





## Professional development courses and alternative assessment strategies for in-service science education teachers

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### ABSTRACT

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The present study aims to determine the effect of in-service professional development training courses on science teachers' acquisition and implementation of alternative assessment strategies (AAS). A random sample of 512 science teachers responded to a questionnaire to determine the degree of acquisition of AAS and an observation card to determine the degree of implementation of AAS. The results of the study indicate that there are significant differences between the means of science teachers' acquisition of alternative assessment strategies due to the variable of enrollment in in-service professional development training courses in favor of the science teachers who were previously enrolled in these courses. On the other hand, the results indicated no significant differences between the mean scores of science teachers' implementation of alternative assessment strategies due to enrollment in in-service professional development training courses. Also, all the correlation coefficients between the degree of science teachers' acquisition of alternative assessment strategies and the degree to which they implement them according to the variable of enrollment in in-service professional development training courses are not statistically significant. The study provides a number of practical and theoretical recommendations for the field of study. For example, the education system in Jordan should provide science teachers with regular professional workshops and training courses. Future research should examine the differences between two groups of science teachers (those who used alternative assessment strategies compared to those who did not) to determine their impact on outcome level variables (e.g., learning and achievement of students).

**Contribution/Originality:** The present study tested the effect of in-service professional development training courses on science teachers' acquisition and implementation of alternative assessment strategies (AAS). The findings will enable the Ministry of Education and science teachers to take proactive steps toward the implementation of these alternative strategies in the classroom.

## 1. INTRODUCTION

International standards take into consideration the needs of students to develop their creativity, interests, and attitudes (Andersson & Palm, 2017; Lam, 2019). Educators emphasize the important role of teachers in achieving the goals associated with the results of the assessment process (Baska, 2014). Therefore, the teacher is considered

the guide, facilitator, leader, and assessor for all the inputs of the teaching and learning processes to achieve those goals (Kirikkaya & Vurkaya, 2011).

Lately, educational trends have called for a new type of assessment known as alternative assessment. The results of this assessment encourage us to rethink educational practices for assessing learners' achievements and educational performance, so we need a new and fundamental shift in the different educational stages to facilitate real assessment in the classroom through the use of alternative assessment strategies (AAS) (Zuo, Josephson, & Scheitrum, 2019). In other words, this type of assessment prepares students for professional success (Sabtawan, Yuanita, & Rahayu, 2019).

Alternate assessment measures students' learning and academic progress through their work, as well as the tasks that require active participation such as research, investigations of complex problems, field trials, and effective performance (Stears & Gopal, 2010). By using this method of performance measurement, we shift from the traditional viewpoint to the constructivist viewpoint of learning. Alternative assessment, therefore, assumes that knowledge is created by students, rather than by teachers who provide it directly to them.

The main objective of this assessment is to provide an integrated picture of student learning (Mallon, 2010). Students are able to observe their progress through alternative assessment strategies, and they are aware of what they have learned throughout each stage of the learning process (Bagley, 2011). This requires teachers to have a positive attitude toward alternative assessment and its importance in their teaching practices. Teachers can acquire knowledge about alternative assessment through professional development and continuous training in professional development programs (Schildkamp, van der Kleij, Heitink, Kippers, & Veldkamp, 2020). The way teachers view education induces them to transform their traditional assessment practices into a new perception of assessment, which is reflected in the classroom, thus helping them to improve their students' learning outcomes (Ichsan et al., 2021).

Many scholars also focused on teachers' classroom practices that are important to educational reform, including curriculum change (Robinson, Myran, Strauss, & Reed, 2014). Teachers must comprehend the philosophy of the new curriculum before implementation. Changing teachers' philosophy requires them to be aware of the new curriculum and teaching strategies, and the assessment that is needed to implement the curriculum effectively (Mitchell, 2016). Strong implementation of the developed curriculum is connected with the development of teachers themselves (Ozdamar & Kuzu, 2015). On the other hand, the implementation of new strategies also becomes futile if it is not implemented well (Givens, 2000). It is well documented that in-service professional development programs have a positive impact on improving pedagogy for science teachers and provide an opportunity for teachers to build various assessment tools and apply them within teaching contexts during these training courses (Çoruhlu & Çepni, 2010).

