



## Self-Regulated Learning Skills Among Preservice Mathematics and Science Teachers During Their Field Experience

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### ABSTRACT

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**Purpose** The current study aimed at investigating self-regulated learning skills among preservice mathematics and science teachers during their field experience at the University of Sharjah in United Arab Emirates (UAE). **Methods:** The data were collected via the self-regulated learning skills questionnaire. The sample of the study consisted of (70) preservice mathematics and science teachers enrolled in the teacher education program. The data were analyzed using the means, standard deviations, and t-test.

**Findings:** The findings of the study revealed that preservice mathematics and science teachers showed a high level of possession of self-regulated learning skills. In addition, it was revealed that there was no statistical significance due to the academic rank variable among preservice mathematics and science teachers. **Implications for Research and Practice:** Based on the research findings, it is significantly implied that self-regulated learning skills can be coupled with educational professional development programs. Instructional practices can be designed to improve self-regulated learning skills in preservice teachers.

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## Introduction

The last decades of the twentieth century were marked by the development of the teaching skills of preservice mathematics and science teachers during their preservice preparation. One of the approaches to promote and enhance preservice teachers' preparation is the investment in promoting self-regulated learning skills (Arcoverde et al., 2022; Brenner, 2022; Carpenter et al., 2014; Ganda et al., 2018; Jakešová et al., 2015; Panadero, 2017; Tran et al., 2022). This is due to the role of self-regulated learning in preparing individuals to become adaptive to their lives. Such individuals are lifelong learners who are able to think creatively and critically, and are able to involve, interact and work individually and collaboratively (Brenner, 2022). Self-regulated learning is well defined as the ability of an individual to manage the cognitive, behavioral, metacognitive, emotional and motivational aspects of oneself to achieve particular learning objectives (Arcoverde et al., 2022; Zimmerman, 2013).

Similarly, self-regulated learning is defined by numerous educational researchers, as a process in which students and teachers activate, take responsibility to control and evaluate their teaching and learning (Gholamreza et al., 2015; Kim & Nor 2019). Furthermore, Paris and Paris (2001) stated that self-evaluated learning is the way in which a preservice teacher constructs his/her individual philosophy of self-regulated learning. Self-regulated learning was described by Pintrich (2000) as an active productive process that enables learners to set certain targets and goals for their learning, as well as they were able to monitor, organize and control their thinking, behavior, and attitudes. This is while being guided and constrained by their targets in the contextual features in the environment. These activities can enhance the relations between learners, the context, and their overall performance.

Based on previous studies, it is premised that self-regulatory activities can trigger self-thoughts, feelings and acts that are planned and adapted systematically in order to achieve personal goals (Boekaerts et al., 2000; Arcoverde et al., 2022). According to Mikroyannidis et al. (2012), it can be concluded that self-regulated learning is a term that describes a student teacher's ability to learn how to learn. Current pedagogical theories encourage teacher mentors to motivate and support their students in achieving a high level of self-regulation in their training (Brenner, 2022; Jang et al., 2016). Hence, teacher preparation programs must set promoting self-regulated learning skills among preservice mathematics and science teachers as one of the objectives to focus on learning processes and progressively attain their academic independence (Arcoverde et al., 2022; Brenner, 2022; Fraihat et al., 2022).

## Literature Review

Self-regulated learning is regarded as one of the most central components of educational reform in developed and developing countries. It is a self-directed and knowledgeable process that enables students to participate in learning by themselves. It facilitates learning through training the independent student teachers (Koosha et al., 2020; Vrieling-Teunter et al., 2021). Self-regulated learning contributes to better training and a greater sense of competence in learning environments. It helps preservice teachers to define their educational goals, supervise and organize their knowledge, motivation, and behavior,

and it can control their educational performance before, during and after training and help them recognize their strengths and weaknesses (Dent & Koenka, 2015; Koosha et al., 2020; Vrieling-Teunter et al., 2021). The use of self-regulated learning empowers preservice teachers to assess their planning, monitoring and their own progression in instructional performances, with an intrinsic motivation to develop a variety of learning practices (Dent & Koenka, 2015; Koosha et al., 2020).

