Action Research in Science Teacher Education Program: Significance and Benefit According to the Students-Teachers' Assessments

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Abstract

Action research aims to train in-service professionals, encourage them to communicate their professional ideas, and build their evaluation abilities by encouraging instructors to be self-reflective and critical regarding their professional practices. The study analyzed the action research in the science teacher education program at Sultan Qaboos University according to the student's assessments. A sample of 111 male and female students from Sultan Qaboos University was collected for this study. For the statistical analysis of this study, Smart PLS 3.0 is utilized. This study found that teacher learning, teacher learning, and the relationship between instructors and students influence the implementation of action research. The work makes a substantial theoretical contribution to the existing body of knowledge. Furthermore, the work has practical implications for improving the implementation of action research in science teacher education programs. The future directions of this research are essential for advancing the body of knowledge.

Keywords. Action Research, Teacher Education, Student-Teachers, Sultan Qaboos University

1. Introduction

Since the beginning of existence, scientific investigation has been tied to the emergence of humanity. Man interacts with his surrounding environment, himself, and the components of his personality via his mind. Many scientific research methodologies contribute to solving issues given by scientists. Scientific research is

divided into basic research aimed at acquiring knowledge of theories, laws, and facts, abstract theory, and applied research focused on addressing specific problems and applying the results to problem-solving (Abdel Latif, 2021). Action research is the most notable example of applied research (Bawaneh, Moumene, & Aldalalah, 2020). Action research is one sort of applied scientific research since it focuses on applying theories, knowledge, or scientific laws to improve and develop reality by solving existing problems procedurally (Bendtsen et al., 2021).

Training in-service workers and encouraging them to express their professional opinions and develop evaluation skills is an important objective of action research. By encouraging teachers to be self-reflective and critical of their professional practices, action research provides a rich data source for improving their classrooms (Mayumbelo & Nyambe, 2019). It also motivates workers in the educational industry to conduct the study, read, and stay abreast of all worldwide changes occurring in their field of expertise, hence enhancing teamwork (Mohammed Idris et al., 2022). In attending to and caring for action research, the teacher's abilities and competencies have been honed to improve the educational process and its outcomes (Bjørke, Standal, & Mordal Moen, 2022). The faculties of Sultan Qaboos University have produced a handbook for action research as a contribution to developing a scientific and practical foundation for action research and its practice techniques.

The College of Education at Sultan Qaboos University aims to prepare distinguished teachers in their professional activities to satisfy the demands of the education area. It also prepares a graduate to be an educational leader with specific knowledge and the ability to maximize self-learning through research findings. Five axes comprise the conceptual framework of the Faculty of Education, including research culture and lifelong learning. It also aims to produce educators who can continuously improve their educational processes. The final semester of the student's education is devoted to practical training, and a course called the graduation project is taught concurrently. In this course, the student does procedural research to address and apply a specific research challenge in teaching the specialization. He analyses the results, makes his recommendations and proposals, and then offers a full report of what he has done, supported by evidence of his project implementation. There is a

continuous conversation between the instructors and their students, between the professors, and sometimes amongst the students over the suggested character of this course and the significance and value of studying it. Thus, this study examines this concept based on student evaluations since they are the beneficiaries of its study and are concerned with transferring the acquired knowledge to the future educational area. The study aimed to evaluate action research in the science teacher education program at Sultan Qaboos University based on student evaluations.

The significance of this study arises from the significance of action research as a course undertaken by students in the last semester of their Bachelor's and Educational Qualification Diploma degrees. The study will assist in directing those in charge of developing science teacher preparation programs and university professors toward a greater emphasis on this course due to its importance in equipping student-teachers with the skills necessary to conduct action research in the field, in line with local and international trends in graduating research teachers. This study can explain how the action research project might be implemented, which can assist the teachers and course creators at teacher preparation institutes and other universities. The study provides feedback to those in charge of the teacher preparation program - at Sultan Qaboos University and elsewhere - regarding students' perceptions of the importance of this course and the extent to which they benefit from it, thereby assisting them in enhancing the program to achieve the desired outcomes.