Jordanian teachers did not use alternative assessment strategies before 2008. Thus, teachers should be informed about the new strategies that must be implemented as they develop curricula. Through their in-service training, teachers can learn how to implement alternative assessment strategies in their assessment practices. Jordan's Ministry of Education offers in-service training for science teachers that provides them with the opportunity to learn about alternative assessment strategies and implement them during their training, which conforms to recent trends in education. As a result, it is necessary to examine the impact of these training courses on science teachers' acquisition and implementation of AAS in their classroom assessment practices.

### *1.1. Research Significance and Questions*

One of the most important goals of the educational process is to ensure quality and positive results (Fawns, 2019). The educational system in Jordan emphasizes the importance of implementing new methods of assessment to help teachers measure the goals that have been achieved, provide continuous feedback, and contribute to modifying and developing the educational process and the quality of its outputs. Therefore, educational institutions that

respond to students' needs, interests and trends help them acquire knowledge, positive behaviors, and positive attitudes toward learning, and take into account their needs and interests that are in line with educational policies, educational plans, and established curricula (Çalışkan & Kaşıkçı, 2010).

As alternative assessment strategies were not incorporated into early science curriculum education, these strategies are considered quite new for teachers in Jordan. Recently, the new science curriculum in Jordan included alternative assessment strategies, and training was provided to teachers on the new curriculum (Oliemat & Harafsheh, 2021). Oliemat & Harafsheh asserted that teachers need training on this new type of assessment, need to increase their understanding of its content and have opportunities to apply it realistically within training programs so that they develop a positive attitude toward alternative assessment and use it sincerely in their classrooms. Based on this, the following research questions were formulated:

1. Do in-service professional development training courses have an impact on science teachers' acquisition of AAS?
2. Do in-service professional development training courses have an impact on science teachers' implementation of AAS?
3. Are there statistically significant differences between the alternative assessment strategies acquired and those implemented by science teachers attributed to the variable of in-service professional development training courses?

## 2. LITERATURE REVIEW

Recent research results emphasize the importance of teachers' practice of AAS in the student assessment process (Abd-Wahab et al., 2016; Sabtiawan et al., 2019). Burnell (2019) indicated that teachers who apply AAS in their teaching practices can help their students learn and motivate them to achieve, reduce the anxiety of traditional tests, take into account individual differences among students, provide an opportunity for their students to work effectively, develop critical and creative thinking skills, and develop positive attitudes toward learning, which increases the motivation to learn and increases opportunities for cooperation between teachers and students.

Clary and Wandersee (2010) concluded that alternative assessment provides multiple sources of learning, expands learning rather than focusing on a specific topic, and diversifies data collection sources, leading to more accurate results. According to Afandi, Sajidan, Akhyar, and Suryani (2019) the implementation of alternative assessment strategies is significantly hampered by teachers' lack of experience and awareness.

Tan (2013) noted that teachers felt less competent when implementing alternative assessment strategies. Hu, Wirth, Harris, and Pear (2020) concluded that training teachers on alternative assessment helps them to overcome the constraints they face in teaching environments; therefore, training science teachers is crucial for their professional development (Margulies & Ghent, 2005).

The development of teaching practices requires continuous training through advanced in-service training courses (Mak, 2019). Additionally, several researchers have argued that teachers should receive in-service training on alternative assessment strategies in order to put these strategies into action in the classroom (Çoruhlu & Çepni, 2010; Hirshberg, Flook, Enright, & Davidson, 2020).

## 3. METHODOLOGY

The study adopted a descriptive research design, and the population comprised 1,100 basic stage science teachers in the Zarqa Governorate during the 2021/2022 academic year. A random sample was selected and consisted of 512 science teachers. The sample constituted 47% of the study population; 207 teachers representing 40% of the sample were not previously enrolled in in-service professional development programs, and 305 teachers representing 60% of the sample were previously enrolled.

