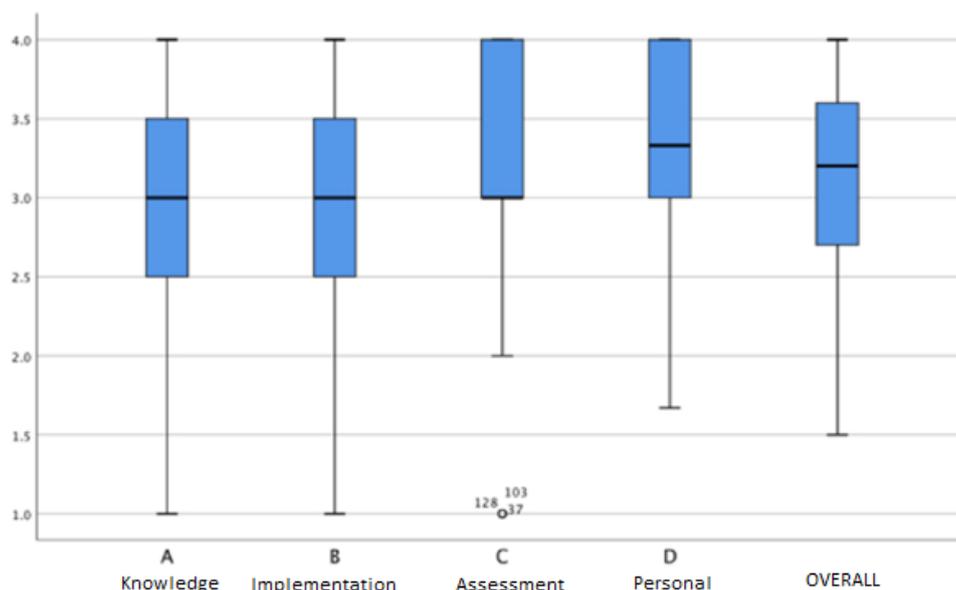


Fig1. The availability degree of pre-service competencies teachers

It is noted in **Figure 1** that the preparation programs provided pre-service teachers with the competencies of knowledge, planning, implementation, and assessment to the same degree. Still, they were distinguished by the personal teaching competencies to a higher degree than the rest of the competencies.

#### The Differences in the availability Degree of Teaching Competencies in the Preparation Programs According to Teaching Experience

Table 7. T-TEST for Differences in the availability Degree of Teaching Competencies in the Preparation Programs According to Experience

Teaching Competencies	Experience	N	M	SD	T-Test	Df	Sig(2-tailed)
Knowledge and Planning Competencies	One year	45	2.9556	.79646	-2.23	140	0.028
	2-3 years	97	3.2320	.63353			
Implementation Competencies	One year	45	2.8722	.71831	-1.41	140	0.160
	2-3 years	97	3.0412	.63603			
Assessment Competencies	One year	45	3.1556	.90342	0.60	140	0.553
	2-3 years	97	3.0722	.71074			
Personal Competencies	One year	45	3.1560	.62220	-2.17	140	0.032
	2-3 years	97	3.4024	.63489			
Overall	One year	45	3.0022	.62468	-1.84	140	0.067
	2-3 years	97	3.1907	.53873			

Table 7 shows, in general, no differences in the availability of degree teaching competencies in preparation programs between mathematics teachers with one year of experience and teachers whose experience ranges between 2-3 years. The table illustrates differences in the availability, degree of

knowledge and, planning competencies, and personal competencies in favor of teachers whose experience ranges between 2-3 years.

#### **4.2. Qualitative Results**

##### **The Teaching Strategies Most Commonly Used in the Educational Process should be focused on in the Early Career Mathematics Teachers Preparation Programs.**

Thirty mathematics teachers were asked about The Teaching Strategies Most Commonly Used in the Educational Process, which should be focused on in the Early Career Mathematics Teachers' Preparation Programs. (60%) They agreed that the most successful and priority teaching strategies focus on attracting students' interest (T1-T8, T10-T13, T19, T21-T23, T27, and T28). At the same time (37%) of mathematics teachers varied their opinions regarding strategies of organizing and managing interactive activities, learning by doing, strategies based on student needs, linking the content to everyday life, systems based on directed questions, and group learning.