2.   Review of Literature

Action research is one of the user inputs in professional development for teachers. It aims to develop and adapt teachers' methods to prevent improvisation and unpredictability as much as possible in their teaching performance (Abdel Latif, 2021). Action research is defined by Aras (2021) as any systematic survey undertaken by research teachers, administrators, school counselors, or other stakeholders in the teaching and learning environment to collect data on how their schools operate, how they teach, and how effectively their students learn. Krause and Eilks (2019) defined it as "investigation, inquiry, and action taken by the teacher on his own to study the features of his teaching methods, and it can stem from a specific problem in the

classroom or the emergence of a new teaching idea and the desire to try it, to increase the teacher's knowledge and develop teaching beliefs and skills." It is defined by Banegas and Consoli (2021) as "an integrated plan in which organized inquiry is used to answer a (puzzling) question for which the researcher does not have an immediate answer, and the survey plan is implemented in a procedural manner that contributes to enhancing the teacher's practices and aids him in making the right decisions at work."

Darwin and Barahona (2019) characterized it as a participatory activity in which teachers grow their educational performance and practices or solve difficulties in the educational process by reflecting on their educational practices to effect the desired change in the educational process. Oolbekkink-Marchand et al. (2022) defined action research as a means that effectively contributes to the professional growth of teachers and provides an opportunity for creativity and excellence. The significance of action research lies in its ability to encourage the teacher to evaluate his performance, reflect on his practices, and identify the problems he faces. To improve the level and quality of education, the teacher will be able to solve them through an appropriate scientific approach and quick solutions to problems that cannot wait for a theory to solve them. He will also be able to issue judgments and correct them. Asif et al. (2020) discussed the significance of action research in the following manner. Increased problem-solving leads to a steady improvement in student performance. In addition, it seeks to enhance understanding of learners' experiences and learning processes and utilizes these insights to take action supported by evidence. In addition, it aims to give systematic patterns and models for problem-solving. Thus, it is for the development of existing projects and reality, as well as updating techniques for applying them to achieve profit from them by overcoming implementation barriers and locating suitable means. In addition, it is to diversify its implementation techniques and collect information and data about the issue through interviews, tests, questionnaires, records, observations, and diaries.

The qualities of action research are derived from its nature, concept, and philosophy. Burns (2009) described the following characteristics of action research: Secondly, it is grounded in the reality of educators' difficulties in their daily work and

classroom practices. Second, it is unique and local, addressing specific phenomena and focused on specific cases in space and time, influenced by the specificity of classroom instructional conditions. Lastly, it is participative, can be completed collectively or individually, and is cooperative in the majority. In addition, it is applied, whereas scientific research does not apply theories or analyze the applicability of their application. It is a type of inquiry based on continuous observation and follow-up of the reality of educational activity and what occurs during school and classroom activities, for instance. Action research steps are typically accompanied by reflective thinking, self-reflection, rethinking, discussion, and dialogue.

According to Idris, Eskender, Yosief, Demoz, and Andemicael, action research comprises five steps (2020). The first step entails defining the problem, in which the researcher selects an urgent practical issue that demands a remedy. The difficulty of the topic is crystallized in the form of a research question formulated by the researcher. Secondly, it is related to sufficient knowledge of the research topic, in which the researcher studies the topic in depth for the literature related to the research topic or its problem, which enables him to gain a thorough understanding of the research topic, and this includes the study of previous research related to the research topic. Finally, it relates to establishing a plan for data collection and change, in which the researcher prepares a precise design for the processes he will take in his research to bring about the desired change, and includes gathering data and information according to the nature of the research question (the subject of the study).

Moreover, it pertains to executing the processes and gathering, organizing, analyzing, and interpreting data. The researcher implements the procedures specified in the preceding steps to observe the impact of the researcher's procedures on bringing about the desired changes. The researcher employs appropriate research methods, such as interviews, surveys, observations, document analysis, or a combination of these, and then arranges the material in a manner that allows him to evaluate, interpret, and consider it to propose options. In the final step, the researcher notes his discoveries to solve the problem at hand, organizes his thoughts, and communicates the results of his research with others.

Implementing action research requires teachers and students to adjust their behavior to the modern instruments and procedures of research. Instructors must be able to enhance their students' understanding of the material and provide a relevant foundation for their research endeavors (Fraser et al., 2022). A teacher's performance improves when they meticulously study all research norms and criteria (Jiang, Yu, & Zhao, 2022). The trustworthy work of professors in their subject is an effective strategy to boost the quality of their research. Teachers' lack of motivation to improve their research techniques significantly impacted students' research-related comprehension (Julia et al., 2022). Action research is an indispensable method for instructors to progress and enhance their knowledge in their respective professions. In terms of learning and comprehension, students and teachers may benefit from having access to research procedures that adhere to accepted research methodologies (Chatzopoulos et al., 2022). There should be no distinction between teacher-student relationships, and the contact between teachers and students should be considered effective (Bergmark, 2022). Students research skills and methodologies can be enhanced with adequate teacher training, expanding their chances (Mohammed Idris et al., 2022). Following a review of the relevant literature, the following hypotheses are developed:

Hypothesis 1: There is a relationship between teacher learning and action research implementation.

