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Action Research to Improve Educational Practices: Case Study to Explore to What Extent Action Research Could Improve Teaching Practices

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Abstract

Action research is now a requirement to ensure continuous professional development. In most urban countries, it is even required for licensure. Encouraging teachers to become researchers and investigate various issues in their classroom would develop their teaching strategies and inform them about the level of their students' understanding. This instrumental case study research explored the effects of action research on improving teachers' pedagogical skills in their classrooms. The study was conducted with two volunteer science teachers in a private high school in Abu Dhabi, and data was collected from open-ended questions, semi-structured interviews, and document analysis. Results supported previous findings of the importance of action research to develop teaching practices, in addition to the essential requirement to include action research performance as a central element in teacher evaluation and appraisal processes discussion and recommendations.

Keywords: Action research, Biology education

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Introduction

Educational reform involves the development of several dimensions that would influence students' learning experience, including curriculum, instructions, and assessment practices. Teachers have a key role in leading this reform and guaranteeing successful results (Sandra Enger 2009). However, this requires commitment and enthusiasm from teachers to be self-regulated, inquire about their current practices, and continuously develop their teaching strategies to attain high expectations towards their students' achievement. In particular Sufian Forawi (2015) presented effective s research based strategies of professional development to enhance teachers to think and reflect upon their own practices.

Statement of the problem

In a study to describe teachers' situation of professional development in the UAE, Forawi, (2015) clarified that in order to achieve educational reform in the UAE, it is required to guarantee teachers' initial qualification, besides managing the continuous professional development that is concerned with keeping teachers' skills and knowledge aligned with recent educational development. In his model "UAE science Teachers Professional Growth" Forawi, (2015) suggested that teachers should contribute to a research-based professional development, which is in line with the promotion of action research as a tool for self-evaluation. If teachers were directed to use action research to identify strength and weakness points in their practices, they will then be able to improve their teaching strategies, creating a better learning environment for their students as well. The aim of this research study is to highlight the importance of using action research to evaluate science-teaching practices by involving teachers themselves, as they will be responsible for their own professional development.
One research question driving this study is "To what extent can action research improve high school science teachers' educational practices?"

Rational and significance

One dimension of educational reform is meant to empower teachers with the essential skills to promote their self-evaluation and independent professional growth. In global context, action research is considered a requirement to validate teachers' profession, seeing that it is adopted as a requirement in most of the international teaching standards. For example, the fourth proposition in the National board for Professional Teaching Standards (NBPTS) entails teachers to think systemically about their practices and learn from them. To fulfill this requirement, teachers must undertake several action research studies during their in-service years of experience. Locally, several studies identified challenges that hinder the use of action research as a professional development tool. Volk (2010) communicated with graduate students with a bachelor's degree in education to explore how they are implementing action research in their profession after graduation. The study revealed that only 25% (28 from 101) from the graduates performed action research, 15 of which were instructed to perform the research by their administration. This poor implementation occurred even though students received one semester of training on action research and how it should be utilized in the classroom before graduation. Graduates mentioned various reasons that hinder the implementation of action research, including time constraints and the amount of the workload required. Into the case of the UAE, however, Forawi, (2015) suggested that the best way to achieve developments in teaching practices is to promote teachers' ambition to learn and develop their own practices. However, teachers' responses in his study revealed little interest in the current professional development programs, due to the limited capacity compared to the amount of work required, which prevents teachers from seeking professional development, besides the lack of differentiation and practical skill development during the current programs. This is supported by a similar study regarding science teachers in Abu Dhabi performed by McMINN, M., KADBEY, H. (2015) revealed that teachers raised a concern regarding professional development, as they required support to develop their pedagogical practices and implement inquiry-based learning and student-centered activities. To overcome workload and time constraint challenges, teachers should be supported to utilize their daily activities in the classroom to collect data and adjust educational strategies, and the administration should consider the requirement of action research in distributing the workload on teachers (Volk, 2010; Forawi, 2015). Using the action research approach would help teachers achieve

desired professional development and improve their teaching pedagogies based on the issues that they face in their own classroom.

