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Requirements for managing differentiated classrooms among Jordanian science teachers

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ABSTRACT

Differentiated instruction (DI) is characterized by the fact that it achieves most educational goals and it is role in deepening the values of justice, equity, and a democratic climate in the learning environment. However, this approach requires highly skilled and qualified teachers, especially science teachers, due to the complexity of science learning tasks and environments. The current study aimed to examine the degree to which science teachers in Jordan possess the requirements of differentiated classroom management, and the extent to which they are affected by variables (gender and professional experience). The study sample consisted of 379 science teachers. A differentiated classroom management scale (DCMS) was prepared to achieve the study's objective, consisting of 38 items with three domains: instruction management, classroom environment management, and managing feelings and emotions in the differentiated classroom. The results of the study showed that the degree to which science teachers in Jordan possess the requirements for differentiated classroom management is moderate. At the same time, there are differences in this degree in favor of the female parameters. However, professional experience did not affect this degree of tenure. The study recommended holding training programs for science teachers in differentiated classroom management and reviewing teacher training programs in Jordan.

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1. INTRODUCTION

The differentiated instruction (DI) approach achieves many educational objectives [1] and its efficacy in improving students' academic achievement has been proven [2], [3]. It further stimulates their motives, abilities, and responses to individual differences among them [4]. It is considered one of the most unbiased and fair instruction approaches in the classroom [5]–[8]. However, according to this approach, the teacher needs high skills in planning for instruction [9]. Managing a differentiated classroom requires capabilities, skills, and broad experience [10], [11]. If the teacher wants to employ a DI approach, s/he needs to prepare many tools to measure students' abilities, interests, aptitudes, tendencies, and learning patterns, in addition to finding appropriate methods and tools to develop a profound knowledge of students. When using the differentiation approach to teach, the teacher needs to know how to change the content, how to teach, and how to test students in a way that works for the school setting [12] and fits the needs of each student [13].

Therefore, teachers face difficulty in managing the classroom according to this instruction approach [14], [15]. DI may have greater chances of success if it is applied in science instruction since science is the

subject of nature, life, the universe, and related concepts [16]. The concepts of science vary; they may be concrete or abstract, concepts, as well as simple and complex concepts. Instruction science needs many and varied strategies [17]; it is implemented in different environments such as the classroom, laboratory, garden, museum, and facilities in the community surrounding the teacher such as forests, seas, factories, and astronomical observatories. Thus, the skills that a science teacher needs to implement DI become more complex, despite the wide range of options and alternatives that achieve the success of DI [18]. This requires training and qualifying science teachers to obtain sufficient experience in identifying students' abilities and aptitudes [19], and students' inclinations and learning styles. Science teachers further need to be familiar with all instruction and assessment strategies and multiple intelligences. They further should enrich their experience related to group management mechanisms, diversified content and processes [20], managing the learning environment, and integrating technology in education activities.

Several studies have shown the effectiveness of science education using the DI method, which had a clear impact on the academic achievement of students and their involvement in learning activities [21]–[23]. Mursi [24] indicated the positive impact of DI on the attitudes of the first basic-stage students in the Kingdom of Saudi Arabia toward learning science. Similarly, the same findings were confirmed by Al-Shograan [25] in a study on Jordan students in the basic stage that showed the effect of DI on the acquisition of scientific concepts and science processes, in addition to its impact on the attitude toward learning science.

2. LITERATURE REVIEW

To achieve differentiation in instruction, the science teacher must establish a link between the fundamental curriculum areas and the DI elements [1], [26]. Thus, the science teacher differentiates not only the content that includes concepts, scientific principles, facts, ideas, skills, and generalizations that the student should learn in the science curriculum [27], but also the methods of providing content in proportion to the student's abilities and different needs [28], [29]. In addition, the teacher determines the time required to present the content, taking into account the different learning speeds of students, which are among the success factors for differentiating the content.

Science teachers could furthermore differentiate the procedures, processes, and activities by which content is presented during instruction [30]. Science instruction is characterized by the possibility of using a wide range of activities and procedures. The science teacher, hence, designs educational activities that interest students, suit their needs, and require them to have higher levels of thinking according to their learning styles. Students' learning styles include practical investigative activities such as observation, classification, experimentation, and the use of numbers, graphs, and maps. Thus, the science teacher guides students to carry out field activities such as collecting samples of plant leaves, rocks, and insects [31].