Hypothesis 2: There is a relationship between teacher training and action research implementation.

Hypothesis 3: There is a relationship between the student-teacher relationship and action research implementation.

3. Methodology

The study population consisted of students from Sultan Qaboos University, and the study sample was selected using simple random sampling as one of the statistical methods employed to represent the study population in accordance with the rules governing the selection of samples in scientific research. 111 male and female students comprised the study sample, and the questionnaire was delivered electronically. The distribution of the study sample is shown in Table 1.

Table 1. Distribution of the study sample according to the primary data (n = 111)

Variable	Category	No.	Percentage
Gender	Male	14	%12.6
	Female	97	%87.4
Program	Bachelor	54	%48.6
	Educational diploma	57	%51.4
GPA	2.29-2	1	.9%
	2.74-2.30	36	%32.4
	3.29-2.75	56	%50.5
	3.74-3.30	16	%14.4
	4-3.75	2	%1.8
Major	Other majors	51	%45.9
	Science (Physics, Chemistry, Biology)	60	%54.1
The nature of the project that was implemented	Research project	107	%96.4
	An applied project without research	4	%3.6
The research methodology carried out	Experimental	85	%76.6
	Descriptive	16	%14.4
	Theoretical (data not collected)	-	-
	Content analysis	3	%2.7
	Case study	7	%6.3
The number of the research sample	Less than 5	2	%1.8
	From 5 to 30	32	%28.8
	From 31 to 60	37	%33.3
	More than 60	40	%36
Data collection instruments	Achievement and thinking tests	90	%59.6
	scales of attitudes and opinion survey	39	%25.8
	Performance observation card	13	%8.6
	Interviews	9	%6

To meet the study's aims, a questionnaire was utilized to collect data about the study's issue, which was produced and developed according to the criteria established by researchers in prior studies and literature. The study instrument was presented to a group of specialists in the field of education to ascertain their opinions regarding the instrument's items' suitability for the purpose for which it was designed, as well as the clarity and correctness of the linguistic wording, and their opinions and suggestions were taken into account until the instrument reached its final form. The internal consistency was validated by computing the Pearson correlation coefficients between the degree of each item and the overall degree of the domain to which it belongs; the findings are presented in the tables below. This research employs Smart PLS 3.0 for statistical data analysis.

4.   Data Analysis and Findings

After depackaging the data in Smart PLS, the normality of the study's data is assessed with skewness and kurtosis values. The significance of skewness and kurtosis for data normalcy is realized when both values are between -1 and 1 (Bai & Ng, 2005; Kim & White, 2004). The results are statistically significant for skewness and kurtosis, as seen in Table 2.

Table 2. Data Normality

	No.	Missing	Mean	Median	Min	Max	Standard Deviation	Excess Kurtosis	Skewness
TL1	1	0	3.267	3	1	7	1.500	-0.424	0.086
TL2	2	0	3.267	3	1	7	1.781	-0.561	0.433
TL3	3	0	3.502	3	1	7	1.886	-0.817	0.309
TL4	4	0	3.502	3	1	7	1.900	-0.797	0.380
TL5	5	0	3.533	3	1	7	1.697	-0.433	0.294
TT1	6	0	3.511	4	1	7	1.787	-0.654	0.243
TT2	7	0	3.498	4	1	7	1.843	-0.900	0.149
TT3	8	0	3.680	4	1	7	1.856	-0.779	0.186
TT4	9	0	3.729	4	1	7	1.848	-0.736	0.305
TT5	10	0	3.671	3	1	7	1.923	-0.766	0.354
STR1	11	0	3.556	3	1	7	1.869	-0.697	0.375
STR2	12	0	3.582	3	1	7	1.841	-0.609	0.359
STR3	13	0	3.613	3	1	7	1.837	-0.681	0.318
STR4	14	0	3.484	3	1	7	1.764	-0.473	0.417
STR5	15	0	3.538	4	1	7	1.902	-0.896	0.209
ARI1	16	0	3.471	3	1	7	1.799	-0.631	0.292
ARI2	17	0	3.667	4	1	7	1.741	-0.566	0.252
ARI3	18	0	3.067	3	1	7	1.482	-0.106	0.603
ARI4	19	0	3.187	3	1	7	1.497	0.482	0.870
ARI5	20	0	3.236	3	1	7	1.434	0.847	0.937

