The Effectiveness of a proposed training programme in formative assessment based on active learning, in the development of teaching performance of science teachers in the primary stage in Saudi Arabia

Abstract:

This work seeks to investigate the effects associated with training initiatives in line with formative assessment, as based on active learning, in an effort to enhance teaching amongst science teachers in Saudi primary schools. The programme comprised training sessions, all of which were ongoing for a period of two months. The researcher adopted an experimental approach centred on the design of the control and experimental groups so as to establish the overall efficiency of the suggested training programme. In the work, a sample made up of 33 primary school science teachers, based in Sakaka in Al-Jouf region, was used; the sample was randomly divided, with some assigned to an experimental group (16 teachers), with the remainder (17) assigned to a control group that had not received any professional development. The findings garnered indicate that the success of the proposed programme, in the case of the experimental group, was more a function of the control group in the telemetric higher. The proposed training programme was found to have a positive impact on the development of teaching performance in relation to different skills, such as think in pairs, group work and questions. Hence, formative assessment, as based on active learning, could fundamentally change the quality of teacher–student interactions.

Keywords: Science teachers, formative assessment, active learning, training programme, teaching.

1. Introduction

Within the curriculum, there are four individual elements, as highlighted by Tyler (1949): assessment, content, objectives (or learning outcomes) and strategies. In the view of Tyler, the curriculum's development should be viewed as linear and sequential; otherwise stated, a curriculum plan should be designed by the instructor through establishing the learning objectives, choosing the content linked to such objectives, selecting ways in which the objectives should be taught, and accordingly evaluating the findings so as to improve the curriculum's future reiterations. In the present time, such aspects are devised with the adoption of a more interactive nature, with all aspects linked and therefore needing to be considered together as evaluation is designed (Gibson and Shaw, 2010). More specifically, the objectives will establish, to a significant degree, the type of evaluation needing to be applied in order to effectively evaluate the learning process

(ibid). Comparably, the content will outline and suggest the strategies required in order to effectively teach the content. Accordingly, it should be repeated that, in order to evaluate active learning, there first is a need for instructors to take into account the objectives suggested for the learning activities. It is necessary that active assessment be included in active learning (ibid). Formative assessment is recognised as a learning process that is both deliberate and active, with the teacher and student coupled in such a way so as to systematically and continuously collect learning-based evidence with the explicit objective to enhance the achievement of students (Moss & Brookhart, 2009). Intentional learning refers to cognitive processes that detail learning as a goal as opposed to an incidental outcome (ibid). Formative assessment is recognised as being both an accountability tool with the ability to establish whether learning has occurred, and also an instructional tool that is used by teachers and students whilst learning is ongoing (ibid). Formative assessment is regarded as valuable and effective owing to the fact it has a direct effect on the two most valuable players in the teaching–learning process, namely the student and the teacher (ibid).

Essentially, formative assessment affects the overall quality and number of interactions between the student and teacher (ibid). Nonetheless, this research suggests that the application of key elements of formative assessment are clear and direct learning goals, teacher–student collaboration, peer and self-assessment, and descriptive feedback, all of which can be achieved through the provision of a training programme for science teachers, with emphasis placed on formative assessment centred on active learning. Accordingly, teachers require assistance in professionally growing and developing so as to ensure quality can be improved. In this regard, the view of Hayes (2010) emphasises that professional development garners results in three different areas: (a) educators learn new knowledge and skills because of their participation; (b) educators use what they learn to improve teaching; and (c) student learning and achievement increase because educators use what they learned in professional development. The value garnered through the application of formative assessment is clearly outlined and document in the research on effective learning and teaching practices. However, further work is required in order to improve educational practice in the professional development arena. Accordingly, this work sought to analyse the overall efficiency of the training programme.

2. Literature Review

2.1 Effective Tools of Assessment for Learning

Key elements of formative assessment are explicit learning goals, collaboration amongst teachers and students, self- and peer assessment, and descriptive feedback to students about their performance. A learning goal describes what pupils should know, understand, or be able to do by the end of the lesson; however, in the researcher's opinion, the purpose of what pupils are doing needs to be reinforced during the course of the activities and at the end; this can be achieved by asking them regularly, 'What did you learn from that?' Therefore, learning goals are recognised as what students should accomplish during the lesson. Leaning goals are important for children as they are able to assess their progress only when they have a clear notion of what they are aiming towards.

Classroom dialogue and questioning is another key aspect of assessment for learning as it helps teachers to establish what is inside children's heads to assess them to learn (Black & Wiliam, 1998). The dialogue and questions between pupils and teacher should be thoughtful, reflective, focused on evoking and exploring understanding, and conducted in such a way that all pupils have an opportunity to think and express their ideas.