To select the study sample, the researchers communicated via e-mail with science teachers who taught the developed science curricula for the basic stage to obtain their consent to participate randomly in the three directorates of education related to the Zarqa region in 2022. A total of 512 teachers responded, and they were informed that the information would be used for the purposes of scientific research and that their information would be confidential to preserve their privacy. They were also informed that participation in the study includes two stages: the first stage entails answering the questionnaire, and the second stage is the observation of their teaching practices by educational supervisors while they are teaching. After gaining their approval, the questionnaires were sent to the science teachers electronically due to the Covid-19 pandemic.

### 3.1. Instruments of the Study

To achieve the objectives of the study, two research tools were used. The first is a questionnaire to measure the degree of competence of science teachers regarding the use of alternative assessment strategies. The questionnaire was built based on previous studies (Çoruhlu & Çepni, 2010; Hambleton & Murphy, 1992; Ogan-Bekiroglu, 2009; Shahbari & Abu-Alhija, 2018). The researchers adopted a five-point Likert scale for the questionnaire, where 5 is a very high score, and 1 is a very low score. The questionnaire was used to answer the first question of the study: Are there statistically significant differences in the degree to which science teachers acquire alternative assessment strategies due to the variable of enrollment in in-service professional development courses?

The first part of the questionnaire focuses on the participants' demographic information. To determine the degree to which the science teachers acquired alternative assessment strategies from their point of view, according to the study variable, the second part includes paragraphs that cover five alternative assessment strategies: Performance-based evaluation, pen and paper, communication, observation, and self-evaluation. The reliability of the questionnaire's content was confirmed by presenting it to a group of arbitrators comprising university faculty members, educational supervisors, teachers, and measurement experts to check the wording, the suitability of the study sample, and the suitability of the paragraphs to the alternative evaluation strategies. Eight paragraphs were modified based on the arbitrators' observations and feedback.

To verify the validity of the questionnaire, it was applied to an experimental sample consisting of 30 science teachers from outside the study sample twice, with an interval of three weeks between the two applications. Cronbach's alpha coefficient between the two applications of the tool reached 0.87. Table 1 shows the coefficients.

**Table 1.** Test-retest reliability coefficients and internal consistency coefficients of the questionnaire.

Alternative assessment strategy	Internal consistency coefficient	Test-retest reliability coefficient	No. of paragraphs
Performance-based assessment	0.80	0.83	13
Pen and paper	0.92	0.76	12
Observation	0.70	0.84	10
Communication	0.85	0.83	10
Self-reflection	0.84	0.86	10
Scale as a whole	0.87	0.88	55

Additionally, a note card was used to determine the extent to which science teachers implemented alternative assessment strategies. In developing the final form of the note card that was used in this study, researchers drew upon previous studies and built on the questionnaire items (Ghazali, Rabi, Hassan, & Wahab, 2018; Nguyen & Khairani, 2017; Singh et al., 2022). The note card consisted of two parts: demographic information about the study sample (teacher), and the indicators of alternative assessment strategies (the performance-based strategy, the pen and paper strategy, the communication strategy, the observation strategy, and the self-assessment strategy). The observation card was used by the educational supervisors, and the observations were made on the card to study the relationship between the degree of science teachers' acquisition of alternative assessment strategies and the degree

of their implementation thereof, according to the study variable of enrollment in in-service professional development training courses. To verify the wording, the suitability of the study sample, and the suitability of the paragraphs to the alternative evaluation strategies, the validity of the content of the note card was confirmed by presenting it to a group of reviewers, including university faculty members, educational supervisors, teachers and measurement experts. Ten paragraphs were modified based on the reviewers' observations and feedback.

The observation card was applied twice to an experimental sample of ten science teachers outside the study sample with a three-week interval between the first and second applications. The Pearson correlation coefficient of the reliability of the observation card was 0.84. A Cronbach's alpha equation was also used to calculate the stability of the internal consistency of the note card over the pre-application of the tool (0.93). Table 2 shows these coefficients.