Self-regulated learning skills are crucial to acquiring and developing knowledge. It is a major and important goal in the learning and teaching process to acquire these skills. Specifically, self-regulated learning skills have emerged as one of the cognitive terms to develop the educational process and a focus for research as well as an indispensable benchmark of teaching and learning practices (Habiba et al., 2020; Montalvo & Torres, 2004; Reynolds & Miller, 2003). Self-regulated learning skills are multiple in nature and therefore can motivate learners of all types. Autonomous learners tend to become well-educated and able to perform different tasks such as planning, regulating, and evaluating their cognitive, affective, behavioral, and contextual processes. Self-motivated learners know how to learn and know their potential and weaknesses. Accordingly, they can utilize their knowledge and control the learning processes, and they can adapt it to the purposes and to the context in a way they develop their performance and skills through practice settings (Habiba, et.al, 2020; Gardee & Brodie, 2022; Kilic & Dogan, 2022; Montalvo & Torres, 2004; Vrieling-Teunter et al., 2021).

Although self-regulated learning is considered important in both educational practice and theory as a 21<sup>st</sup> century skill and as a means to motivate students, most teachers find it difficult to integrate self-directed learning into their practice. This is attributed as a weakness in student teacher training as a result of which some training programs are not effective in their application of self-regulated learning skills (Ennab, et al., 2020; Bataineh & Al-Barakat, 2011). Educationists have observed that self-regulated learning requires some important facets and strategies that should be used to train students or preservice teachers. These strategies include observing processes modelled by other teachers, imitating and practicing self-regulated learning behavior, internalizing the teaching strategies independently, recording successful strategies and monitoring progress, and reflecting on the use of strategies and controlling future behavior accordingly. Central to these strategies are facets like student awareness and deliberate engagement with self-regulated learning (Harding, et.al., 2018; Gardee & Brodie, 2022; Kilic & Dogan, 2022).

Promoting self-regulated learning skills among preservice mathematics and science teachers to develop their performance is crucial in developing instructional performance. In this context, social cognitive theory indicates that self-regulated learning skills have three sub-processes: self-observation, self-judgment and self-reaction. Self-observation implies the intentional monitoring of individual's practices which demands the regulation of performance and can trigger higher motivation. Self-judgment states assessing learners' performance levels in comparison with the target level. Self-reaction comprises individual's behavioral, cognitive, and affective responses that lead to self-judgments. It can be motivating to the learners if their beliefs result in more progress towards the target goals (Bandura, 2001; Lawson et al., 2019; Tran et al., 2022).

In current years, teacher training in mathematics and science education is regarded as the greatest significant constituent of active teacher education programs. Several studies have found links between preservice teachers' possession of self-regulated learning skills, and their instructional performance in the classroom (Bataineh et al., 2007; Fraihat et al., 2022; Gitomer et al., 2011; Michalsky & Schechter, 2018a). In addition, many researches have revealed that preservice teachers can learn how to teach using methods that encourage pupils to develop self-regulated learning skills. This emphasizes that there is a very strong correlation between preservice teachers' possession of self-regulated learning skills and their ability to develop self-regulation facets among their pupils in a regulated teaching and learning environment (Dent & Koenka, 2015; Koosha et al., 2020; Pintrich, 2000; Perry et al., 2006; Zimmerman, 2002; Yusuf, 2011).

Teacher education programs around the world seek to raise the practical levels of preservice teachers by promoting the finest and best ways in which preservice teachers can rely on themselves in developing their teaching skills. This process requires a focus on students in order to enable them to build their knowledge and their teaching skills, based on the highest standards of quality teacher preparation (Goldhaber et al., 2017; Goldhaber et al., 2019; John et al., 2018; Michalsky & Schechter, 2018b; Ronfeldt et al., 2018; Suwono et al., 2022; Walsh & Putman, 2021). In this context, Goldhaber et al., (2019) confirm these standards concerning preservice teacher preparation based on their professional needs through mentor teachers, so that they supervise the student teacher to become an acquirer of self-regulated learning skills, which is the starting point for continuous professional development. Vrieling-Teunter's et al., (2021) study revealed the positive effects of preservice teacher training on self-regulated learning skills. It became clear the great role of supervisors in developing student-teacher abilities to practice self-regulated learning skills. Brenner (2022) found that self-regulated learning enhances preservice teachers' abilities to become practitioners of metacognition, motivation, and strategic planning. This will reflect positively on improving the social and professional competencies of trainees.