Furthermore, the study's reliability and validity are tested with a convergent validity test. The Cronbach alpha, composite reliability, and average variance factor is determined. Furthermore, the factor loadings values are also considered for this test. The outcomes reported in Table 3 show that the research has achieved significant Cronbach alpha > 0.70 (Taber, 2018), composite reliability > 0.70 (Alarcón, Sánchez, & De Olavide, 2015), average variance extracted > 0.50 (Alarcón et al., 2015) and factor loadings 0.60 (Peterson, 2000). Therefore, the data has reliability and validity.

Table 3. Convergent Validity

Construct	Items	Factor Loadings	Cronbach's Alpha	Composite Reliability	Average Variance Extracted
Action Research Implementation	ARI1	0.850	0.896	0.922	0.702
	ARI2	0.842			
	ARI3	0.816			
	ARI4	0.858			
	ARI5	0.822			
Student-Teacher Relationship	STR1	0.910	0.944	0.957	0.818
	STR2	0.886			
	STR3	0.923			
	STR4	0.902			
	STR5	0.900			
Teacher Learning	TL1	0.902	0.941	0.955	0.810
	TL2	0.908			
	TL3	0.914			
	TL4	0.894			
	TL5	0.881			
Teacher Training	TT1	0.924	0.949	0.960	0.829
	TT2	0.912			
	TT3	0.893			
	TT4	0.903			
	TT5	0.920			

Consequently, the Heteritrait-Monotrait (HTMT) approach is also used to test the discriminatory validity of the data. This method of discriminant validity yields statistically significant results when HTMT values are less than 0.90. (Gold, Malhotra, & Segars, 2001). The statistics shown in Table 4 revealed the significance of this test. The research data, therefore, have discriminant validity.

Table 4. HTMT

	Action Research Implementation	Student-Teacher Relationship	Teacher Learning	Teacher Training
Action Research Implementation				
Student-Teacher Relationship	0.768			
Teacher Learning	0.709	0.778		
Teacher Training	0.687	0.687	0.694	

Using the partial least square method, the study hypotheses are confirmed in a major way. The results were evaluated using a significance level of p 0.50 (Sarstedt & Cheah, 2019). According to the results, hypothesis 1 is significant and correlates with

teacher learning and action research implementation. In addition, it is observed that hypothesis 2 is significant and that there is a correlation between teacher training and the execution of action research. Similarly, it is reported that hypothesis 3 is supported, and a correlation exists between the student-teacher relationship and action research implementation. The results of these tests are shown in Table 5.

Table 5. Path Results

	Original Sample	Standard Deviation	T Statistics	P Values
Teacher Learning -> Action Research Implementation	0.526	0.119	4.414	0
Teacher Training -> Action Research Implementation	0.223	0.028	7.964	0
Student-Teacher Relationship -> Action Research Implementation	0.129	0.019	6.789	0

5.   Discussion

According to the partial least square approach, the results of this study are widely recognized. The first hypothesis stated that empirical evidence confirms the relationship between teacher learning and action research implementation. This association is novel to the literature but is tested by comparing these findings to those of past studies. Teachers must have the abilities necessary to expand their understanding of research and give students a practical guide for improving their research actions. When a teacher works diligently to master all research norms and criteria, the instructor's performance improves (Fraser et al., 2022). Teachers' dependable work in their research fields is a crucial strategy to improve the quality of their research. Teachers less eager to develop their research skills failed miserably to improve their pupils' research-related comprehension. Undoubtedly, action research is crucial for developing and enhancing instructors' expertise in their particular fields (Jiang et al., 2022). The practical work of the research is important because it can enhance the teachers' comprehension and advancement. When a teacher has strong research skills, his performance improves, resulting in a more trustworthy output for that particular research. Teachers' research should be improved over time, and they must attend many seminars to get a deeper understanding of the discipline (Jiang et

al., 2022). The reliability of research is a resource for educators that may be utilized realistically with appropriate ways to improve knowledge and behaviors.