**Table 2.** Test-retest reliability coefficient and internal consistency coefficient of the observation card.

Alternative assessment strategy	Internal consistency coefficient	Test-retest reliability coefficient	No. of paragraphs
Performance-based assessment	0.81	0.83	15
Pen and paper	0.73	0.86	10
Observation	0.83	0.75	7
Communication	0.94	0.72	7
Self-reflection	0.91	0.88	6
Total	0.93	0.84	45

Science teachers' use of alternative assessment strategies was monitored through an observation card to answer the second research question: Are there statistically significant differences in the number of alternative assessment strategies implemented according to the variable of in-service professional development training courses? Teachers participating in the study were monitored by educational supervisors while they were teaching in order to assess how well they were implementing AAS. The researchers communicated with the supervisors to gain their approval, and the supervisors expressed their interest and lack of objection.

#### 4. DATA ANALYSIS

To answer the first research question, "Do in-service professional development training courses have an impact on science teachers' acquisition of AAS?", and the second question: "Do in-service professional development training courses have an impact on science teachers' implementation of AAS?", the Statistical Package for the Social Sciences (SPSS) was employed to calculate the means (M) and standard deviations (SD). The means were calculated to determine the AAS acquisition degree in the first question and the AAS implementation degree in the second question. To judge the degree of acquiring and implementing AAS (e.g., [Oliemat and Harafsheh \(2021\)](#)) the following scale was adopted:  $1.33 > M = \text{low}$ ,  $2.67 \geq M \geq 1.33 = \text{medium}$ ,  $M > 2.67 = \text{high}$ . A t-test was also carried out to compare the means of the two independent samples.

To answer the third question of the study "Are there statistically significant differences between the alternative assessment strategies acquired and those implemented by science teachers attributed to the variable of in-service professional development training courses?", the researchers calculated the correlation coefficient between the acquisition degree of AAS and the execution degree of AAS, and a Z value was also calculated.

#### 5. RESULTS

To answer the first question, the means and standard deviations of the science teachers' responses to the questionnaire were calculated to determine the degree of their acquisition of AAS according to the study variable "enrollment in in-service professional development programs." Table 3 shows that the mean of science teachers

who were previously enrolled in in-service professional development training courses was high ( $M = 3.71$ ), while those who were not previously enrolled acquired a medium score ( $M = 2.56$ ).

**Table 3.** T-test of the significance of the differences between the means of the degree of AAS acquisition.

Alternative assessment strategy	Enrollment in professional development courses	No.	M	SD	t	Significance level
Performance-based evaluation	Previously enrolled	305	3.81	3.412	1.845	*0.000
	Not previously enrolled	207	2.34	3.356		
Pen and paper	Previously enrolled	305	3.77	2.546	1.555	*0.032
	Not previously enrolled	207	3.56	2.756		
Observation	Previously enrolled	305	3.50	4.235	1.363	*0.000
	Not previously enrolled	207	2.05	3.980		
Communication	Previously enrolled	305	3.31	2.581	0.900	*0.001
	Not previously enrolled	207	2.42	2.358		
Self-reflection	Previously enrolled	305	3.20	1.258	1.362	*0.012
	Not previously enrolled	207	2.56	1.769		
Total score	Previously enrolled	305	3.71	0.745	1.756	*0.000
	Not previously enrolled	207	2.56	0.782		

Note: \* $p < 0.01$ .

Table 3 also shows statistically significant differences between the average degrees of acquisition of alternative assessment strategies of all kinds among science teachers in the basic stage due to the variable of enrollment in in-service professional development training courses in favor of those who were previously enrolled in these courses. The value of  $t$  as a whole is 1.756, with statistical significance of  $\alpha = 0.000$ .

These differences are statistically significant in all alternative assessment strategies, and all differences are in favor of the science teachers who had previously enrolled in in-service professional development training courses.

It is also noted from Table 3 that AAS were acquired unevenly by the science teachers who previously attended in-service professional development training courses.

The performance-based assessment strategy ranked first with a mean score of 3.81; the pen and paper strategy ranked second with a mean of 3.77; the observation strategy is third with a mean of 3.50; in the fourth place is the communication strategy with a mean of 3.31; and the self-assessment strategy is last with a mean of 3.20.

The same table shows that in the acquisition of science teachers who did not previously enroll in in-service professional development training courses, the pen and paper strategy ranked highest with a mean of 3.56, followed by the self-assessment strategy with a mean of 2.56, in third place is the communication strategy with a mean of 2.42, fourth is the performance-based evaluation strategy with a mean of 2.34, and in last place is the observation strategy with a mean of 2.05.