Self-assessment is an important tool for assessment for learning because, when pupils are to learn, they are required to identify any gaps between their actual and optimal performance. Pupils need to be able to work out why these gaps occur; they also need to identify the strategies they might use to close the gaps. Furthermore, it is difficult for pupils to achieve a learning goal unless they understand this goal and can assess what they need to do to reach it (Sadler, 1989). Peer assessment involving pupils assessing the performance of other students has some advantages: for example, pupils will allow talking on their own level and discussing work in a way that they understand. Such feedback can be easier to grasp and act upon when compared with advice offered by an adult. Moreover, observing what pupils do together in their assessment is a useful way for teachers to save time. Peer assessment allows pupils to judge their work by recognising similar or different qualities in the work of their peers. For instance, pupils' learning could be enriched by marking another pupil's work; this could help pupils to understand the meaning of the quality criteria in a given piece of work.

An essential part of assessment for learning is feedback to learners, both in assessing their current achievements and in indicating the next steps in their learning trajectory. Taras (2005,

p. 468) stated, "For an assessment to be formative, it requires feedback which indicates the existence of a gap between the actual level of work being assessed and the required standard and how the work can be improved to reach the required standard".

2.2 Active Learning

Throughout the 20th Century, there have been two key teaching and learning methods applied, namely traditional and child-centred. In the case of the former, teachers adopt a central role in the teaching process, during which knowledge is transferred from the teacher to the student, with the student receiving passively. On the other hand, the latter method is centred on the practical and self-directed learning activities of the child (Sahar, 2014). Active learning involves students as a key partner in the process, and aids them in taking responsibility for their own learning. In a more conventional way, passive learning commonly comprises one-way information and course content delivery, passed on to the student by the teacher (Gleason et al., 2011).

In mind of the above, as highlighted by McCormack & Jones (1998), active learning may be defined as anything that students do in a classroom other than merely passively listening to a lecture. This can involve listening tasks, which assist children in absorbing what they hear, or even writing tasks where students respond to material, and complex group exercises where course materials are applied by the student to 'real life' situations and settings.

In active learning activities, teachers adopt a key role as facilitator (Sahar, 2014). The main role of the teacher is to ensure a classroom setting is created, which is pivotal in assisting the learner in actively participating and interacting in the learning environment (ibid). Moreover, they also carry out a number of different behaviours that encourage children to have active involvement in the learning process (ibid).

Accordingly, active learning may be viewed as a teaching approach as opposed to an individual, particular method. It requires active involvement in classroom activities that have been well planned and designed by teachers (ibid).. Such a strategy can encourage student involvement, improve relevance, and enhance motivation through actively involving students in experiential learning environments and classrooms.

2.2.1 Common Techniques of Active Learning

Three common active learning techniques are pair share, group work and questioning. Pair share is a collaborative learning strategy that (1) is effective in very large classes, (2) encourages students to be reflective about course content, (3) allows students to privately formulate their thoughts before sharing them with others, and (4) can foster higher-order thinking skills (Gibson and Shaw, 2010). Pair share provides students with the opportunity to think on or talk about topics in the classroom setting. Group work is another active learning technique that should be considered. In group work, each member of the group has responsibility to work together in order to accomplish a given task. Furthermore, it is more satisfying for students to work in a group because it enables them to learn more. Working in a group where students are dependent on each other is an effective way of reminding students about their social needs (Sahar, 2014). Moreover, questioning is another important technique that should be applied by teachers in order to change their style of teaching.

There are various strategies that should be adopted by teachers to make questions work well. First, Jones (2005) suggests that teachers should plan questions rather than merely hoping a question pops into their minds at a suitable moment. It would be useful to list appropriate questions on the reverse side of the lesson plan and to use them to check learning at appropriate times; they should remember that the order in which teachers ask these questions is also important. Nevertheless, Jones further found that teachers might have to alter the questions or use a series of unrehearsed questions in mind of the need to respond to answers they receive from pupils. Thus, "teachers need to plan a questioning strategy, but be prepared to develop tactics on the spot"(p. 11).

Second, questions that ask pupils to express their ideas require time to answer. In the writer's own experience, some teachers often give answers to questions after a few seconds delay; this is done in order to save time. Therefore, pupils probably do not try to work out the answer because they already know that the teacher will give the answer immediately after the question. Allowing enough time after asking a question plays a crucial role in helping pupils to think and give an appropriate answer. Buddow (1974) found that, when teachers were advised to increase the waiting time after asking questions requiring explanations, children's answers were longer and responses were better and more in-depth.

Third, Black et al. (2003) suggested that teachers should allow every pupil to think, advising pupils not to put their hands up if they know the answer to a question. Teachers should find alternative ways of engaging and encouraging pupils to think and answer the question: for instance, suppose the question is, 'Could you tell me what causes the day and night?' Every pupil could have a white board and try to write down what they think the answer is. The role of the teacher is to train and teach them to hold it up at the same time and consider only their thinking, regardless of whether or not they are correct. As highlighted by Hicks (1996, p. 66), "Children must learn not only what to say and how to say it but also when to say it". Finally, teachers should create a supportive environment to help pupils to be comfortable with giving a wrong answer (Black et al., 2003), particularly with very young children who tend not to answer because they are afraid of receiving negative feedback. The role of teachers is not to reward the answer because it is correct, but rather to reward the answer that is discussed and shared by the entire group. Consequently, children will be happy when other children help to further explore their wrong answer.