Structure of the research study

This research study includes five main sections. The current section introduces the aim and the significance of the research study. The second section, the literature review, presents the theoretical framework and pervious empirical studies that investigated science teachers' self-evaluation using action research. The third section explains the methodology and the research design of this study. The fourth section presents the results and data analysis. Finally, the fifth section compares the result with other research studies and summarizes the conclusion of this study.

Literature review

Theoretical framework

Science teachers and self-regulation

Self-regulation is a process that is utilized by all learners to improve their achievements. (Zimmerman 2002, 2013)defined self-regulation as autonomic actions and behaviors performed to achieve desired targets. He identified three main phases for this process: self-control or observation, self-reflection, or judgment and finally, the forethought phase, in which learners set goals and action plans for development. Schraw, Crippen, and Hartley (2006) identified similar steps required for a person to become a self-regulatory learner, including setting targets and strategies to achieve them, and monitoring progress made in achieving the goals. Through self-regulation, people undergo a sequenced learning experience, where new information is related to existing concepts, then interpreted to produce new rules and concepts. This is aligned with the constructivist learning theory (Long, M., Wood, C., Littleton, K., Passenger, T., Sheehy 2011; Slavin 2014). The constructivist theory suggest that learners can build new information and concept representations based on their pervious knowledge and form new schemas (Long et al, 2011). In education, teachers would discover new information from relating previous observations, allowing them to formalize a new approach in teaching. Following the zone of proximal development concept developed by Vygotsky, this can be achieved through utilizing reflective methodologies in collecting and analyzing data to investigate teacher' own practices, relating them to new knowledge gained through professional development, and making responsible decisions to reconstruct their instructional methodologies.

The Role of Action Research

(Swason 2005) suggested the theory-research-development-practice cycle adopted in Figure 1, to demonstrate the correlation between the constructivist theory in science education, action research, and development and the actual teaching practice, highlighting how each of them can be considered a starting point in this cycle. Using action research, educators use their practices as a starting point and undertake research to prove a theory or contribute to the further development of the field of education. As a type of research, action research is a systematic method in which a researcher develops a question regarding one of the teaching practices. Then, the researcher designs a procedure and selects suitable instrumentations for collecting data from students, parents, or other professional staff. After that, the researcher analyzes the data and comes to conclusions that answer the question asked at the beginning and support the development of teaching practices. Slavin, (2014) confirmed that action research provides an in-depth insight on educational practices for teachers or administrators. Furthermore, (Sandra Enger 2009) introduced action research

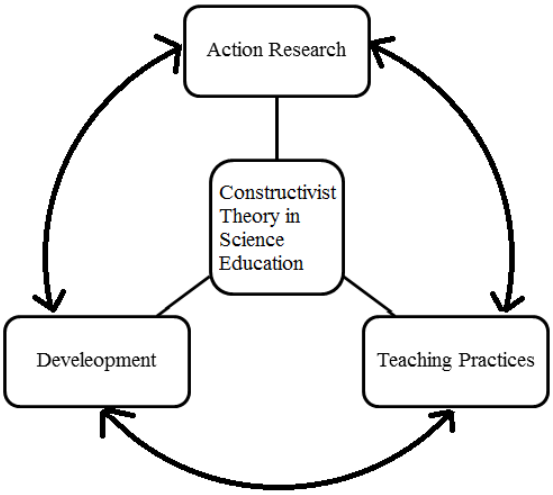

Figure 1Educational Theories Related to the Research

as a central research method used to evaluate teaching practices. When followed by the teachers themselves, they could develop their teaching strategies based on real data from their own classrooms. Similarly, Goodnough (2010) confirmed that an important conception of the relation between teachers' knowledge and their daily practice is "knowledge of practice" in which teachers are the central source of information and they generate knowledge based on systematic inquiry activities, then communicate their findings to inform curriculum development and school polices.