In order to answer the second question of the study, the means and standard deviations of the science supervisors' observations on the note cards were calculated to determine the degree of science teachers' application of AAS according to their enrollment in in-service professional development training courses.

Table 4 shows that the science teachers who were previously enrolled development training courses and those who were not implemented the alternative assessment strategies with respective mean scores of 2.39 and 2.10.

The results in Table 4 indicate that there are no statistically significant differences between the average means of the science teachers' implementation for all alternative assessment strategies based on whether the teachers were previously enrolled in in-service professional development courses or not, as the value of  $t$  is 2.365 and the level of statistical significance is  $\alpha = 0.086$ .

**Table 4.** T-test of the significance of the differences between the means of the degrees of implementation of AAS.

Alternative assessment strategy	Enrollment in professional development courses	No.	M	SD	t	Significance level
Performance-based assessment	Previously enrolled	305	2.60	1.865	2.526	0.145
	Not previously enrolled	207	2.34	1.751		
Pen and paper	Previously enrolled	305	3.56	1.368	3.586	0.068
	Not previously enrolled	207	3.41	1.982		
Observation	Previously enrolled	305	2.56	2.452	2.513	0.187
	Not previously enrolled	207	1.87	2.897		
Communication	Previously enrolled	305	2.24	1.856	1.827	0.075
	Not previously enrolled	207	1.98	1.356		
Self-reflection	Previously enrolled	305	2.23	1.845	1.425	0.358
	Not previously enrolled	207	2.11	1.450		
Total	Previously enrolled	305	2.39	0.745	2.365	0.086
	Not previously enrolled	207	2.10	0.782		

Looking at the results in Table 4 in depth, the means of implementation of AAS by science teachers who were previously enrolled in in-service professional development training courses is uneven, as the pen and paper strategy came first ( $M = 3.56$ ), followed by the performance-based assessment strategy ( $M = 2.81$ ). In third place is the observation strategy with an average of 2.56, followed by the communication strategy ( $M = 2.24$ ), and last is the self-evaluation strategy ( $M = 2.23$ ). It is also noted from Table 4 that the implementation of the pen and paper strategy by the science teachers who were not previously enrolled in in-service professional development training courses ranked first with a mean of 3.41, ranked second is the performance-based assessment strategy with a mean of 2.34, in the third place is the self-evaluation strategy with a mean of 2.11, in the fourth place is the communication strategy with a mean of 1.98, and in last place is the observation strategy with an average of 1.87.

To answer the third study question "Are there statistically significant differences between the alternative assessment strategies acquired and those implemented by science teachers attributed to the variable of in-service professional development training courses?", the correlation coefficient was calculated between the degree of acquisition of AAS that was reached through the science teachers' responses to the questionnaire, and the degree of their implementation of AAS, which was reached through the observation card used by the educational supervisors. The correlation coefficient was calculated between the degree of acquisition and degree of implementation according to the study variable "enrollment in in-service professional development courses", and the Z value was calculated. The results in Table 5 show that all the correlation coefficients between the degree of acquisition of alternative assessment strategies and the degree of their implementation by science teachers according to their enrollment in in-service professional development courses are not statistically significant, where the significance level is  $\alpha = 0.065$ .

**Table 5.** Correlation coefficients between the degree of acquiring alternative assessment strategies and the degree of their application by female science teachers.

1 <sup>st</sup> end of the relationship	2 <sup>nd</sup> end of the relationship	Enrollment in an in-service professional development course	Correlation	No.	Z	a
Acquiring degree	Application degree	Previously enrolled	0.32	305	0.432	*0.065
		Not previously enrolled	0.25	207	0.361	

Note: \* Statistically significant at the level of  $\alpha \leq 0.05$ .