2.3 Formative Assessment and Active Learning

The core of the assessment is the learning, with formative assessment centred on active learning, which requires an interactive relationship between the student and teacher, with the development of the individuals' learning the emphasis of the assessment (Clarke, 2008). Accordingly, active learning offers a number of different valuable opportunities for implementing various formative assessment methods.

On the other hand, however, active learning techniques offer further prospects for formative assessment to take place, with the student's performance observed by the instructor and the learning experience amended as necessary (ibid). In providing effective formative assessments, dialogue was highlighted as paramount (Fox-Turnbull, 2006). More specifically, in the current work, it has been established that providing students with the opportunity to discuss their work not only aids them in their knowledge and growth, but also further provides teachers with insight into the way in which their learners think. Accordingly, teachers could utilise this as an opportunity to respond to students in relation to the practicality, usefulness and overall quality of their thinking, such as through posing questions in an effort to widen understanding (ibid). Thus, activities in formative assessment, as implemented throughout the course of a lesson or study unit through the application of active learning techniques,

can both support and also enhance student learning (Gibson & Shaw, 2010).

The application of formative assessment is most common when teachers are seeking to change their teaching methods in line with student learning, or otherwise when they seek to enable students to make changes to their own learning in line with performance feedback (ibid). Formative assessment is diagnostic in nature owing to the fact that it provides student learning data, which then can be utilised in mind of changing and enhancing learning and teaching to facilitate the satisfying of students' needs (Black & Wiliam, 1998). Therefore, formative assessments are carried out throughout the learning process itself, thus facilitating changes to be made in both learning and teaching (Gibson & Shaw, 2010).

2.4 Professional Development Related to Formative Assessment

Only a select few researches have been recognised as associated to the link between formative assessment and professional development (Cole, 2010). In this vein, Meisels et al. (2003) have analysed student performance as an outcome measure associated with the effects of professional development focused on formative assessment. Standardised test scores have been analysed in mind of assessing the effects of a three-year implementation of an embedded performance assessment system in schools that have been self-selected inn mind of the programme's application. This study further established significantly higher standardised reading scores for the treatment group. In this vein, the work of Wiliam et al. (2004) has detailed a number of different elements inherent in an 18-month professional development programme aimed at providing teachers with support in further improving their application of formative assessment. A total sample of 24 teachers at secondary school level (12 mathematics and 12 science) spent 6 months learning about four strategies of formative assessment, namely descriptive feedback, questioning, self and peer assessment, and sharing learning criteria with students. Subsequently, action plans were created by the teachers, which outlined the various aspects of formative assessment to be adopted in their classrooms. Throughout the duration of the school year, there was the observation of teachers, with the opportunity to consider and discuss with other professionals how the formative assessment practices detailed in their action plans could be implemented. The findings suggest that those involved in such development demonstrate notable changes in their perceptions of themselves as professionals.

A study utilising a sample of 25 secondary teachers in maths and science, located in New South Wales Australia, was conducted by Panizzon & Pegg (2007) with the aim of exploring assessment and its changing nature, and the effects this has on in-classroom practices. Across a two-year study, teachers attended a number of professional development sessions and received continuous consultative support. All of the sessions underwent recording and subsequent transcription, whilst there was the completion of interviews with all teachers at the end of the school year. The key aspect inherent in the study was the questioning, whereas assessment linked to pedagogy, attention to cognition, classroom advantages for students, classroom advantages for teachers, pedagogical practices and teaching strategies were recognised as the six contributing aspects. These findings signify a significant change in the perceptions of teachers regarding assessment, redirecting focus from the accumulation of students' marks to one of diagnosis with the objective to direct teaching towards improving the mathematical and scientific understanding of students.

Teachers were provided with a short-term professional development session by Yin et al. (2008) in mind of teaching them how a particular embedded assessment could be applied in their science classroom. The scholars both designed and implemented formative assessments in an inquiry science-based unit. The sample utilised comprised 12 middle-school science students and their students, all of whom were chosen randomly and accordingly assigned to a control group or to an experimental group, with 6 in each group. The embedded assessments were provided to the control teachers, without the inclusion of training. The findings showed that teachers varied significantly in terms of their effects on achievement, conceptual change and student motivation. Nonetheless, the effects of the formative assessment treatment on such outcomes was found to be lacking in statistical significance.

In the study by Phelan et al. (2009), 91 teachers were randomly assigned within schools to a treatment or control group. In regards the treatment, teachers were provided with training on three lessons in the 6th grade, which were to be taught throughout the year, with emphasis placed on maths and formative assessments. On the other hand, those in the control group were not provided with training, but rather were asked to teach the students the same maths topic with their own lesson plans. Furthermore, following each of the three lessons, the teachers in the experimental group met with the researchers to review the work of the learners and accordingly analyse common errors. Upon contrast of the conditions, when considering student performance of standardised math outcome measures, as well as

teacher math outcomes, the findings showed a number of key differences in favour of the treatment group.