The participants (T9, T25, and T30) mentioned that the active learning strategy is the most important in the classroom, while others (T29 and T8) referred to other strategies such as problem-solving and inquiry. Some teachers (T2, T12, T20, and T27) pointed out the importance of simulation-based learning and linking knowledge with objects because it has a role in motivating students. The teacher (T20) said,

"One of my students came to me the next morning for a class implemented using simulation through a video. she said that she spoke with her mother about what we had covered in the class, explained to her the scientific material presented, and how she played the role of the teacher."

##### **The Effectiveness of the Preparation Programs on Teaching Performance**

Nearly half of the mathematics teachers (T1-T6, T8, T10-T13, T19, T21-T22, T27, and T28) confirmed that preparation programs provide teachers with teaching strategies. A third of the respondents (T1, T3, T15, T17, T18, T20, T23, T25, and T27) believed the preparation programs provided teachers with the necessary personal competencies to deal effectively with their students.

The teachers (T3, T19, T22, and T24) said the preparation program provided the mechanisms to prepare the mathematical content for teaching. the teacher (T19) stated, "the preparation program taught me how to reformulate content so that it engages students and inspires them to learn."

Teachers (T1, T5-T18, T2, and T30) indicated that the preparation programs were useful because they taught us how to measure pre-student levels. Teacher T7 summarized their opinions by saying, "The preparation programs provided me with practical steps that enabled me to identify students' interests and levels before I began teaching. If you know the level of your students and their interests, you can create interesting and engaging content easily."

Teachers (T2 and T4) reported that the preparation program enabled them to implement group learning, which is more efficient because it achieves the goals more quickly. Teacher T4 declares, "Learning in groups significantly increased confidence among students with lower achievement. During the proportionality lesson, we divided the students into groups, gave each group a specific law to discover, and provided immediate feedback. The results were amazing."

##### **The Challenges Early Career Mathematics Teachers Face to Implement the Competencies They have Acquired from the Pre-service Preparation Programs.**

Forty percent of the teachers stated that the biggest challenge is the lack of financial capabilities that would create an infrastructure capable of providing a suitable classroom environment for learning. Teacher T18 said that "Weak capabilities may be the biggest challenges. Sometimes students suffer from high heat or extreme cold in the classroom due to the inability to provide the required cooling and heating devices. In addition, many schools still lack the necessary equipment and laboratories to implement the scientific content as planned."

On the other hand, (40%) of teachers believe that the number of students compared to the size of the classroom is a major barrier. Teacher T3 said, "A large number of students in the class is the biggest obstacle facing the mathematics teacher, and here the teacher must consider the individual differences between the students on the one hand and the time available to complete the lesson plan on the other hand. Teacher T14 also mentioned that parents' intervention represents the biggest challenge, while (T2, T15, and T24) said that the student's behavior in the classroom is a challenge of high priority.

Teachers (T6 and T27) pointed out individual differences as the main challenge from their point of view. Teacher (T8) indicated that the mathematics teacher's greatest challenge is the large number of tasks associated with the teaching process. Teachers (T9 and T10) mentioned that all challenges could be addressed if there is no resistance and lack of cooperation from the general administration of the school.

The teacher (T23) stated that the classroom environment does not consider people with special needs. He said, "The competencies I gained from the pre-service preparation programs did not prepare me to deal with students with special needs, which made me unable to deal with one of my students who had Down syndrome."

### **The Recommendations of Early Career Mathematics Teachers for Graduate Students who are about to Enroll in the Teaching Profession**

(57%) Participants recommended the need to maintain the continuity of learning and training, to be keen on exchanging experiences among colleagues inside and outside the educational institution, and to stay aware of academic and technical developments in learning and teaching.

Teacher (T15) stated, "Teaching mathematics is a difficult profession that needs teachers who are up to date with developments, can continue learning and are open to receiving the information they do not know from their colleagues."

Teacher (T26) said, "Teaching mathematics needs a teacher who is intrinsically interested in engaging in training courses that would make him an eminent teacher. We are now in the era of skills. Differentiation in education is not through certificates but scientific and technological development."

Teachers (T4, T10) advised graduates who are about to enroll in the teaching profession to focus on how to manage their lessons. (T10) said, "Based on the scarcity of capabilities and the absence of supervision, I see that mathematics teachers, who have lessons with good plans, and administrative skills to control their classes, are the most successful."

### **5. Conclusions and Discussion**

The pre-service teacher preparation programs succeeded in providing early career mathematics teachers with the most important teaching competencies necessary for them in the teaching-learning process. The study chose a sample of mathematics teachers who underwent various preparation programs during university studies or enrolled in preparation programs after graduation, such as a professional or educational diploma. In the various preparation programs, emphasis was placed on the

teaching competencies that early career teachers should possess, enabling them to practice the teaching profession successfully (Ministry of Jordan, 2018).