## 6. DISCUSSION

The purpose of this study was to determine whether in-service professional development courses improve science teachers' acquisition and implementation of alternative assessment strategies (AAS) and to test the correlation between the degree of AAS acquisition and their implementation according to the variable of "enrollment in in-service professional development training courses". The results of previous research asserted the

importance of alternative assessment in teaching, and that providing training for teachers through in-service professional development courses contributes to teachers' acquisition of AAS, and that their effective implementation of these strategies in their teaching practices is positively reflected in students' learning (Alotaibi, 2021; Hu et al., 2020; McMillan, Venable, & Varier, 2013).

The results of the study found statistically significant differences between the average means of science teachers' acquisition of AAS as a whole and is attributed to the variable of "enrollment in in-service professional development training courses." For each of the alternative assessment strategies, all previous differences were in favor of the science teachers who had previously enrolled in in-service professional development training courses. The results agree with those of Robinson et al. (2014) who found that through a diverse collection of professional development training courses, and by incorporating pedagogy into their internal content, science teachers can gain in-depth knowledge and effective alternative assessment strategies. This finding is also in line with Mak (2019) who determined that professional development courses provide teachers with opportunities to practice during workshops. Such practical exercises allow teachers to become familiar with alternative assessment tools and how to construct and use them in the classroom, whereas teachers who do not develop themselves professionally do not have the opportunity to effectively engage with AAS training opportunities (Baska, 2014).

The results also showed that the science teachers who had previously enrolled in in-service professional development training courses gained a very high AAS score, whereas those who had not had a medium score. In light of the results of previous studies and the current study, this result may be attributed to the fact that teachers who were not previously enrolled in professional development training courses acquired AAS from the preparation notebook, which explains them in detail as abstract concepts written at the beginning of the teacher's preparation notebook. This allows teachers to read about them without understanding them in depth. In their supervisory visits to schools, educational supervisors also explain these strategies to science teachers, but in a superficial manner and without great detail due to the lack of time or lack of specialization in the subject (Tan, 2013).

Educational supervisors use these strategies as an evaluation criterion in their visits, and due to this, teachers attempt to acquire these strategies, at least in part, to demonstrate that they know and can assess these strategies in order to obtain high evaluation scores. On the other hand, the conditions that are created for teachers in professional development training courses help them to acquire AAS effectively, and the assessment part of these courses is carried out by specialists in the field of assessment and evaluation, which increases the opportunity for teachers to acquire these strategies in depth (Mak, 2019).

It was also noted that science teachers' acquisition of the pen and paper strategy was very high regardless of whether the teachers had previously enrolled in in-service professional development training courses or not. Teachers in schools place great emphasis on pen and paper tests in evaluating their students because of the assessment system used in schools; 80% of students' grades are based on different types of tests. This result is consistent with the study by Alotaibi (2021) who indicated that the pen and paper strategy is the most popular strategy used by teachers. It also agrees with Cheng (2006) who asserted that teachers prefer traditional exams for their own considerations.

The results also showed that there were no statistically significant differences between the average means of science teachers' implementation of AAS as a whole due to the variable of enrollment in in-service professional development training courses and for each of the alternative assessment strategies. Previous research has indicated that there are multiple factors that negatively affect teachers' effective implementation of alternative assessment strategies, including poor application of the training that teachers underwent in in-service professional development courses in the classroom, lack of incentives for implementation, and the need for more support in the practical field of these workshops. Teachers who previously enrolled in in-service professional development training courses were influenced by the traditional assessment practices of their colleagues who had not enrolled in in-service professional development training courses (Abu Shaira, Ashtiwa, & Ghobari, 2010; Al-Harthy, 2015; Alotaibi, 2021). Those



factors may have contributed to the lack of difference in the AAS implementation means between the science teachers who had previously enrolled in in-service professional development courses and those who had not. Based on the foregoing, in-service professional development courses did not positively impact science teachers' implementation of AAS in the assessment of their students.

Similarly, the results also indicate that the science teachers who were previously enrolled in in-service professional development courses and those who were not had moderately implemented performance-based, observation, communication and self-assessment strategies. Previous studies have indicated that the degree of implementation of AAS is affected by a number of factors, such as the lack of training programs offered to teachers, poor financial capabilities, failure to provide the necessary requirements for implementation, overcrowding in classrooms, short class time, and the great effort required in the preparation process. These factors seem to have negatively affected the degree of science teachers' implementation of AAS (Margulies & Ghent, 2005; Nguyen & Khairani, 2017; Schildkamp et al., 2020).