Features of Science Education

Besides improving innovation, creativity and design skills, science education has also majorly contributed to developing students' cognitive level (Hanauer and Bauerle 2012). During science instruction, teachers can provide various chances to enforce students' collaboration and the practice of appropriate problem-solving strategies (Bruce 2011). Ideally, the Science classroom should create the most suitable environment for students to develop 21st Century skills.

To encourage students to develop scientific reasoning and build scientific literacy, teachers should use inquiry-based learning within science instructions. Applying inquiry-based learning in science classrooms requires changes in teachers' behavior and pedagogical approaches. To measure the effectiveness of these changes, teachers can use numerous evaluation tools and perform self-evaluation strategies to reflect upon their practices and devise plans for further improvements. The role of science teacher research is to support teacher-learning (Anon n.d.) mentioned various examples on how science teacher research is considered an important method that improves teacher learning, including preservice and in-service programs that presented significant improvements in science teachers' learning.

Previous empirical studies

The field of education is vast and dynamic, which urges the necessity of continuous effort to address constantly raised questions and concerns in regular practices. Nolen and Putten (2007) confirmed that action research is an effective tool that should be introduced during early preparation for teachers and included it as an essential requirement in teacher licensure process.

Capobianco, and Feldman, (2006) emphasized that when teachers contribute to collaborative action research as one community, they will attain a better understanding of their teaching practices, since sharing their results with colleagues and administrations would deepen their understanding and further inform decisions makers to consider their findings when making improvements in the educational system. In a later study M, Capobianco. B. and Feldman (2010) described action research as the kind of inspection teachers perform to improve their practices and communicate their experience to the educational community. Likewise, a research study examined how teachers use their students' feedback to improve their teaching practices found that teachers used their students' feedback effectively to reflect upon their own practices and caused the implementation of instructional changes in the classroom (Jill M. Aldridge, Barry J. Fraser, Lisa Bell 2012). Additionally, a study regarding utilizing reflective practices in continuous professional development programs, McCullagh (2012) confirmed that using video recordings for a teacher's lesson would promote his/her own reflection upon his/her teaching practices, and accordingly improve teaching pedagogies. This result was supported by Vygotsky research regarding the zone of proximal development, as the teacher will view his current practices, interpret behaviors and actions, and then establish new rules and skills to improve practices observed. An example of an action research study by Trauth-Nare and Buck (2011), examined the use of reflective practices to inform teaching practices in the classroom; they found that the use of reflective practices in action research was necessary and crucial to develop their pedagogy and establish a trustworthy environment in the classroom. A recent study in Philippine by Morales et al. (2016) examined teachers' conceptions regarding the need of action research; their study revealed that teachers' belief in the power of action research to develop teaching strategies and achieve professional growth. However, they had concerns about the time available to conduct action research and the requirement of professional development to improve essential research skills required to undertake this type of study.

Research studies in literature described the effect of developing self-regulatory learning skills on teachers' readiness and performance in the classroom. Wright, Ellis, and Baxter (2012) suggested that the use of video recording for self-evaluation had a positive influence on teachers' behavior and can