2.5 Features of Effective Professional Development on Formative Assessment

Unquestionably, effective professional development requires much focus and is a continuous process, but enables strong, effective working relationships to be built and maintained between teachers. Nonetheless, the majority of teachers are not able to access professional development that, as standard, fulfils all necessary criteria (Trumbull & Lash, 2013). Importantly, more than 90% of all US teachers have been involved in some form of professional learning comprising only short-term workshops or conferences, with a lower number of teachers involved in other types of development, such as university courses associated with teaching (36%) and observational visits to other schools (22%). Those teachers who attended classrooms in other schools were seen to drop from 34% to 22% when comparing 2000 to 2004, respectively (ibid). Although it is common for teachers to require significant professional development in a particular domain (close to 50 hours) in order to improve their skills and their students' learning, it remains that the majority of professional development opportunities in the US context are not as long (ibid).

In much the same way as learners, teachers also need to actively engage with new ideas and strategies in an effort to ensure understanding and their effective application (ibid). Active learning may be promoted through discussions with colleagues, practical tasks in mind of specific techniques, and the reviewing of work (ibid). Cordingley et al. (2005) established change in teaching practice as arising as a result of collaborative rather than individual CPD; conversely, the work of Dalgarno & Colgan (2007) recognised changes in practice when teachers were given the freedom to test ideas and take risks throughout CPD. Essentially, intensive professional development, especially when there is an element of knowledge application in line with the instruction and planning activities of teachers, is far more likely to influence teaching practices; subsequently, this results in student learning improvements (ibid).

2.6 Theoretical Framework

This paper's theoretical framework is concerned with the view that professional development centred on formative assessment is not entirely optimal with only a select few formative assessment topics: it is unrealistic to expect teachers to implement and include new formative assessment approaches within their work without there being any extensive in-service professional

development. Studies on formative assessment (see Trumbull & Lash, 2013) suggest that extensive professional development and teacher preparation are fundamental should formative assessment realise its potential as an instrument geared towards enhancing student learning. More specifically, opportunities for teachers to analyse their thinking surrounding learning and teaching, and to do so collectively, is recognised as a critical element in their professional development (ibid). The completion of a formative assessment requires teachers to be supported over a prolonged period as instruction-related changes can arise iteratively and slowly, with teachers needing time to adapt and revise their instructional routines in line with new learnings.

2.7 Formative Assessment in Saudi Arabia

From a historical perspective, summative assessments, that emphasise the generating of results that highlight the performance of students, was found to be the key assessment practice in schools in the Kingdom of Saudi Arabia: the examination system is recognised as being the only educational assessment tool in adoption (Al-Sadaawi, 2007).

During recent times, however, Saudi Arabia has implemented a shift towards a more constructivist approach in the educational domain, which is seen to highlight problem-solving (Alaudan, 2015), analysis and research as opposed to mere repetition and memorisation (ibid). Regardless of such changes, however, there has been the neglect to consider FA, which is regarded as being best utilised in a constructivist environment (ibid). This study poses the view that he reason behind failing to adopt formative assessment is that education in the KSA is associated with a lack of teaching training in mind of implementing efficient assessment.

Essentially, professional development is rarely provided to science teachers in the KSA (Al-Sadaawi, 2007), with the suggestion made by Doran et al. (1994) that teachers have very little training in teacher education programmes in regards to how classroom formative assessments should be carried out. Moreover, they also have little technical assistance across their day-to-day professional practices. In addition, it is stated by Berry (2008) that a number of teachers are not even provided with adequate professional development on learning assessment. In this area, it was also established that Saudi teachers lack in the necessary skills to evaluate students in the most suitable way.

In line with the above, the present work poses the argument that there is a pressing need for teaching staff to acknowledge the aim and overall method of formative assessment,

as well as the effective tools of formative assessment, including collaboration amongst students and teachers, explicit learning goals, descriptive feedback to students in regards their performance, and self and peer assessment. In this regard, the view is adopted by Yin (2005) that teachers engaged in training programmes should be provided with formative assessment tools and helped in their application.

The present work considers that there is a need for relevant professional training to be delivered to teachers in order to ensure the assessment results for improving education in schools can be used. It is held that student learning can be enhanced through formative assessment, as has been established in other works, as discussed above, meaning professional development on formative assessment should be focused on improving student attainment. Accordingly, there is a need for formative assessment to be one element of professional development as this is recognised as a fundamental aspect of teaching, which encourages students' higher-order thinking and further assistants students in satisfying the standards to a high level of proficiency (Trumbull & Gerzon, 2013).

3. Research Methodology

3.1 Research Question

What is the impact of the proposed training programme in formative assessment based on active learning in the development of teaching performance of science teachers in the primary stage in Saudi Arabia?

The research question is addressed by posing three sub-questions:

1. **What is the impact of the proposed training programme in formative assessment based on active learning in the development of teaching performance in relation to the 'think in pairs' skill?**
2. **What is the impact of the proposed training programme in formative assessment based on active learning in the development of teaching performance in relation to the 'group work' skill?**
3. **What is the impact of the proposed training programme in formative assessment based on active learning in the development of teaching performance in relation to the 'question' skill?**

3.2 Experimental Approach

The researcher adopted the experimental method based on the design of the control and experimental groups so as to determine the overall effectiveness of the proposed training programme in developing the strategies for using formative assessment amongst Saudi science teachers in primary schools. The researcher designed the programme. The reason for using an experimental approach in this study was due to the researcher controlling the independent variable, namely the proposed training programme.