Despite the fact that science teachers who had previously enrolled in AAS professional development courses had a high acquisition grade, their implementation was moderate. On the other hand, the results show that the science teachers, whether or not they had enrolled in in-service professional development courses, implemented the pen and paper strategy to a high degree. This result is consistent with Cheng (2006) who showed that teachers prefer the implementation of traditional tests over other assessment strategies due to the ease of test preparation, ease of score collection, being unaffected by classroom overcrowding, and no complex requirements.

Additionally, based on the variable of enrollment in in-service professional development courses, none of the correlation coefficients between the degree of science teachers' acquisition of AAS and their implementation of it are statistically significant. Science teachers who enrolled in professional development courses acquired AAS at a high level but did not implement it at the same level in their assessment practices; therefore, where they acquired it thanks to enrolling in professional development courses, it did not reflect their implementation of the strategies to the same degree. This finding is consistent with Schildkamp et al. (2020) who stated that teachers who enroll in professional development courses acquire alternative assessment strategies for success in course requirements and utilize these courses for career advancement according to a teacher rating system that moves them from one rank to another.

Scholtz (2007) also confirmed that teachers' weak follow-up conveys the impact of the training they received in the courses. This is reflected negatively in their evaluation practices, and leads to the trained teachers being affected by the evaluation practices of their colleagues who have not been trained. In light of the above, decision makers and those responsible for training courses must take into account the follow-up and transfer of the impact of training as one of the aspects of evaluation and as a mandatory condition for moving from one level to another so that teachers are motivated to implement the AAS they learn about through training courses in their assessment practices.

## 7. CONCLUSIONS AND IMPLICATIONS

It can be concluded from the results of the study that the acquisition of AAS does not necessarily mean their implementation to the same degree in the classroom. Teachers of science gained AAS to a high level but only applied them moderately. The degree to which they acquired AAS in the courses was not reflected in their assessment practices. Therefore, in-service professional development courses in their current form have not contributed effectively to AAS implementation during science teachers' assessment practices. Based on this outcome, it is recommended that science teachers acquire these strategies by enrolling in professional development courses and demonstrating the impact of training in the classroom as assessment requirements for teachers. The educational system in Jordan can provide teachers with professional workshops and training courses on a regular basis. Further, follow-ups should be conducted to ensure that science teachers are implementing these strategies in the classroom.

Based on the above discussion, it is necessary to conduct a comprehensive review of the content of training courses, especially the alternative assessment strategies, and allocate a mark for the practical side of the training courses in the classroom as a requirement to pass those courses and also allocate a mark to ensure the transmission of the impact of training as a mandatory condition for moving up the ranks in the teacher ranking system.

It was also concluded that science teachers focus their assessment practices through the implementation of various types of tests on the pen and paper strategy, as this is their preferred strategy and is considered the most common in their assessment practices. On the contrary, they focus less on performance-based evaluation, observation, communication, and self-evaluation strategies. It is recommended that the Ministry of Education in Jordan set new evaluation standards for assessing students' performance.

Finally, it was concluded that AAS acquisition and implementation require certain conditions to support the teacher's role in their application. In addition, administrative and technical follow-up from school administration and educational supervisors should be carried out to encourage teachers to apply AAS in their assessment practices.

From a theoretical standpoint, it is recommended that the following processes are conducted: First, comprehensive scale research should be carried out to determine the acquisition and implementation of alternative assessment strategies on a sample representing all science teachers in Jordan based on school type (public vs. private). Second, future studies are needed to determine the impact of demographic variables on the implementation of alternative assessment strategies by science education teachers (e.g., gender, income level, educational level, and years of experience). Third, future research should use advanced statistical designs, such as path analyses, for two groups of science education teachers (those who used alternative assessment strategies compared to those who did not) to determine their impact on outcome level variables (e.g., learning and achievement of students).

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**Transparency:** The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.

**Competing Interests:** The authors declare that they have no competing interests.

**Authors' Contributions:** All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript.

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