Alvi & Gillies (2020) have highlighted that teacher mentors must offer preservice mathematics and science teachers with situations that promote their self-regulatory learning activities so that they become reflective, motivated and autonomous learners. In respect of the importance of self-regulated learning, different studies were conducted in various contexts which confirmed the benefit of self-regulated learning in developing the teaching and learning process. Voskamp et al. (2020), for example, carried out a case study to investigate how teachers at four Dutch secondary schools perceived self-directed learning, and how they work on improving it among their students. It was revealed that the teachers' descriptions of self-directed learning varied from students working autonomously, which appeared closer to the concept of self-regulation, to students making judgments about learning aims and content. Besides, it was indicated that the range of the techniques used to improve self-directed learning from having direct instruction and well-regulated learning materials to having students who carried out self-designed projects. Teachers' methods in coping with these differences were also affected by their schools' explanations of self-directed learning.

A set of previous studies (Al-Hassan et al., 2012; Ejubović & Puška, 2019; Michalsky & Schechter, 2018) revealed that preservice teachers become more interested in improving the pedagogical practices through applying self-regulatory strategies. Likewise, a few other studies (Koosha et al., 2020; Vrieling-Teunter et al., 2021) showed substantial correlation between the motivation towards professional development, self-regulation and performance in teaching and learning settings.

To ensure that teacher programs succeed in developing preservice teachers to possess self-regulated learning skills, teacher mentors must use such instruments that encourage self-regulated learning among their preservice teachers. In addition, such training techniques should also be used that could make preservice teachers aware of the right understanding for meaning and practicing self-regulated learning skills. In this context, Mikroyannidis et al. (2012) undertook a survey with educators in the UK and other European countries, concerning their perceptions of self-regulated learning. The findings provided an insight into the challenges involved in teaching students with different self-regulated learning levels, in addition to the way in which the instruments were used by teachers to encourage self-regulated learning among their students.

Damanpreet (2019) examined critical thinking and self-regulated learning skills among professional students of Punjab (India) while considering variables like gender and course experience. Data was collected through a questionnaire carried out on a sample of 200 preservice teachers. The results showed no statistically significant difference due to the presence of gender factor in critical thinking and self-regulation of preservice teachers. It was also revealed that preservice teachers with either a low or a high level of course experience showed no significantly higher levels of thinking, such as critical thinking and self-regulation. In contrast, it was revealed that preservice teachers proved a moderate level of critical thinking that was above the average level of self-regulation. The study recommended that higher-order thinking skills among professional students need to be investigated widely to reveal its causation and enhancement.

Other studies have showed that enhancing preservice teachers' possession of self-regulated learning skills will prepare generations of mathematics and science teachers who are self-reflective, metacognitive, strategic and self-regulating (Arcoverde, et al., 2022; Vosniadou et al., 2021). This underlines that preservice mathematics and science teachers must not only master specific theoretical knowledge, but also acquire the methods and approaches in which they can help their students to be responsible for their own learning (Arcoverde et al., 2022).

A review of previous studies reveals that there are points of agreement between the current study and previous studies, in terms of emphasizing that the development of self-regulated learning skills is directly linked to teachers' practices and classroom performance. In other words, owing to being consistent, the current study has benefited from the previous studies in enriching its theoretical framework, preparing the instruments of the study, and discussing and interpreting the results. The current study also differs from previous studies in many other aspects like its objectives, sample size, research locale and time duration. The national trends in the United Arab Emirates are much different from other locales, culturally and linguistically, so it is much more challenging to train preservice mathematics and science teachers to acquire self-learning skills until these skills

become an integral part of their classroom practice. Despite the efforts made to achieve this goal, there is still a gap between theory and practice. The current study aimed to fill this gap, as it addressed the lack of knowledge and awareness about self-regulated learning among the preservice mathematics and science teachers in the Emirati environment, represented by the Emirate of Sharjah.