The partnership between the Ministry of Education and various preparation institutions such as the Queen Rania Foundation and some universities has led to the continuous provision of these institutions with actual feedback from the field. Plus, the professional needs necessary to prepare teachers according to the basic teaching competencies are frequently provided by (Queen Rania Foundation, 2018).

The study concluded that there are no differences in the opinions about the availability degree of teaching competencies in preparation programs between early career mathematics teachers who have one year of experience and those whose experience ranges between 2 to 3 years.

The absence of differences can be attributed to the fact that mathematicians in this category are early career teachers and do not have many years of service that may develop these competencies or increase them through professional development in the job (Bledsoe et al., 2016). Also, the mathematics teacher preparation programs succeeded in providing them with teaching competencies that enable them to practice the profession properly from the beginning of their appointment (Ariff et al., 2017).

The most effective teaching strategies in the classroom focus on students' interests. Achieving long-term learning and effective learning for students requires the optimal use of teacher-planned methods that stimulate students' motivation and are compatible with their needs and interests (Gokalp, 2016). the preparation programs provide them with the teaching competencies of implementing the appropriate educational strategies for the educational learning situation and diversifying these strategies to match the students' needs and ensure the interaction that achieves deep learning for them (Aslan and Zhu, 2015)

Therefore, mathematics teachers realize from the beginning of their work the importance of these strategies and work on implementing them (Verner et al., 2019).

The biggest challenges that hindered early career mathematics teachers from applying the competencies they gained from preparation programs were the challenges related to infrastructure, followed by the challenges of the students' comprehension capacity within one classroom.

The current study was implemented in Jordan's government schools and the public sector since education faces important challenges. Lack of resources, crowded classes, and lack of training and professional development opportunities for teachers are some of the difficulties that mathematics teachers in government schools face. In implementing some teaching strategies that require material resources or time, it is difficult to apply these strategies to many students. Large numbers of students consequently represent a great challenge for teachers to represent all the teaching competencies they have been trained on during the preparation programs, such as active learning and group learning. Moreover, using technology in teaching or practical assessment methods requires the presence of financial capabilities and limited numbers in the classroom (Queen Rania Foundation, 2018).

One of the most important recommendations made by early career mathematics teachers to graduates is to ensure that they acquire the most prominent modern educational and technological skills related to the learning and teaching process by joining the most advanced academic courses.

Mathematical knowledge is constantly evolving. This is usually accompanied by development and change in school mathematics curricula, teaching methods, and strategies. Students' needs and interests also change, leading to a change in ways of dealing with and communicating with them. The continuation of the success of the mathematics teachers requires them to be up to date with this

development and to possess more knowledge, competencies, and skills during work by continuous enrollment in professional development programs, work on developing their technological skills, staying informed of the knowledge development in their specialization, and to employ all this in delivering the school curricula. Among the personal competencies that the preparation programs provide for mathematics teachers are work on self-development and openness to scientific knowledge and new methods of education (Ariza & Poole, 2018).

#### 6. Recommendations:

- Providing continuous professional development programs for mathematics teachers during their service to enrich and develop their teaching competencies.
- Teacher preparation programs should embrace new teaching competencies that allow teachers to focus on the interests and needs of their students.
- Preparation programs should focus on implementing competencies that contribute to successful interaction between students and teachers, as well as on solving many of the problems that mathematics teachers face at the beginning of their teaching.
- Using various programs to prepare teachers to face and manage anticipated challenges in public schools and train them to collaborate with institutions and local community members to confront and minimize such challenges.
- Continuous updating of teacher preparation programs and teaching competencies compatible with technological advancements in the education sector, as well as improving mathematics teachers' attitudes toward self-development at work across moral and material incentives.