3.3 Sample

The population of this study was all science teachers in primary schools in one educational administrations in Saudi Arabia (Aljouf); the total number of teachers in this administration was 120. The administrations were chosen as it would be easier to conduct the study as the researcher both live and work. The administration department of the Saudi of Ministry of Education was asked for a list of e-mails for all science teachers in Aljouf City where the research was conducted. Subsequently, an email was distributed amongst all teachers (120). Four weeks later, A total number of 33 teachers responded.

The researcher then sent another e-mail to all 33 teachers to explain explaining the purpose of the current study and the other process of investigation in the current study. Only 16 teachers agreed to take part in the proposed training program based on formative assessment. Hence. the study sample comprised 33 science teachers from primary schools in Sakaka in the Al-Jouf region, divided and randomly assigned to an experimental group (16 teachers) and a control group (17).

3.4 Tools of the Quantitative Approach

The tools used in this approach were as follows: first, an observation checklist was prepared by the researcher in mind of measuring the effectiveness of the proposed training programme in the formative assessment, as based on active learning in the development of teaching performance of science teachers in the primary stage in Saudi Arabia; and second, a training programme encompassing 15 training sessions for a duration of two months, with only the experimental group exposed to this programme.

3.4.1 Programme Sessions Description

The programme adopted in the current research was a 15-training session focused on the strategic skills of using formative assessment based on active learning amongst the Saudi science teachers at the primary school level.

General Objective of the Programme

To achieve the development of teaching performance in the case of science teachers in the primary stage in light of a proposed training programme in formative assessment, based on the active learning strategy, according to the following objectives:

1- **To achieve the development of teaching performance in light of the use of the 'think in pairs' skill.**
2- **To achieve the development of teaching performance in light of the use of the 'group work' skill.**
3- **To achieve the development of teaching performance in light of the use of the 'questions' skill.**

Programme Approaches

The researcher adopted several approaches for training on the proposed programme, which took into consideration their suitability to the needs of science teachers being trained, the resources available, the duration of the programme, and the overall sample size. These approaches are discussions, cooperative learning, workshops and the exchange of visits amongst teachers.

Development of the Programme Content

The training sessions revolved around the following themes:

- **The differences between Behaviourist Learning Theory and Constructivist Learning Theory.**
- **The differences between formative assessment and summative assessment.**
- **The differences between learning and teaching, and assessment and evaluation.**
- **Training the teachers in the use of some strategies in formative assessment: for instance, explicit learning goals, collaboration between teachers and students, self- and peer assessment, and descriptive feedback to students concerning their performance.**

- **Give teachers practical examples of the importance of formative assessment in improving teaching.**

Programme Evaluation

- **Evaluation before training on the proposed programme: application of the pre-observation card on the study sample who have been trained on the proposed training programme.**
- **Evaluation during training on the proposed programme: evaluating the trainee's performance and the orientation thereof at the workshop and through the application of tasks to be implemented in the practical aspect.**
- **Evaluation after training on the proposed programme: application of the post-observation card on science teachers who have been trained on the proposed training programme.**

Credibility of the Proposed Programme

To verify the appropriateness of the training programme, the programme has been introduced in its initial form to a group of arbiters amongst the faculty members specialising in methods of teaching science in different Saudi universities. For example, such arbiters came from Al Jouf University, Northern Border University and University of Tabuk. The total number of the arbiters amounted to 10, in addition to 10 experts in education administration from different regions. The arbiters were asked to give their opinions on the content of programmes that were very focused on the use of the known formative assessment strategies.

3.4.2 Observation

The observation method had been used in this study to gather data on the implementation of active learning approaches in classrooms as a result of the effect of the formative assessment training programme with Saudi science teachers. The following areas are concentrated by the structure observation of the classrooms: (a) using of the 'think in pairs' technique, (b) using the 'group work' technique, and (c) using the 'questions' technique. The researchers observed all the teachers in both groups, i.e. the control and experimental groups, both before and after the training programme. The researcher used his observation checklist—or what was referred to as the card observation (see Appendix 1)—to record what she saw and heard during the class session of different subjects (45 minutes). The checklist was created by the research. Teachers' teaching performance in their observed lessons was rated according to the

18 features that describe active teaching, with a 4-point rating ranging strongly agree (3), agree (2), slightly agree and (1) not observed (0).

Validity and Stability

The card observation, in its initial form, was introduced to a number of professors specialising in curriculum and teaching methods in general and in methods of teaching science in particular, as well as to some educational supervisors at the Science Department, to express their opinion in terms of the association of each tool with the appropriate skill, the accuracy of such tools, and the clarity of their significance. After making the amendments recommended by the specialised professors, the card, in its final form, now comprises three basic skills, under each of which a group of sub-skills falls. In order to assess card stability, the researcher observed a number of eight science teachers in the primary stage (First Application). Six months later, the card was reapplied on the same sample (Second Application). Applying the Cooper Equation, the card's stability ratio was 92.0, which indicates the stability of the observation card.