be utilized as an effective professional development tool. Likewise, a Turkish study by Kösterelioğlu and Üniversitesi (2016) confirmed that teacher candidates were able to recognize their strength and weakness points after the utilization of self-assessment methods and argued that utilizing these methods will have a positive effect on their career in future. However, another study on the same topic done by Shawer (2010) investigated the effect of self-regulatory skills on student-teachers' ability to design their courses in a local university in the UAE. Unexpectedly, the results revealed that whether student-teachers presented high or low self-regulating skills, they had the same results in their ability to design courses. Different scenarios explained this strange result, including that student-teachers could be using self-regulatory learning skills unconsciously, or that the tools that were used to collect data regarding course design were not precise enough. All assumed scenarios required further research for more justification and scientific explanation. An additional extended case study by Mitchener and Jackson (2012) confirmed the importance of action research on teachers' self-directed professional growth. In their study, they presented how a teacher can utilize the action research cycle to investigate one question, find the gap between the teachers' target and students' performance, and conduct continuous assessment to collect data regarding students' performance. Literature also discussed methods to advance inquiry-based science education, seeing as it is important to support science teachers to change their beliefs and pedagogical practices to implement IBL instructions. A case study performed by (Tatar 2012) found that pre-service teachers' beliefs about inquiry were affected by their previous experience as students. However, whether the pre-service teachers experienced inquiry-based learning activities during their early education or not, they all developed their abilities to use inquiry-based instructions after an appropriate training as a part of their teacher preparation courses. A study by Selçuk, Çalişkan, and Şendur (2015) revealed that from teachers' perspective, there is a need to develop instructional practices that utilize active learning methodologies in science classrooms. A similar study by Hong and Vargas (2015) confirmed that most of the teachers contributed in their study believed in the importance of the implementation of inquiry-based instructions. However, their actual practices did not reflect their beliefs, as they required extra support and professional development to trust IBL instructions. To develop teachers' confidence in IBL they can be encouraged to perform action research to recognize their weakness points in implementing IBL, improve their teaching practices and establish an interactive classroom environment. One example of the utilization of action research to improve science education is a recent study regarding the development of Biology teaching instructions by Udeani, Atagana, and Esiobu (2016), who have successfully used action research methodology and proposed new curricular design to improve teaching practices.

Several recommendations were raised from literature reviewed in this study, Capobianco, and Feldman, (2010) and Morales et al., (2016) called for developing teachers' competencies in doing action research, in addition to improving the quality of the studies that are performed. (Dorman, Aldridge, and Fraser 2006) recommended further research to identify to which extent the use of students' feedback through action research can provide the required support for science teachers. Further research to investigate science teacher professional growth model (Forawi 2015) which requires teachers to participate in research-based professional development was also recommended. Therefore, the intention of the current study is to use a qualitative case study to explore the effect of action research on the improvement of high school science teaching practices.

Method

Design

The main research approach followed in this study is qualitative. The research type is a case study, to establish an in-depth understanding of the effectiveness of the use of action research in improving teachers' knowledge and educational practices. This inductive investigation uses data from document analysis and semi-structured interviews, collected in two weeks' time. The main purpose of data collection is to establish a detailed description regarding the effect of action research on teaching practices for secondary science teachers in a private school in Abu Dhabi(Creswell 2011; Merriam 2009). Case study is a distinctive research method in three ways: first, being specific to a particular situation, which makes it suitable to investigate the use of action research with three specific teachers. Second, being highly descriptive, as the product of this research will describe in detail how utilizing

action research affected each teacher and improved his/her teaching practices. Third, being heuristic, which means that at the end of this research study the reader will be able to identify the relation between action research and the development of teaching pedagogies (Merriam, 2009, p44). The researcher is the main instrument for data collection and analysis, through interviews and document analysis procedures (Merriam, 2009, p15). Based on Merriam's (2009) classification of case study, this research is an instrumental case study, as it focuses on understanding the in-depth effect of action research and establishes generalizations that could lead secondary science teachers' research in future.

Instruments

Participants

Purposeful sampling was followed in selecting participant teachers (Creswell, 2011). The researcher contacted several science teachers individually and explored whether they performed action research previously. Selected teachers are working in a private high school in Abu Dhabi. The interviews were arranged during the last week of term one in the Academic Year 2016-2017. During the semi-structural interviews, teachers responded to probing questions to share their experience in doing action research and reflected upon their results.

Limitation

Like most qualitative studies this study, case studies could provide valuable innovative results. However, due to the limited sample size, it will be difficult to establish generalization. Giving context details and comprehensive description of the results can generalize on similar situations possible.