### **Problem statement and Study rationale**

Possessing self-regulated learning skills is regarded as a supportive and helpful tool for preservice mathematics and science teachers; it is the evidence that a teacher is effective, and his/her professional performance ideally suits teaching and learning settings. In addition, when preservice mathematics and science teachers become more self-regulated with their professional development, their motivation grows manifold and they can potentially make a more positive effect on their pupils. Numerous studies (Boer et al., 2013; Tashtoush et.al., 2020; Fraihat et al., 2022) have reported that teacher preparation programs should develop the self-regulated learning strategies to the preservice mathematics and science teachers through which they can self-regulate their learning in order to improve their enthusiasm.

Sharjah university is one of those centers where there prevails a high level of desire for development and change in among the preservice mathematics and science teachers. One of the goals of the teachers training program at Sharjah University is to equip preservice mathematics and science teachers to acquire self-regulated learning to be effective teachers rather than passive teachers during their field experience. Developing self-regulated learning skills is therefore a good opportunity for preservice teachers during the course of field experience. Such skills are essential to be a part of their learning practices in classrooms, where they can act as a role model for their pupils and inspire them to be effective learners. It could prove to be a useful method for the preservice teacher trainees at Sharjah university to increase their motivation levels in teachers training program.

This study thus aimed at finding out the extent to which the preservice mathematics and science teachers can develop their self-regulated learning skills during the course of field experience. It also aimed at making them aware about self-regulated learning skills by including relevant activities into their teaching process. In short, the main objective of this study was to investigate the degree of preservice mathematics and science teachers' possession of self-regulated learning skills during their field experience. To achieve this, the following two questions were discussed:

1. What extent do preservice mathematics and science teachers possess the self-regulated learning skills during their field experience?
2. Does academic rank influence preservice mathematics and science teachers' possession of the self-regulated learning skills during their field experience?

This study would prove significant to preservice mathematics and science teachers as it would make them aware of their strengths and improve their self-regulated learning skills during field experience. Moreover, this study would also address the issue of low teaching and learning practices that obstruct greatly their preparation and possession of self-regulated learning.



## Methodology of the study

- *Population and sample*

The population of this study comprised 100 preservice mathematics and science teachers, who had joined the practicum program (field experience) in their final semester of the undergraduate program in mathematics and science education at the Department of Education at University of Sharjah, United Arab Emirates during the first semester of 2021/2022. A random sample of 70 preservice mathematics and science teachers was chosen from the population. This sample technique gave everyone in the population a chance to be member of the study sample. In this context, educationists (Bryman & Bell, 2018; Cohen et al., 2020, Oliver, 2016) underlined that if the characteristics of the sample accorded with the characteristics of the population, the sample would be representative and the researcher would be able to avoid any bias.

- *Instrument of the study*

A questionnaire based on the comprehensive review of the previous literature was developed as the data collection tool. A pilot survey with a sample of 25 preservice mathematics and science teachers was made to find out whether or not they had any particular self-regulated learning skills required for the professional preparation of their field experience. The questionnaire was checked for validity by a panel of seven professors in the disciplines of teacher education, teaching methods, psychology and measurement and evaluation. Based on the revision and expert comments, a few amendments were made in the questionnaire such as deleting some items and a slight modification in the wording and sequencing of items. Initially, the questionnaire which comprised 42 items was reduced to 40 items after the validity test. Each item was measured on a five-point Likert scale, when participants were requested to rate items on a 1-to-5 response scale where 1= never, 2= seldom, 3= sometimes, 4= often, and 5= always.