3.5 Statistical Analysis

Due to this study aiming at identifying the effects of the proposed training programme on the experimental group compared to the control group, a comparison between the experimental group and the control group was carried out, as well as a comparison between the tribal and dimensional measurement using the T-test to denote the differences between the two groups by SPSS (Ver programme. 20.0).

4. Presenting Findings

This section presents the quantitative findings, as based on the T-test, in order to discover the effects of the proposed training programme in formative assessment, as based on active learning in the development of teaching performance of science teachers in the primary stage in Saudi Arabia. The researcher applied the programme, and data have been statistically processed by calculation of arithmetic means, standard deviations and (t) values for the differences between mean scores of members of the two groups.

4.1 Before Applying the Proposed Training Programme

The researcher analysed the pre-application results to ensure homogeneity of the study groups. The results are detailed in the following table.

Table 1: The differences between the averages of the experimental group and the control group before applying the proposed training programme.

skills	PrCntrl N=17		PrExper N=16		t	Sig.
	Mean	Std. deviation	Mean	Std. deviation		
Think in pairs	1.06	0,77	1.00	0.87	0.22	non statistical
Group work	0.50	0.52	0.94	0.83	1.82	non statistical
Questions	0.50	0.52	0.71	0.56	1.07	non statistical
The total	2.06	1.34	2.65	2.21	0.91	non statistical

The above table indicates an absence of statistically significant differences between the mean scores of the experimental and case–control study groups in the pre-performance of the 'think in pairs' skill, the 'group work' skill, the 'questions' skill and teaching skills as a whole. This indicates homogeneity of the two study groups in the results of each of the 'think in pairs' skill, the 'questions' skill, the 'group work' skill, and teaching skills as a whole.

4.2 Think in Pairs

The (t) value has been calculated in order to show the significance of the differences between the mean scores of the performance of the experimental group for the 'think in pairs' skill before and after the application of the proposed programme.

Table 2: The differences between the averages of the experimental group before and after applying the proposed training programme in related to 'think in pairs' skill.

skills	PrExper N=16		PoExper N=16		t	Sig.
	Mean	Std. deviation	Mean	Std. deviation		
Think in pairs	1.00	0.87	12.29	1.69	27.61	0.001

The above table show a statistically significant differences at 0.001 between the mean scores of the performance of the experimental group before and after the application of the proposed programme in favour of the post-performance of the 'think in pairs' skill, where the (t) value was 27.61, which is a high statistically significant value. This demonstrates that the programme has a positive impact on the development of the 'think in pairs' skill and the sub-skills falling under it.

Moreover, the (t) value has been calculated to show the significance of the differences between the mean scores of the performance of the experimental and case–control study groups in the post-performance.

Table 3: The differences between the averages of control group and the experimental group after applying the proposed training programme in related to 'Think in pairs' skill.

Skills	PoCntrl N=17		PoExper N=16		t	Sig.
	Mean	Std. deviation	Mean	Std. deviation		
Think in pairs	1.06	0.85	12.29	1.69	23.89	0.001

The table indicates the statistically significant differences at 0.001 between the mean scores of the performance of the experimental and case–control study groups in the post-performance in favour of the experimental group for the 'think in pairs' skill, where the calculated (t) value was 23.89, which is a high statistically significant value. This demonstrates that the proposed training programme has a positive impact on providing teachers with the 'think in pairs' skill and the sub-skills falling under it, where the experimental group outperformed the case–control group after their equivalence had been proven before the

application of the programme with respect to that skill.

4.3 Group Work

In order to show the significance of the differences identifiable between the mean scores of the experimental group's performance for the 'group work' skill, both prior to and following the adoption of the proposed programme, the (t) value was calculated.

Table 4: The differences between the averages of the experimental group before and after applying the proposed training programme in related to 'group work' skill.

Skills	PrExper N=16		PoExper N=16		t	Sig.
	Mean	Std. deviation	Mean	Std. deviation		
Group work	0.94	0.83	14.88	1.45	35.09	0.001

The table above shows that statistically significant differences at 0.001 between the mean scores of the performance of the experimental group before and after application of the proposed programme in favour of the post-performance of the 'group work' skill, where (t) value was 35.09, which is a high statistically significant value. This demonstrates that the programme has a positive impact on the development of 'group work' skill and the sub-skills falling under it.

Furthermore, the (t) value has been calculated in order to emphasise the significance of the differences between the mean scores of the performance of the experimental and case–control study groups following performance.

Table 5: The differences between the averages of control group and the experimental group after applying the proposed training programme in related to 'Group work' skill.

skills	PoCntrl N=17		PoExper N=16		t	Sig.
	Mean	Std. deviation	Mean	Std. deviation		
Group work	1.06	0.85	14.88	1.45	33.04	0.001

The above table shows statistically significant differences at 0.001 between the mean scores of the performance of the experimental and case–control study groups in the post-performance in favour of the experimental group for the 'group work' skill, where the calculated (t) value was 33.04; this is recognised as being a high statistically significant value. This emphasises that the suggested training programme has a positive effect on teachers having the 'group work' skill and its associated sub-skills, with the experimental group found to be more productive and performing better when compared with the case–control group after their equivalence had been proven before the application of the programme with respect to that skill.