Ethical consideration

The researcher explained the purpose of the research and the role of the researcher in the email sent to collect responses for the open-ended questions. In addition, the teachers who contributed to the interviews were informed that the information collected in this research will be confidential and anonymous. Their agreement to share the information was recorded at the beginning of the interview transcript (Steinar Kavle 2015).

Procedure

The tools used for this research are the recommended data collection tools for case studies, including semi-structured interviews, open-ended questions and document analysis (Merriam, 2009). Triangulation is achieved through collecting data from three different teachers using semi-structured interviews and document analysis. The open-ended questions were sent earlier for seven teachers to allow written responses as a third source of data that is used in thematic analysis. Based on teachers' responses, three were selected for the semi-structured interview and they were asked to share their artifacts that show the improvements after implementing the action research.

The following open-ended questions were used to categorize the information collected from the interviews and teachers' action research-associated documents.

- How did the teacher engage in the research inquiry procedure as a researcher?
- What was the improvement in the teacher's knowledge after the research?
- What implications did the research have on the teaching practices?
- What type of reflective practices the teacher uses to collect data for the action research?
- To what extent was students' feedback considered in the decision taken?

The use of interviews is common to collect data in qualitative research methods, as it provides full insight regarding participant responses and enables interactive questioning to explore the issue investigated in depth. The semi-structured interview in this study is guided by five main questions that could have flexible answers.

Specific data regarding action research is required from all respondents. The interviews are

recorded and transcribed to get precise information (Merriam, 2009). In literature, Morales et al., (2016) used open-ended questions and interviews to evaluate teachers' perceptions regarding the use and the importance of action research in their professional growth. In addition, Volk, (2010) used structured telephone interviews to explore graduate students' implementation of action research in their workplace. Another extended study used semi-structured interviews to collect data to gain additional insights on participants' views and changes in their pedagogical practices after a professional development session regarding action research implementation (Brown, Christopher 2016). The open-ended questions used in the interviews in this research focused on the nature of the investigation that each teacher undertook, the mechanism of data collection and the impact of this research on the development of the actual teaching practices in the classroom. A checklist was used to identify the methods of data collection and intervention plans prepared by the teacher.

Documents used in this research are personal written artifacts produced by teachers during and after they performed action research. The artifacts consist of the data collected to perform action research and action plans or specific lesson plans that show improvement in planning and implementation after the action research. The use of this data will be useful for the research results as they provide an extra source of data to confirm the information collected during interviews. In addition, they could present spontaneous data that teachers recorded unconsciously, which supports the research's integrity. On the other hand, as these documents were not produced for research purposes, hence, they could have irrelevant material that the researcher should be able to exclude (Merriam, 2009).

Results And Data Analysis

This section presents the data collected from the answers to the open-ended questions, teachers' interviews, and document analysis.

Open-ended questions

From the eight teachers who responded to the questions, five performed action research previously; two females did 3 action research studies, 1 male and two females did only one study in the previous three years. Problems questioned by the teachers in their studies were regarding science teaching methods and students' behavior. Methods used to collect data were questionnaires, interviews, self-evaluation forms, students' assessment results and video recordings. All the teachers who did action research clarified that it was beneficial, and they developed their teaching strategies accordingly.

Interview results

Two teachers, one female and one male both having 10 years of teaching experience in science and Biology agreed to contribute to the interviews, where five main topics were discussed. Detailed responses are listed below.

Type of the research

The female teacher did three different action research studies; one was extended for one year, and two other shorter studies. The topics were regarding improving students' competencies in learning science and Biology. The main cause for the inquiry investigation was a problem in students' results. The teacher was the researcher and started the inquiry process when she questioned the causes of the low achievement, as students were not able to use application, interpretive and analysis skills properly. Likewise, the male teacher did action research regarding the improvement of Grade 9 students' competencies in life science. The teacher was the researcher, as the management required all teachers to provide pieces of evidence on how they improve their students' skills. It is worth mentioning that the teachers were working in Lebanon when they performed the study. Hence, the management required each teacher to undertake this research, their career development and appraisal was linked to their performance in this research. This practice was described by UNRWA management of their official website, the teacher performance is evaluated through encouraging them to undertake action research (UNRWA 2016).