The third element in the instruction process, the outcome students achieve under their teacher's guidance, achieves differentiation. This outcome is attained after assigning various tasks to students and giving them the chance to select the suitable task, which would result in various learning outcomes of different levels [32]. This could include producing models that mimic nature and life phenomena, creating experiments, writing scientific reports, and displaying data. The outcome could be differentiated by using technology such as sound recording, the Paint program, searching on the internet, or multiple computer programs.

To achieve the goals of DI, a positive classroom climate full of love, friendliness, and cooperation must be established. Further, the teacher accepts and develops students' abilities. Teacher should understand that each individual is a different case from others, with their interests, inclinations, and preparations. Therefore, most learning tasks are carried out in cooperative and flexible groups formed according to clear standards that serve the student's progress in academic achievement and the development of abilities.

The successful management of the differentiated classroom requires the science teacher to prepare tools to identify the students' abilities, readiness, learning styles, tendencies, and needs. It also requires the design of learning tasks and activities in cooperation with the people involved in the science lab, museum, garden, and multimedia room, as well as stakeholders in the community surrounding the teacher [33]. In science instruction, a set of tasks and activities are carried out to study natural phenomena in space, environment, soil, water, seas, forests, and natural changes. They are also interested in observing and studying the changes to which humans are exposed, such as growth, disease, and disaster, as well as the impact of technology on humans and nature. In addition, they implement scientific experiments in the laboratory or directly in the environment and prepare scientific reports supported by pictures, videos, figures, and graphs [34].

Science teacher faces many difficulties in implementing DI [13] and this makes them in constant need of training and qualifying to continue implementing the changes that help in this field. To succeed in managing the differentiated class, a teacher needs continuous support from all elements and parties of the educational process [35]. In Jordan, the adoption of modern trends in instruction deepens with time. Because Jordanian students are doing worse on international science tests, teachers are under a lot of pressure to use teaching methods and strategies that care for the student, focus on their needs and tendencies, and their main

roles in the classroom, while also taking into account how each student is different [36]. On top of these approaches is the introduction to DI, which creates an exciting, fair, and equitable learning environment that takes into account individual differences among students, it develops their abilities and skills and enhances their creativity. This instruction approach which requires skills in planning for instruction, designing scientific material, tests and measures, and managing the instruction environment opens the door to a significant question, which is the extent to which science teachers in Jordan possess the requirements for managing a differentiated science class.

Jordan is one of the countries where the gender gap in education appears most [37]. Thus, this study sought to identify the impact of the gender of the science teacher in possessing differentiated classroom management requirements. Previous studies have always indicated the impact of teachers' professional experience on their instruction performance and skills inside the classroom [38], which prompted the researchers in this study to focus on examining the impact of the professional experience of science teachers in Jordan on the degree of their possession of differentiated classroom requirements.

3. METHOD

In planning for the development of education and achieving educational goals, it is necessary to know all the factors that affect this trend, foremost of which is the teacher, who is the person who implements ideas and directions within this system. Recognizing the philosophy and beliefs adopted by the teacher may be the first step in planning for success in achieving the goals of education. Instruction science is most related to engineering and technology, and to keep pace with the deepening of the use of DI in education in Jordan, especially in instruction science in differentiated classrooms. As a result, this study will identify the estimates of science teachers in Jordan, the degree to which they meet the requirements of differentiated classroom management, and the extent to which they are affected by certain variables. Hence, the following objectives are posed in the form of questions:

i) What is the degree to which science teachers in Jordan possess the requirements of differentiated classroom management?
ii) Does the degree to which science teachers in Jordan possess the requirements of differentiated classroom management vary according to their gender?
iii) Does the degree to which science teachers in Jordan possess the requirements of differentiated classroom management vary according to their professional experience?

The current study seeks to measure the degree to which science teachers in Jordan possess the requirements of a differentiated classroom and the extent to which this degree is affected by the variables of gender and the professional experiences of science teachers. Table 1 shows the selection of a sample of 379 male and female science teachers from various regions of Jordan using a cluster sampling method. Researchers prepared the scale (differentiated classroom management) based on their understanding of the characteristics of DI, theoretical literature, and previous studies. The measuring scale consisted of 39 items divided into three domains: instruction management, classroom environment management, and managing feelings and emotions in the differentiated class. To ensure the measuring scale's validity and reliability, it was arbitrated by group of specialized arbitrators who suggested certain amendments, which were modified in light of their observations. A pilot sample consisting of 30 male and female science teachers in Jordan was selected and exposed to the differentiated classroom management requirements measuring scale twice with a time difference of two months, and the reliability coefficient was calculated between the two application times and it is value was appropriate.