To guarantee the reliability of the instrument, Cronbach alpha coefficient was used to measure the internal consistency of the questionnaire, which was established at 0.89, which was appropriate for the purpose of this research. Furthermore, the reliability of the questionnaire was established using the test-retest technique on a random sample of 26 preservice mathematics and science teachers with an intervening period of two weeks between the test and retest. Pearson correlation coefficient of the instrument was measured at 0.93

- *Data collection and analysis*

Using all preservice mathematics and science teachers as a sample, a total of 70 copies of the questionnaire were distributed to preservice mathematics and science teachers participating in the Teacher Preparation Program at the Department of Education at the University of Sharjah in the first semester of the 2021/2022 school year. All 70 questionnaires (100%) were returned for data analysis. To analyze data, arithmetic means, and standard deviations were calculated for each item and each field of the questionnaire. All means were then ranked in descending order from highest to lowest to identify the skills valued most. In addition, t-test was used to determine if there were any statistically significant differences which could be attributed to the variable of academic rank of the respondents of the study.

### Findings

The findings of the study are presented with respect to each question of the study. The first research question stated: What extent do preservice mathematics and science teachers possess the self-regulated learning skills during their field experience?

To answer this question, Means and Standard Deviations were calculated of each item separately for each of the five fields of the questionnaire, namely (1) Awareness of professional development planning; (2) Professional development strategies; (3) Carrying out professional development activities; (4) Persistence to learn through professional development programs; (5) Self-assessment of professional development

Table 1 presents the results of the first field of "Awareness of professional development planning." This field included nine items related to preservice mathematics and science teachers' possession of self-regulated learning skills in the domain of awareness of professional development planning.

**Table 1**

*Mean and SD in the domain of awareness of professional development planning*

No.	Items	Mean	Standard deviation
1	I design my plans in light of my personal philosophy of professional development.	4.82	0.945
2	I set my goals in light of my vision of what is new.	4.70	1.055
3	I do my reflective journals based on my future visions to improve the quality of my professional performance.	4.33	1.124
4	I make a list of the goals that I seek to achieve in the field of my professional development.	4.21	0.787
5	I put in my plans my primary priorities that achieve my vision and mission as an educator.	4.21	0.787
6	I understand all the improvement points that need to be planned.	4.15	0.784
7	I do reflective journals to get my work done.	4.14	0.756
8	I do my best to make plans capable of achieving my own goals.	4.14	0.891
9	I put keywords in my layout processes so I can remember them.	4.07	0.858
<b>Total</b>		<b>4.30</b>	<b>0.887</b>

It is evident from Table 1 that the total average of the items in the field of awareness of professional development planning recorded a high average of 4.30. With regard to each item of the field, it was found that all the means averaged between 4.82 and 4.07. This confirms that the preservice mathematics and science teachers had a high level of awareness of professional development planning skills. For example, item No. 1 recorded a high average of 4.82. This gives empirical evidence that the preservice mathematics and science teachers had an excellent performance in possessing the ability to practice self-regulated learning regarding the design of various plans in light of their personal



philosophy of professional development. Moreover, item number 2 scored the second rank with a mean of 4.39. This also reflects that the preservice mathematics and science teachers had another distinction related to the presence of ability to set their goals based on their vision of what is new. With regard to the rest of the items, it is clear that these items (3-9) had scored high mean ranging between 4.33 and 4.07. This provides strong evidence that preservice mathematics and science teachers had high abilities in self-regulated learning skills, especially since all of these items are distributed within the degree of excellence, being more than the prescribed average 4.00.

Table 2 presents the results of the second field of professional development strategies. This field includes seven items related to preservice mathematics and science teachers' possession of self-regulated learning skills in the domain of professional development strategies.

**Table 2**

*Mean and SD in the domain of professional development strategies*

No.	Items	Mean	Standard deviation
1	I strive to motivate myself to search for sources to develop my professional performance.	4.29	0.659
2	I find that self-learning strategies help to develop my professional performance.	4.23	1.016
3	I feel that I am able to identify appropriate self-learning strategies for my professional development.	4.20	0.793
4	I am looking for answers to questions related to improving my professional performance through my colleagues.	4.18	0.772
5	I raise a set of questions for tasks that I find difficult.	4.11	0.737
6	I gather information for my professional development from a variety of sources.	4.11	0.737
7	I use IT-based self-learning strategies.	4.03	0.900
<b>Total</b>		<b>4.16</b>	<b>0.802</b>

The results presented in Table 2 reveal that the overall average for all items in this field was 4.16. With regard to the arithmetic averages of each item separately, it is noted that all the items recorded arithmetic averages higher than 4.00, which ranged between 4.29 and 4.03. For instance, item No. 1 recorded the highest arithmetic average of 4.29. This confirms that preservice mathematics and science teachers had high skills that pushed them to motivate themselves to search for sources to develop their professional performance.