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#### References

- Abu Naba'h, A., Al-Omari, H., Ihmeideh, F., & Al-Wa'ily, S. (2009). Teacher education programs in Jordan: A reform plan. *Journal of Early Childhood Teacher Education*, 30(3), 272–284. <https://doi.org/10.1080/10901020903084413>
- Ariff, N., Mansor, M., & Yusof, H. (2017). Preparing pre-service teacher in professionalism practice. *International Journal of Academic Research in Business and Social Sciences*, 7(2), 749–756. <http://dx.doi.org/10.6007/IJARBS/v7-i2/2683>
- Ariza, E. F., & Poole, P. M. (2018). Creating a teacher development program linked to curriculum renewal. *Profile: Issues in Teachers' Professional Development*, 20(2), 249–266. <https://doi.org/10.15446/profile.v20n2.67937>
- Aslan, A., & Zhu, C. (2015). Pre-service teachers' perceptions of ICT integration in teacher education in Turkey. *Turkish Online Journal of Educational Technology*, 14, 97–110.
- Atmaca, Ç. (2017). A comparison of pre-service and in-service English teachers' teaching competency levels. *Yükseköğretim ve Bilim Dergisi*, 2, 353–368.
- Balyer, A. (2017). Pre-service teachers' perceptions of their competency for the teaching profession. *Cumhuriyet International Journal of Education*, 6, 230–248. <https://doi.org/10.30703/cije.334295>

- Tabieh, A., Alsmadi, M., Abu-Loum, K., Al-haj, I., & Sadieh, N. (2022). The role of Pre-service teacher's preparation programs in improving the teaching performance of early career mathematics teachers. *World Journal on Educational Technology: Current Issues*, 14(6), 1779-1794. <https://doi.org/10.18844/wjet.v14i6.7811>
- Bledsoe, C., Trotti, J., Hodge, K., & Talbert, T. (2016). Preparedness of exemplary early career teachers. *Teacher Education and Practice*, 29(1), 115–137.
- Braaten, M., Granados, E., & Bradford, C. (2022). Making sense through dissonance during pre-service teacher preparation. *Teaching and Teacher Education*, 109, 103541. <https://doi.org/10.1016/j.tate.2021.103541>
- Braksiek, M. (2022). Pre-service physical education teachers' attitude toward, and self-efficacy in, inclusive physical education: Measurement invariance and influence factors. *Teaching and Teacher Education*, 109, 103547. <https://doi.org/10.1016/j.tate.2021.103547>
- Gokalp, M. (2016). Investigating classroom teaching competencies of pre service elementary mathematics teachers. *Eurasia Journal of Mathematics, Science and Technology Education*, 12(3), 503–512. <https://doi.org/10.12973/eurasia.2016.1296a>
- Hassanein, E. E. A., Alshaboul, Y. M., & Ibrahim, S. (2021). The impact of teacher preparation on pre-service teachers' attitudes toward inclusive education in Qatar. *Heliyon*, 7(9), e07925. <https://doi.org/10.1016/j.heliyon.2021.e07925>
- Koca, S. (2016). The competency of pre-service classroom teachers' regarding the learning-teaching process in a music course: Implementation from a Turkish university. *Journal of Education and Practice*, 7(33), 143–155.
- Maba, W., Perdata, I. B. K., Astawa, I. N., & Mantra, I. B. N. (2018). Conducting assessment instrument models for teacher competence, teacher welfare as an effort to enhance education quality. *International Research Journal of Management, IT and Social Sciences*, 5(3), 46–52.
- Ministry of Jordan. (2018). *Ministry of Education strategic plan 2018-2020*. Unesco: [www.unesco.org](http://www.unesco.org)
- Noben, I., Deinum, J. F., Douwes-van Ark, I. M. E., & Hofman, W. H. A. (2021). How is a professional development programme related to the development of university teachers' self-efficacy beliefs and teaching conceptions? *Studies in Educational Evaluation*, 68, 100966. <https://doi.org/10.1016/j.stueduc.2020.100966>
- Nzilano, J. (2013). Pre-service teachers' teaching competencies: The experience of practising teaching in secondary schools and teacher colleges. *African Journal of Teacher Education*, 3. <https://doi.org/10.21083/ajote.v3i1.2030>
- Peterson-Ahmad, M. B., Hovey, K. A., & Peak, P. K. (2018). Pre-Service teacher perceptions and knowledge regarding professional development: Implications for teacher preparation programs. *Journal of Special Education Apprenticeship*, 7(2).
- Prezi. (2016). *12 professional teaching competencies*. [Prezi://http://prezi.com](http://prezi.com)
- Queen Rania Foundation. (2015). *QRF national teacher survey 2014*. <https://qrta.edu.jo>
- Queen Rania Foundation. (2018). *From teaching to learning*. <http://www.qrf.org>
- Ricketts, J. C., Duncan, D. W., & Peake, J. B. (2006). Science achievement of high school students in complete programs of agriscience education. *Journal of Agricultural Education*. <https://doi.org/10.5032/jae.2006.02048>
- Ries, F., Cabrera, C. Y., & Carriedo, R. G. (2016). A study of teacher training in the United States and Europe. *The European Journal of Social & Behavioural Sciences*, Issue 2. <https://doi.org/10.15405/ejsbs.184>
- Ryan, T. G., Young, D. C., & Kraglund-Gauthier, W. L. (2017). Action research within pre-service teacher education. *Transformative Dialogues: Teaching and Learning Journal*, 10(3), Article 3. <https://journals.kpu.ca/index.php/td/article/view/831>