Table 1. Demographic characteristics of respondents

Gender	Professional experience/year				
	1-5	5-10	10-15	15 and above	Total
Male	18	28	33	26	105
Female	50	58	76	90	274
Total	68	86	109	116	379

4. RESULTS AND DISCUSSION

4.1. Differentiated classroom management requirements

The study's results and first question were found by finding the means and standard deviations of how much science teachers think they meet the three types of differentiated classroom management requirements. The results are shown in sub-section.

4.1.1. Requirements for managing instruction in the differentiated classroom

Table 2 shows the means, standard deviations, and degrees of estimates of science teachers for possessing differentiated classroom management requirements in the domain of instruction. The table reveals that science teachers in Jordan have a moderate level of proficiency in differentiated classroom management, with a mean score of (3.34). Furthermore, it shows that most of the items in this domain were moderate, expect for items (2, 10, and 14), which indicated that teachers help students learn according to their abilities and that they use a variety of instructional strategies to provide their students with learning content in a variety of forms and styles. This is due to the beliefs of teachers that DI skills are not easy to possess and apply in the classroom [35]. Moreover, the degrees of their estimates for the level of their skills and knowledge in this type of instructional strategy are due to the teachers' confidence in their abilities. At the same time, teachers realize their need for training and qualification in this field to master the practice of DI in science classes [10].

Table 2. Science teachers' estimates of requirements for managing instruction in the differentiated classroom

S. No.	Instruction management	Mean	Standard deviation	Degree
1	I set learning objectives that include a challenge for the students.	3.66	0.601	Moderate
2	I work to involve each student in learning according to his ability.	3.85	0.414	High
3	I carry out tests to identify the talents and interests of students.	2.75	0.532	Moderate
4	I carry out tests to identify the students' learning styles.	3.25	0.925	Moderate
5	I distribute the students into small groups according to various criteria (interests-preparations–tendencies).	2.83	0.427	Moderate
6	I carry out tests to identify the abilities of the students.	3.59	0.645	Moderate
7	I design learning activities according to the strategy of multiple intelligences.	2.87	0.382	Moderate
8	I distribute the students into small groups to solve real-life mathematical applications.	2.88	0.376	Moderate
9	I use descriptive assessment to find out the needs of the students.	3.38	0.751	Moderate
10	I vary the instruction methods (lecture-dialogue and discussion-investigation-project).	3.84	0.461	High
11	I use technology in the instruction process.	2.94	0.240	Moderate
12	I design learning tasks that fit the characteristics of all students.	2.96	0.202	Moderate
13	I ask the students to design different learning outcomes (writings-drawings-shapes-pictures-videos-models-experiments).	3.65	0.594	Moderate
14	I offer educational content in a variety of forms and styles.	3.80	0.488	High
15	I provide different alternatives for learning activities (laboratory-scientific visits-projects).	2.90	0.346	Moderate
16	I vary the forms and nature of the homework.	3.70	0.558	Moderate
17	I relate the learning activities to the students' lives.	3.88	0.402	Moderate
	Total	3.34	0.266	Moderate

4.1.2. Requirements for managing a differentiated classroom environment

To determine the extent to which science teachers in Jordan can manage the learning environment in the differentiated classroom, the averages of their estimates of this ability were calculated in Table 3. The table clearly demonstrates that science teachers' assessments of their ability to manage differentiated science classroom environments were average, with a mean score of 3.27, which is consistent with most items in this domain. However, items (1, 2, and 7) were of a high degree, indicating the science teacher's ability to help organize and adjust a flexible and safe learning environment that stimulates learning in differentiated classroom. This is because science teachers believe that this matter is easy to implement [39], while they indicated in item 9 their weak abilities to provide students with clear guidelines to help them know how to make appropriate decisions. In several studies, teachers have indicated poor skills in planning for DI [40].

4.1.3. Requirements for managing students' feelings and emotions in the differentiated classroom

In this item, arithmetic averages were calculated for the study members' estimates of their ability to manage students' emotions in the differentiated classroom and they are shown in Table 4. In contrast to the first and second domains, the estimates of science teachers of the degree to which they possess the requirements of managing students' feelings and emotions were high, with a mean of 3.81. This is because of the teachers' belief that managing feelings and emotions and creating a positive atmosphere, freedom, love, and respect in the classroom is easier to achieve than achieving instruction requirements and managing the classroom environment. This result is consistent with the study of Buczynski and Hansen [38].