Table 3 presents the results of the third field of carrying out professional development activities. This field contains eight items related to preservice mathematics and science teachers' possession of self-regulated learning skills in the domain of carrying out professional development activities.

**Table 3**

*Mean and SD in the domain of carrying out professional development activities*

No.	Items	Mean	Standard deviation
1	I feel pleasure when I start achieving my goals.	4.71	.460
2	My motivation increases when carrying out professional development activities.	4.39	.685
3	I pay attention to getting feedback when carrying out professional development tasks.	4.36	.678
4	I conduct a self-review when carrying out professional development activities.	4.30	.669
5	I link the theoretical side with the practical during the implementation of professional development programs.	4.18	.612
6	I consult specialists about any problem that I encounter during the implementation of professional development tasks.	4.18	.905
7	I employ reflective thinking skills when carrying out professional development tasks.	4.03	.900
8	I feel highly capable of employing all professional development strategies.	4.02	.900
<b>Total</b>		<b>4.27</b>	<b>.726</b>

Table 3 shows that the total mean of this field scored 4.27, and that items number 1, 2, 3 and 4 topped the list of skills, with means of 4.71, 4.39, 4.36 and 4.30, respectively. This confirms that preservice mathematics and science teachers felt happy and highly motivated when carrying out professional development tasks, so even though they were involved in the self-review of their performance, they needed feedback from their coaches. With regard to the rest of the items, they achieved means ranging between 4.18 and 4.03. This result reflects outstanding performance in the possession of students' learning skills.

Table 4 presents the results of the fourth field of persistence to learn through professional development programs. This section covered six items related to preservice mathematics and science teachers possession of self-regulated learning skills in the domain of persistence to learn through professional development programs.

**Table 4**

*Mean and SD in the domain of persistence to learn through professional development programs*

No.	Items	Mean	Standard deviation
1	I give attention to help my colleagues who need it.	4.59	.694
2	I break down tasks when I find it difficult to perform them.	4.44	.698
3	I collaborate with my colleagues on tasks related to the development of professional performance.	4.42	.703
4	I make sure to ask others for help if I find myself in need.	4.41	.501
5	I keep attending all the workshops and training courses required of me.	4.37	.967
6	I give attention to follow the workshops and courses so as not to miss anything.	4.36	.907
<b>Total</b>		<b>4.43</b>	<b>.745</b>

Table 4 shows that the overall average for this field was 4.43, which is the highest compared to others. With regard to the means related to the items of this field, it can be said that all the items recorded the highest averages, which ranged between 4.59 and 4.36. This confirms the manifestations of high distinction among preservice mathematics and science teachers with regard to their possession of self-regulated learning skills. This finding provides evidence of a persistent love among preservice mathematics and science teachers to learn through professional development programs.

Table 5 presents the results of the fifth field of self-assessment of professional development. This field consists of ten items related to preservice mathematics and science teachers possession of self-regulated learning skills in the domain of self-assessment of professional development.

Table 5 shows that the overall average for all items was 4.03. Moreover, the averages for all items ranged from 4.39 to 4.02. This confirms that preservice mathematics and science teachers possessed self-regulated learning skills especially in the items that achieved the highest ranks; the first and second rank recorded an average of 4.39 and 4.37 respectively. This result confirms that preservice mathematics and science teachers looked for their mistakes in the field of professional development and were able to direct themselves to develop professionally.

**Table 5**

*Mean and SD in the domain of self-assessment of professional development*

No.	Items	Mean	Standard deviation
1	I look for areas of goals that have not been highly successful.	4.39	0.580
2	I monitor myself when doing professional development tasks.	4.37	0.688
3	I look for any mistakes I have made.	4.26	0.656
4	I review all self-development activities.	4.25	0.928
5	I accept any constructive criticism directed at me.	4.19	0.921
6	I constantly review my goals.	4.15	0.907
7	I see that achieving a goal considers an incentive to do more.	4.11	0.875
8	I review my performance regularly.	4.07	0.979
9	I prepare activities that challenge my thinking.	4.04	0.838
10	I do a self-assessment of all my activities.	4.02	1.177
<b>Total</b>		<b>4.18</b>	<b>0.854</b>

The second research question of the study stated: Does academic rank influence preservice mathematics and science teachers' possession of the self-regulated learning skills during their field experience?