4.4 Questions

T value has been calculated to show the significance of the differences between the mean scores of the performance of the experimental group for the 'questions' skill before and after application of the proposed programme.

Table 6: The differences between the averages of the experimental group before and after applying the proposed training programme in related to 'Questions' skill.

skills	PrExper N=16		PoExper N=16		t	Sig.
	Mean	Std. deviation	Mean	Std. deviation		
Questions	0.71	0.59	16.71	2.49	28.46	0.001

The above table shows that statistically significant differences at 0.001 between the mean scores of the performance of the experimental group before and after application of the proposed programme in favour of the post-performance of the 'questions' skill, where (t) value was 28.46, which is a high statistically significant value. This demonstrates that the

programme has a positive impact on the development of the 'questions' skill and the sub-skills falling within it.

Moreover, (t) value has been calculated in order to highlight the significance of the differences between the mean scores of the performance of the experimental and case–control study groups in the post-performance.

Table 7: The differences between the averages of control group and the experimental group after applying the proposed training programme in related to 'questions' skill.

skills	PoCntrl N=17		PoExper N=16		t	Sig.
	Mean	Std. deviation	Mean	Std. deviation		
Questions	0.69	0.48	16.71	2.49	25.23	0.001

The above table details statistically significant differences at 0.001 between the mean scores of the performance of the experimental and case–control study groups in the post-performance in favour of the experimental group for the 'questions' skill, where the calculated (t) value was 25.23; this is recognised as being a high statistically significant value. This highlights that the suggestion training programme is positive in giving teachers the 'questions' skill and its associated sub-skills, with the experimental group found to perform better than the case–control group after their equivalence had been proven before the application of the programme with respect to that skill.

4.5 The Training Programme's Impact in Formative Assessment, based on Active Learning

In the previous sections, the results in regard to the impact of the proposed training programme of the three skills were presented. The current section therefore will present the results linked to the impact of the proposed training programme in formative assessment, as based on active learning in the development of teaching performance of science teachers in the primary stage in Saudi Arabia. The (t) value has been calculated in order to show the significance of the differences between the mean scores of the performance of the experimental group for the main teaching skills as a whole both before and after the application of the proposed programme.

Table 8: The differences between the averages of the experimental group before and after applying the proposed training programme group for the main teaching skills as a whole.

skills	(Pre) Exper N=16		(Post) Exper N=16		t	Sig.
	Mean	Std. deviation	Mean	Std. deviation		
Think in pairs	1.00	0.87	12.29	1.69	27.61	0.001
Group work	0.94	0.83	14.88	1.45	35.09	0.001
Questions	0.71	0.59	16.71	2.49	28.46	0.001
The total (the whole skills)	2.56	2.21	43.88	3.35	52.93	0.001

The table shows statistically significant differences at 0.001 between the mean scores of the performance of the experimental group before and after application of the proposed programme in favour of the post-performance for the main teaching skills as a whole, where the calculated (t) value was 52.93, which is a high statistically significant value. This demonstrates that the programme has a positive impact on the development of the main teaching skills as a whole and the sub-skills falling under them.

Moreover, the (t) value has been calculated in such a way so as to highlight the significance of the differences between the mean scores of the performance of the experimental and case–control study groups in the post-performance for the main teaching skills as a whole.

Table 9: The differences between the averages of control group and the experimental group after applying the proposed training programme for the main teaching skills as a whole.

skills	PoCntr N=17		PoExper N=16		t	Sig.
	Mean	Std. deviation	Mean	Std. deviation		
Think in pairs	1.06	0.85	12.29	1.69	27.61	0.001
Group work	1.06	0.85	14.88	1.45	35.09	0.001
Questions	0.69	0.48	16.71	2.49	28.46	0.001
The total (the whole skills)	2.81	1.94	43.88	3.35	42.72	0.001

The table indicates statistically significant differences at 0.001 between the mean scores of the performance of the experimental and case–control study groups in the post-performance in favour of the experimental group for the main teaching skills as a whole, where the calculated (t) value was 42.72, which is a high statistically significant value. This demonstrates that the programme has a positive impact on the development of the main teaching skills as a whole and the sub-skills falling under them.

5. Discussion and Implications

This section discusses and synthesises the findings with a view to answering the research question: What is the effect of the proposed training programme in formative assessment based on active learning in the development of teaching performance of science teachers in the primary stage in Saudi Arabia? As can be seen when considering the analysis of the findings, it may be interpreted that there was a statistically significant difference between the experimental and the control group in favour of the experimental group (see tables 8 and 9). Hence, the proposed training programme, ongoing for a period of two months (60 hours), was successful in the development of teaching performance in formative assessment based on active learning. The study implemented intensive professional development, which, when combined with the application of knowledge in line with the instruction and planning of teachers, was found to be better at influencing teaching practices and, in turn, at results in

student learning gains. This finding is in line with Wiliam et al. (2004), who reported that teachers participating in professional development, as based on formative assessment for 18 months, significantly changed their perceptions of themselves as professionals.