Table 5 shows the Jordanian science teachers' estimates of the degree to which they possess the requirements of differentiated classroom management in all domains. Overall, a mean of 3.46 indicates that science teachers in Jordan have a moderate level of proficiency in differentiated classroom management. This means that training programs must be held for science teachers in Jordan to improve their readiness to implement DI and manage the differentiated classroom. These skills are, in return, of great benefit to teachers

and their students in achieving the goals of effective instruction, as DI is a holistic approach. There is an increased call from various countries around the world to adopt it in instruction as it achieves academic effectiveness and balances all areas of cognitive, skill, and emotional learning [29].

Table 3. Science teachers' estimates of requirements for managing a differentiated classroom environment

S. No.	Classroom environment management	Mean	Standard deviation	Degree
1	I organize a flexible learning environment that stimulates learning.	3.84	0.435	High
2	I make sure to create a safe learning environment.	3.91	0.361	High
3	I make sure to provide an attractive environment that lessens boredom and estrangement.	3.89	0.381	High
4	I am keen to provide multiple learning resources and tools (papers-pens-colors-models-maps and pictures-equipment-books, and references).	2.98	0.153	Moderate
5	I allow students to bring a variety of learning materials and resources into the classroom.	2.94	0.261	Moderate
6	I provide the requirements for creativity and innovation in the learning environment.	2.91	0.305	Moderate
7	I vary the types of learning environments (classrooms-laboratories-workshops-gardens-outdoor environments).	3.73	0.530	High
8	I involve students in managing the learning environment and providing responsible freedom.	2.93	0.273	Moderate
9	I provide clear guidelines for students to help them know how to make appropriate decisions.	2.66	0.558	Low
10	I involve the local community in some class activities.	2.96	0.203	Moderate
	Total	3.27	0.214	Moderate

Table 4. Science teachers' estimates of requirements for managing students' emotions in the DC

S. No.	Managing feelings and emotions	Mean	Standard deviation	Degree
1	I make sure to gain the students' trust from the first moment I meet them.	3.91	0.381	Moderate
2	I offer multiple support and reinforcement to the students and make it possible for everyone to succeed.	3.89	0.378	High
3	I always have high expectations of students.	3.79	0.472	High
4	I accept students as they are and provide them with opportunities to be involved in learning tasks.	3.88	0.392	High
5	I understand the circumstances of the students and their characteristics.	3.91	0.335	High
6	I satisfy students' tendencies and enhance their motivation.	2.96	0.144	Moderate
7	I appreciate the students' performance consistently.	3.91	0.102	High
8	I accept the differences between students.	2.92	0.313	Moderate
9	I support the autonomy of students, and allow self-evaluation.	3.86	0.407	High
10	I treat students with love and mutual respect.	3.93	0.306	High
11	I am keen to appreciate students' feelings and solve their emotional problems.	3.92	0.362	High
	Total	3.81	0.262	High

Table 5. Science teachers' estimates of the requirements for possessing differentiated classroom management

Differentiated classroom management	Mean	Standard deviation	Degree
Instruction management	3.34	0.266	Moderate
Classroom environment management	3.27	0.214	Moderate
Managing feelings and emotions	3.81	0.262	High
Total	3.46	0.228	Moderate

4.2. The effect of the gender variable on science teachers' possession of differentiated classroom management skills

To identify the impact of teachers' gender on the variation in their possession of differentiated classroom management requirements, the means and standard deviations of their estimates were calculated according to the gender variable as shown in Table 6. The table shows that there are minor differences between the average estimates of science teachers to the degree of their possession of differentiated classroom management requirements and in favor of females. To identify the significance of these differences, a t-test was used for the differences between the independent groups, as shown in Table 7.

Table 7 indicates that the differences between the average estimates of the teachers' possession of differentiated classroom management requirements were statistically significant and in favor of females. This result is almost consistent with the reality of female teachers' efficiency and performance in Jordan compared to male teachers. There are several reasons why female teachers have characteristics consistent with instruction effectiveness. Other reasons include the higher degree of job satisfaction and self-realization across the instruction profession by female teachers compared to male counterparts.