To answer this question, a t- test was used. Table 6 presents the descriptive statistics representing the effect of academic rank on preservice mathematics and science teachers' possession of the self-regulated learning skills during their field experience.

**Table 6**

*t-test results for the effect of academic rank on preservice mathematics and science teachers' possession of the self-regulated learning skills during their field experience*

Fields	Academic rank*	Frequency (n=70)	Mean	Standard Deviation	t- value	Significance
Awareness of professional development planning	Excellent	36	4.38	0.90	1.025	0.857
	Very good	34	4.33	0.89		
Professional development strategies	Excellent	36	4.24	1.09	1.020	0.632
	Very good	34	4.26	0.97		
Carrying out professional development activities	Excellent	36	4.29	1.07	0.993	0.847
	Very good	34	4.33	0.98		
Persistence to learn through professional development	Excellent	36	4.17	1.02	0.956	0.100
	Very good	34	4.40	0.99		
Professional development self-assessment	Excellent	36	3.81	0.69	0.603	0.547
	Very good	34	3.75	0.67		
The questionnaire as a whole	Excellent	36	3.76	0.90	0.598	0.614
	Very good	34	3.58	0.83		

\* All respondents of the study sample were distributed on two levels, Excellent and Very Good, because the required level of mastery must be higher than the degree of Good

It is evident from Table 6, that the t-value for the domains and at the total level of the questionnaire were not significant at the level ( $\alpha = 0.05$ ), because the significance (t-value) for all domains, and at the total level is higher than 0.05. This result means that there are no statistically significant differences due to the influence of academic rank on preservice mathematics and science teachers' possession of the self-regulated learning skills during their professional development.

### Discussion

The results of the study revealed that the preservice mathematics and science teachers' self-learning skills recorded very high averages, above the 4.00 level for all questionnaire fields. This result can be attributed to the intensive professional development in the Department of Education, University of Sharjah. In addition, preservice mathematics and science teachers were found to have a great desire to develop self-learning skills; they enthusiastically participated in professional development programs to become effective teachers and achieve the highest levels of educational excellence in professional performance.

More specifically, the results of the study also showed a few distinct features in the professional performance of preservice mathematics and science teachers in terms of constructive awareness in professional development planning with their self-regulated learning skills. One feature was that they planned their structural development through their critical and crucial awareness of professional needs; second, their professional needs were based on the existence of a personal philosophy and a specific vision for their professional development. This was evidenced by their ability to write reflective journals, and to be aware of everything new in the field of professional development. This finding is in line with previous studies (Koosha et al., 2020; Vrieling-Teunter et al., 2021) in the framework of the initial training of preservice teachers. This gives a clear indication of the crucial role of gradual transition from teacher control to student control.

The results of the study also revealed that the preservice mathematics and science teachers possess self-regulated learning skills in terms of professional development strategies, as it became clear that they did their best to practice various professional development strategies to answer all their questions and inquiries. This aligns with what was discussed by educational researchers (Lawson et al., 2019; Michalsky, 2020; Michalsky & Schechter, 2013; Michalsky & Schechter, 2018a; Panadero, 2017; Porter & Peters-Burton, 2021; Tran et al., 2022) regarding the critical and effective role of self-regulated learning skills in improving the instructional performance of preservice mathematics and science teachers.

The study also revealed that self-regulated learning skills were not limited to the students' possession of professional development strategies, but rather preservice mathematics and science teachers had a high ability to implement various professional development activities with great motivation and desire and employ reflective thinking skills and write reflective journals for developing their professional performance (Al-Hassan et al., 2012; Jarvis & Baloyi, 2020).