However, this finding is inconsistent with the work of Yin et al. (2008), which treated science teachers with a short-term professional development session based on formatives assessments. Results from the study showed that the impact of the formative assessment treatment on these outcomes was not statistically significant. Hence, this finding was unanticipated, and therefore suggests that teachers who attend a one-off professional development workshop, or who are merely provided with new instructional materials, make few changes in their everyday professional practice (Meiers & Beavis, 2005). Darling-Hammond et al. (2009) showed that professional development programmes offering 30–100 hours (an average of 49 hours) over a period of 6–12 months had a 'positive and significant effect' on student achievement (p. 9). Professional development offering a limited number of hours (5–14) produced no significant impact in relation to achievement. This finding has important implications for the Ministry of Saudi Education in regards the view that providing support for science teachers is critical in order to implement what they are learning.

Teachers should be trained on assessment programmes to be updated with new moves (Alotabi, 2014). However, professional development requires strong, highly visible organisational support and could be implemented in many ways (Almazroa & Alshamrani, 2015). Sufficient time, resources and professional assistance should be provided in an effort to support Saudi teachers in integrating new knowledge and skills into everyday practices (ibid). Organisational support can be key to the success of any professional development effort (ibid). When Saudi teachers participate in a professional development programme on formative assessment, teachers have to implement their training in schools where students are only graded on a summative assessment (ibid).

Furthermore, it is recognised that formative assessment does not commonly arise in more conventional, teacher-focused lessons, which communication tends to be one-way, with students providing very little input (Gibson & Shaw, 2010). More conventional methods of assessment are usually viewed as unsuitable owing to the overall nature of active-learning experiences (ibid).

The suggested training programme in formative assessment, as based on active learning, had a positive impact in the development of teaching performance in relation to different skills, such as think in pairs (see tables 2 and 3), group work (tables 4 and 5) and questions (tables 6 and 7). These skills play a crucial role in helping teachers to improve their instruction. The interaction could help Saudi teachers to see learning as an active rather than passive activity, and to try to practice student-centred methods rather than the teacher-centred ones common in Saudi schools. It is the view of the writer that such a change would be valuable as formative assessment based on active learning essentially changes the overall frequency and quality of interactions between teachers and students.

The findings garnered in this work are recognised as consistent with Buck & Trauth-Nare (2009), who found that, after implementing formative assessment strategies within the classrooms, successful science teachers asked open questions to gain the trust of their students so the students would not shut down if they did not know the right answers. This finding is seen to run parallel with that of Panizzon & Pegg (2007), who found that teachers who attended a series of professional development sessions based on formative assessment experienced a major shift in teachers' perceptions of assessment, changing from a focus on the accumulation of students' marks to one of diagnosis as a means of directing teaching to enhance students' scientific and mathematical understandings.

On the other hand, however, the implementation of formative assessment could be limited by other conditions in the classroom. Carless et al. (2003), for example, found that teachers at all levels tend to meet heavy workloads; under such circumstances, it might be a challenge to expect them to engage into learning-centred discussion with individual pupils. When teachers are overloaded with a number of responsibilities, they may perceive formative assessment as something of a luxury.

To conclude, formative assessment is widely recognised as adding additional value in the domain of teaching and learning. Nonetheless, further work is required in the professional development arena as a way of improving this educational practice. Accordingly, this work sought to analyse the overall effectiveness of the training programme in formative assessment, based on active learning in the development of the teaching performance of science teachers in the primary stage in Saudi Arabia.

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Appendix 1: Teachers' teaching performance were rated according to the 18 features, with a 4-point rating ranging from strongly agree (3), agree (2), slightly agree (1) to not observed (0).

Skills	The level of performance			
Think in pairs	Strongly agree 3	Agree 2	Slightly agree 1	To not observed 0
Teachers divide the students in to couples to work on their tasks.				
Teachers allow students to share some questions with each other.				
Teachers encourage children to listen each other.				
Teachers encourage children to argue each other .				
Teachers encourage children to draw the conclusion.				
Group work				

Skills	The level of performance			
Think in pairs	Strongly agree 3	Agree 2	Slightly agree 1	To not observed 0
Teachers create a classroom environment that supports children to have active involvement in the classroom.				
Teachers arrange the students into groups of more than two pupils.				
Teachers encourage students to have discussion between each other on the task.				
Teachers allow sufficient time for group work				
The teachers connect the ideas raised to course content and objectives				
The teachers connect the ideas raised to course content and				

Skills	The level of performance			
Think in pairs	Strongly agree 3	Agree 2	Slightly agree 1	To not observed 0
objectives				
Questions				
Teachers ask open-ended questions.				
Teachers give enough time for students to think after asking questions.				
Teachers encourage students to ask questions.				
Teachers encourage children to learners to justify their response.				

Skills	The level of performance			
Think in pairs	Strongly agree 3	Agree 2	Slightly agree 1	To not observed 0
Teachers use the students comment to improve their teaching.				
Teachers use the students comment to improve their teaching.				
Teachers help students to take responsibility for their own learning.				