Reflective practices used in the action research

The female teacher used students' individual interviews to explore their understanding, in addition to the data collected from a series of formative assessment tools. Specific question analysis for students' responses enabled her to recognize individual gaps in learning, which was a tool used to bridge these gaps with the students. She explained the importance of question analysis tools as she said: *"When I analyze students' results, I look at each question and not looking at the entire mark. Each question requires a different competency and I want to make sure that the students gained this skill. The competency building is important, as we teach the students' how to get the information and not giving the information".* The male teacher introduced another reflective strategy, as he used video recording as a tool to investigate his own performance and identify strength and weakness points to address them in the following lesson, in addition to assessment results. The teacher explained the importance of using video evidence, as he stated that *"The most important thing for the teacher is to know his mistakes by himself, and to try to improve and cover all the missing points in his lesson. When a consultant visits the class he will give some points, but he can't identify specifically which point he can improve".*

Utilization of students' feedback

The female teacher utilized students' feedback during the individual interviews and asked them about the main cause of their low performance. Their input was then used to build action plans to deal with the problem. She commented that *"Maybe my way in the classroom was not suitable and they didn't understand, their feedback will help to change the method and address the problem and make an action plan. The good teacher shouldn't wait to document the action plan, as when the teacher faces a problem directly, he will address the problem and solve it"*. The male teacher also highlighted the importance of using students' feedback by using a questionnaire about teachers' practices, as he said: *"I may look at the class from different point of view form the students, or I think students should know the information and they didn't. It is important to get their feedback about their understanding*".

Knowledge and skill improvement

The female teacher was confident that the action research studies performed were beneficial to build her knowledge and skills, as now she can identify different problems in the classroom. Furthermore, she can address problems regarding the level of students' understanding and skill development by using suitable activities and class management strategies. Similarly, the male teacher clarified that teachers' improvement is cumulative and results from the experience of several years; In the long run, every action research will add new information and experience.

Pedagogical improvements

The female teacher confirmed that her skills in utilizing cooperative learning to implement different activities, and building students' self-regulatory skills, as she investigated each student response in the activity. In her statement, she mentioned that *"Each time you make an action plan, this will be additional experience for you. Without action plan involving the teacher solving problems in the classroom, he will not be a good teacher".* More specifically, the male teacher mentioned that he improved his strategy using teacher graph analysis and experimental design skills; he used groups of three in his research, so that he can control the differentiation in the class. He explained by saying that *"When three students work together, they will be all involved in the activity. I can know exactly the low achievers and high achievers; in groups of three they can help each other better".*

Document analysis

Looking at the artifacts provided by teachers confirmed the information provided in the interview. The female teacher provided her research paper entitled "To improve the performance of students in grade- 12- (society and economics) in Al-Galilee Secondary school in Beirut in (Interpretation of scientific documents) in life science subject". The research paper presented the research stages and the intervention plans implemented, along with question analysis sheets for the pre- and post-exams, that reflected students' progress and advancement in their critical thinking skills. The research paper explained the statement of the problem and different possible causes of this problem, the

students' results in the pre- quiz, identification of weak students, and causes of individual student's case that was presented through the individual interviews to identify the main weakness for each student. The research paper included suggested methodologies to solve the problem and the procedure used to select one methodology with a suitable justification. The document recorded the process of question analysis and the post-quiz results, then a comparison in students' results that showed 40% improvement.