One of the most prominent features discovered in this study of the preservice mathematics and science teachers was the possession of self-regulated learning skills through their perseverance to follow-up professional development programs. They made efforts to attend various practical workshops and help each other through the use of strategies for dividing professional questions into parts and cooperation in solving them.

In addition to the above, it is worth pointing out that preservice mathematics and science teachers possessed self-regulated learning skills through their use of various forms of self-assessment, which provided them the opportunity to learn from their mistakes and accept feedback and constructive criticism, especially as they looked for mistakes to learn from and correct them in order to reach the highest levels of professional performance.

These findings align with those of Alqasa & Afaneh (2022) and Betti et al. (2022), who found that students can be happier in an active learning environment. This gives a clear picture of the miscellaneous behaviors in which preservice mathematics and science teachers work on the development of their self-regulated learning abilities. It also suggests how they met their professional needs. It appears that preservice mathematics and science teachers had a continuum in the extent to which they influenced and had responsibility for developing their professional education.

These results reveal that preservice mathematics and science teachers were well prepared to possess self-regulated learning skills. They could build a solid practical background as future teachers and become innovators, educators, researchers, and leaders who can help their pupils to think and reflect extensively and solve the most confronting challenges being faced by the teaching and learning process. These findings are in line with previous studies that revealed the role and importance of practicing and owning self-learning skills to be an integral part of preparing teachers (Boer et al., 2013; Tashtoush et al., 2020).

These findings are in line with the previous studies (Lawson et al., 2019; Michalsky & Schechter, 2018a; Michalsky & Schechter, 2018b; Perry et al., 2006; Tan et al. 2022) which underlined that preservice mathematics and science teachers' possession of self-regulated learning skills was the key constituent of teacher education programs. Due to having self-regulated learning skills enabled them to train their pupils to remain active in their learning. This can be developed when preservice mathematics and science teachers used higher levels to think about what they were learning, understand the facts, infer them, and apply them in real-life settings, and to look for new explanations to different issues at hand.

The domain of teacher education can meet preservice mathematics and science teachers' professional needs only by taking into consideration a self-regulated learning skills approach. Such an approach would enable preservice teachers to think from different standpoints, triangulate them all, and succeed in thinking to a whole new level than restating the facts. This underlines that preservice mathematics and science teachers' possession of self-regulated learning skills will contribute in their preparation to think creatively, critically, reflectively, and draw out various decisions related to students' learning and enable them to become practitioners of higher-level thinking skills.

### **Conclusions, recommendations and limitations**

The main objective of this study was not to state how preservice mathematics and science teachers approach self-regulated learning skills, but to get insight into how these self-regulated learning skills may be interpreted and combined in educational professional development programs, to generate ideas for instructional practices that could improve and assist self-regulated learning skills. This research study exhibits a varied picture of explanations and working methods for developing professional development. The results of the study explicitly show how to promote and support self-regulatory learning in preservice teachers, and set benchmarks for other preservice teachers.

The study has a few recommendations. First, it is necessary to continue holding professional development programs and enhance the growth of self-regulated learning skills in future teachers. Second, research efforts should be directed to investigate the effect of self-regulated learning in developing metacognitive skills and constructivist learning practices among preservice mathematics and science teachers at the University of Sharjah in the United Arab Emirates. Third, it is necessary to integrate self-regulated learning skills in professional development programs with attention to employing self-regulated learning in professional preparation programs. Fourth, research efforts should be directed to conduct further research studies to investigate the impact of self-regulated learning in developing metacognitive skills and constructivist learning practices among preservice mathematics and science teachers at the University of Sharjah in the United Arab Emirates.

There are a few limitations of this study that open the way for future studies. First, the data of the study was limited to only one Emirati University, which prevents the generalization of these findings in wider perspective. Second, the study focused on a very small population and sample size. Future research should expand the target population to include the majority of teacher preparation programs in the UAE to generalize the findings more widely. Third, the data collection was limited only to one questionnaire making it a quantitative study. This also prevented a deeper understanding of the studied phenomenon in qualitative terms. Future research should focus on other data collection methods such as in-depth interviews and focus groups in order to deepen the understanding of preservice teachers' practices of self-regulated learning skills.

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