Table 6. Possessing differentiated classroom management requirements according to the gender variable

Management of differentiated classroom	Gender	Mean	Standard deviation
Instruction management	Male	3.20	0.351
	Female	3.39	0.203
Classroom environment management	Male	3.19	0.317
	Female	3.31	0.147
Managing feelings and emotions	Male	3.73	0.370
	Female	3.84	0.197
Total management of differentiated classroom	Male	3.35	0.318
	Female	3.50	0.161

Table 7. The results of the t-test for the differences according to the gender variable

DI management	T-test	Degrees of freedom	Significance
Instruction management	-6.478	377	0.00
Classroom environment management	-4.655	377	0.00
Managing feelings and emotions	-3.831	377	0.00
Total	-5.883	377	0.00

4.3. The role of the professional experience variable in possessing the requirements of managing a differentiated science class

Since the professional experience of teachers affects their effectiveness and efficacy, the impact of the professional experience of science teachers in Jordan on their degree of estimates of their possession of the requirements of DI has been studied. Table 8 indicates the means of these estimates according to the variable of the years of professional experience. The table shows that science teachers' estimates of how well they meet the requirements for differentiated classroom management vary depending on how long they have been teaching. To identify the significance of these differences, a one-way analysis of variance (ANOVA) was used, and the results are shown in Table 9.

It is evident from Table 9 that there are no statistically significant differences between the average estimates of science teachers in Jordan of the degree of their possession of the requirements of differentiated classroom management according to the variable of their years of professional experience. This could be attributed to the fact that teachers' answers are merely beliefs about the degree to which they possess differentiated classroom requirements. Furthermore, this is because all science teachers, regardless of their experience, are subject to similar working conditions. These results are consistent with the study by Siam and Al-Natour [41], which showed that professional experience did not affect teachers' practice of DI in Jordan. Further, they accord with those of the study by Melese and Tinoca [42], which showed that adopting teachers with many years of experience in DI was limited, this makes us ask an important question about the effectiveness of training and qualification in the Jordanian education system.

Table 8. Possessing the requirements according to professional experience variable

Differentiated classroom management	Professional experience/years	Number	Mean	Standard deviation
Instruction management	1-5	69	3.3214	0.34911
	5-10	86	3.3160	0.28377
	10-15	109	3.3492	0.22687
	Above 15	115	3.3662	0.23008
	Total	379	3.3418	0.26670
Classroom environment management	1-5	69	3.2435	0.31599
	5-10	86	3.2674	0.22199
	10-15	109	3.3000	0.15516
	Above 15	115	3.2913	0.17848
	Total	379	3.2797	0.21439
Managing feelings and emotions	1-5	69	3.7997	0.35021
	5-10	86	3.7992	0.29814
	10-15	109	3.8148	0.23274
	Above 15	115	3.8340	0.19087
	Total	379	3.8143	0.26215
Total	1-5	69	3.4394	0.32348
	5-10	86	3.4431	0.24530
	10-15	109	3.4710	0.17948
	Above 15	115	3.4819	0.17561
	Total	379	3.4622	0.22623

Table 9. The results of a one-way ANOVA test according to the professional experience variable

Differentiated classroom management	Sources of variation	Total squares	Degrees of freedom	Squared means	T	Significance
Instruction management	Within groups	0.161	3	0.054	0.751	0.522
	With other groups	26.726	375	0.071		
	Total	26.887	378			
Classroom environment management	Within groups	0.164	3	0.055	1.19	0.313
	With other groups	17.210	375	0.046		
	Total	17.374	378			
Managing feelings and emotions	Within groups	0.079	3	0.026	0.381	0.767
	With other groups	25.899	375	0.069		
	Total	25.978	378			
Total	Within groups	0.121	3	0.040	0.784	0.503
	With other groups	19.225	375	0.051		
	Total	19.346	378	0.054		0.522

5. CONCLUSION

The study concludes that according to their estimates, science teachers in Jordan have moderately differentiated classroom management requirements in all domains. The present study's results align with the educational reality in Jordan, as most studies suggest that teachers in Jordan need to enhance their skills through additional training and qualification programs, particularly for male teachers and those with limited experience. The teachers' average degree of self-esteem for having differentiated classroom management requirements indicates that science teachers do not have these requirements or skills appropriately due to teachers' self-bias. This is what suggests that studies should implement the approach of direct observation of teachers' performance inside the classroom. Some teachers have instruction requirements and skills; nevertheless, they do not implement them or may encounter obstacles.

The results of this study reveal the characteristics of the learning environment in the Jordanian educational system, which need further development to enable democratic education based on equity, equality, and individual rights. This study also confirms the problem of education in Jordan, which is the clear differences in motivation and efficiency between male and female teachers, in addition to the lack of reflection on the impact of teacher training on their performance. This necessitates that the Jordanian educational system adopt a new education strategy.

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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

The authors of this article declare that they have no conflict of interest.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author [MSA], upon reasonable request.

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