Discussion, Conclusion, and Recommendations

Discussion

The aim of this study is to explore the extent to which action research could improve high school science teachers' educational practices. Five of eight teachers who responded to the open-ended questions performed action research and developed their teaching practices. However, three of the teachers who responded did not try the action research due to the workload and other responsibilities. The results established from this research revealed that teachers' knowledge, skills and pedagogical practices are positively affected by the implementation of action research. Together, the male and the female teachers agreed that they enriched their experience, as they were able to evaluate their own practices and address similar problems in their classroom after performing their action research studies. This result is confirmed by several studies in literature, which all agreed that self-evaluation and research have positive effect on teachers' performance (Forawi 2015; McCullagh 2012; Mitchener and Jackson 2012; Volk 2010). The proposal of action research as a professional development methodology is aligned with the numerous insights about measuring and improving teachers' effectiveness. Long et al, (2011) and Mitchener, and Jackson, (2011) explained the importance of using physiology and research in informing the actual practices in the field. Both teachers interviewed confirmed that they were encouraged to perform action research, because it was part of the teachers' annual appraisal and a cause for career advancement. When the male teacher was asked about the purpose of doing only one action research, his explanation was related to the amount of the daily workload required, in addition to the fact that the management did not require it. If the management required action research implementation, he was willing to undertake more studies. Generally, Forawi, (2015) clarified that the workload is a significant factor that hinders teachers from seeking professional development. In this study, it was observed that the implementation of action research was performed by only a minority of teachers. This observation is aligned with Volk's, (2010) findings as the he found that out of 101 graduate teachers, only 28 did action research after graduation, 15 of which received instructions from their respective managements to do so. To address this issue, it is recommended that administrators and policymakers reconsider teachers' workload, to allow them to have enough time for research and development. Then, specific policies should be developed to enforce action research implementation, which is proved to be an effective method to improve teachers' knowledge, skills and pedagogical practices. Campbell, (2013) confirmed that policy makers should consider the development of teachers' knowledge and skills to ensure educational effectiveness.

Regarding the use of reflective practices for data collection, teachers in the study used individual students' interviews. In addition, data was collected from question analysis for formative assessment to evaluate students' performance, identify gaps in their skills and develop methods to mentor individual students based on their level. This is similar to the study that used pre and post assessment to recognize development in students' competences (Lopes, J. Bernardino, Maria Júlia Branco 2010). The male teacher use of videos for self-evaluation confirms the results by McCullagh, (2012) which related the teacher's observation of his own lessons to the Vygotsky's zone of the proximal development theory, since the teacher will be able to identify his own mistakes and develop strategies to address all the gaps in his practices.

Students' feedback also played an important role in action research, as the teachers contributing to this study confirmed that students' input was essential to measure the success of their educational practices. This result is in line with study done by Capobianco, B.M. and Feldman (2006) as they confirmed that the researching teacher should collect information from multiple sources, from different points of view in order to have a better vision of their conclusion.

Conclusion

The current research study's conclusion confirms the importance of action research in closing the gap between the constructivist theory in science education and the actual classroom practices in schools. The teachers contributing to this study confirmed that they have developed the teaching techniques required to address students' needs and develop their scientific skills, after they undertook action research. When individual teachers undertake action research to answer a specific question, and change their teaching practices, then publish their findings or communicate them to the educational field, they will contribute to the development of teaching practices.

An important aspect that can be established from this research study is regarding the fact that teachers withdrew from undertaking action research due to their workload, and not being held accountable for consistently performing action research to develop their practices, and accordingly, their students' performance. Policymakers and administrators should consider teachers' workload and permit sufficient time for the implementation of action research. In addition, new polices should be implemented to add action research to other characteristics and requirement of the teaching profession, based on the consistent implementation of action research as a part of the teaching experience.

Implications in the educational field

The active involvement in action research would have several implications on science educational practices, including the validation of the teaching profession, as it is becoming an essential requirement for teacher licensing. Additionally, the valuable improvement of individual teaching practices, as they will be based on informed research. Furthermore, the application of action research will be a source of constructive feedback for curriculum developers and school administrations to make changes in educational policies and procedures according to the teachers' practical action research results.

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