- Tabieh, A., Alsmadi, M., Abu-Loum, K., Al-haj, I., & Sadieh, N. (2022). The role of Pre-service teacher's preparation programs in improving the teaching performance of early career mathematics teachers. *World Journal on Educational Technology: Current Issues*, 14(6), 1779-1794. <https://doi.org/10.18844/wiet.v14i6.7811>
- Schuck, S., Aubusson, P., Buchanan, J., Varadharajan, M., & Burke, P. F. (2018). The experiences of early career teachers: New initiatives and old problems. *Professional Development in Education*, 44(2), 209–221. <https://doi.org/10.1080/19415257.2016.1274268>
- Selvi, K. (2010). Teachers' competencies. *Cultura International Journal of Philosophy of Culture and Axiology*, 7(1), 167–175. <https://doi.org/10.5840/cultura20107133>
- Shekhawat, M., & Thakur, D. A. (2014). The study of different components of teacher competencies and their effectiveness on student performance. (According to students). *International Journal of Engineering Research*, 3(7), 3.
- Simonsen, B., MacSuga-Gage, A. S., Briere, D. E., Freeman, J., Myers, D., Scott, T. M., & Sugai, G. (2014). Multitiered support framework for teachers' classroom-management practices: Overview and case study of building the triangle for teachers. *Journal of Positive Behavior Interventions*, 16(3), 179–190. <https://doi.org/10.1177/1098300713484062>
- Tang, S. Y. F., Cheng, M. M. H., & Wong, A. K. Y. (2016). The preparation of pre-service student teachers' competence to work in schools. *Journal of Education for Teaching: International Research and Pedagogy*, 42(2), 149–162. <https://doi.org/10.1080/02607476.2016.1143143>
- Tanguihan, L. G. (2016). Teaching competencies of college instructors in the selected higher education institutions of Surigao City. *Social Science Research Network*. <https://doi.org/10.2139/ssrn.3137142>
- Theeb, R. S., Muhaidat, M. A., & Al-Zboon, E. K. (2013). Professional competencies among pre-service teachers in special education from their perspectives. *Education*, 134(3), 195–205.
- Toibazarov, D. B., Seitova, S. M., Tasbolatova, R., Omarov, Z. A., & Ibrayeva, S. N. (2021). The role of applied problems in the training of future mathematics teachers in the 21st century. *Thinking Skills and Creativity*, 42, 100945. <https://doi.org/10.1016/j.tsc.2021.100945>
- Verner, I., Massarwe, K., & Bshouty, D. (2019). Development of competencies for teaching geometry through an ethnomathematical approach. *The Journal of Mathematical Behavior*, 56, 100708. <https://doi.org/10.1016/j.jmathb.2019.05.002>
- Wang, T., Ramdeo, J., & McLaughlin, C. (2021). Experiencing and experimenting: An exploration of teacher agency in an international collaborative teacher professional development programme using experiential learning. *Teaching and Teacher Education*, 104, 103389. <https://doi.org/10.1016/j.tate.2021.103389>
- Yang, H., Yang, M., Batt, L., Xie, X., You, E., & Goff, P. (2021). A new evaluation approach for teacher preparation programs using labor market competitiveness of teacher applicants. *Teaching and Teacher Education*, 104, 103368. <https://doi.org/10.1016/j.tate.2021.103368>
- Yin, Y. M., Dooley, K., & Mu, G. M. (2019). Why do graduates from prestigious universities choose to teach in disadvantaged schools? Lessons from an alternative teacher preparation program in China. *Teaching and Teacher Education*, 77, 378–387. <https://doi.org/10.1016/j.tate.2018.10.011>
- Yuksel, İ., & Saglam, S. (2018). Are pre-service teachers competent enough? A cross-sectional analysis of elt pre-service teachers' perceived teacher competencies. *European Journal of Education Studies*. <https://doi.org/10.46827/ejes.v0i0.1839>