Likewise, the second hypothesis stated that empirical evidence confirms the association between teacher training and action research implementation. Significantly, this relationship is novel to the literature but is tested by comparing these findings to those of past investigations. The action research projects aim to enhance the teachers' comprehension and professional development. Those teachers who possess enough work skills are in the right direction to do action research (Chatzopoulos et al., 2022). Instructors must have the required instruction to increase and enhance their research degree. The growth of research can serve as a resource for teachers to learn more and improve the research practices of their pupils. Teachers' abilities and knowledge should be improved over time and provided with more stable employment possibilities to hone their research abilities (Bergmark, 2022). The availability of research abilities following research methodology can facilitate teachers' and students' learning and comprehension. There should be no distinction between the interaction between teachers and students and the relationship between students and teachers (Mohammed Idris et al., 2022). Fair training of teachers to students can enhance students' research skills, thereby advancing their research practices and creating greater chances for students.

The final hypothesis concluded that empirical evidence confirms the association between the student-teacher relationship and action research implementation. In addition, this link is novel in the literature; nonetheless, comparing these findings with those of previous research is undertaken to validate the results. For a more accurate evaluation of pupils, teachers and students should maintain an equitable connection because action research is an essential method for advancing and enhancing instructors' subject-specific knowledge (Møller-Skau & Lindstøl, 2022). The research's practical applicability is noteworthy, which can improve instructors' understanding and professional development. A teacher adept at conducting research will perform better and generate more reliable findings (Murphy Odo, 2022). The development of teachers' research should be enhanced over time, and they should participate in seminars designed to enhance their research

comprehension. By employing the appropriate strategies, educators can utilize the reliability of research to enhance their practices and comprehension (Bice & Tang, 2022). The action research projects aim to enhance the instructors' understanding and professional growth (Poulter & Cook, 2022). Teachers who are competent in their occupations are ideally suited to conduct action research (Yuan et al., 2022). To realistically grow and improve their level of research, teachers must obtain the appropriate training (Smets, De Neve, & Struyven, 2022). The advancement of research may provide teachers with new information and possibilities to assist students directly with their research techniques (Saribas & Akdemir, 2022). The teachers' abilities and knowledge should be enhanced over time, and those who expand their research skills may have greater opportunities for secure employment.

6.   Conclusion

This study's findings revealed increased interest in procedural research and training in its usage, as well as the creation of favorable conditions for university-based users. Moreover, this study suggested that using various research methods to conduct procedural research, including observation cards and interviews, is essential. Thus, the institution should provide action research training courses and seminars for students and professors. In addition, engaging and encouraging instructors and students to do action research to fix the challenges they confront in the field is essential. In addition, it is shown that designing a set of procedures to assure the implementation of the program designed for this aim and its follow-up, evaluation, and evaluation is essential for its success.

7.   Theoretical and Practical Implications

This study adds to the body of knowledge, and the relationship it establishes contributes to the corpus of literature. The research has made a substantial contribution to the body of knowledge by demonstrating that teachers' learning has a considerable impact on implementing action research. In this regard, the findings of this study are novel in the scientific literature, as no other investigations have documented these implications. In addition, the research has contributed significantly to the literature by

demonstrating that teacher training has a considerable impact on implementing action research. Thus, the findings of this study are novel in the scientific literature, as no prior investigations have documented these implications. In addition, the research has contributed significantly to the literature by demonstrating that the student-teacher relationship substantially impacts the implementation of action research.

Moreover, the findings of this study are novel in the scientific literature because these implications have not been previously documented. Thus, these ramifications are novel to the corpus of literature and will give scholars detailed insight into the interaction between these variables. Thus, this research's theoretical contribution to the knowledge of action research implementation is credible. In addition, this study revealed that action research is crucial for teachers to improve student projects and research. The training and education of teachers are the primary sources for advancing action research. When teachers receive the proper training to do action research, they will improve the student's knowledge and performance in this area. The relationship between professors and students is essential for students' mindful learning.

8.   Future Directions

This study found that teacher learning, teacher learning, and the relationship between instructors and students influence the implementation of action research. The work makes a substantial theoretical contribution to the existing body of knowledge. In addition, the work has practical implications for enhancing the application of action research in programs for science teacher education. The study advised that researchers investigate the moderating effect of curriculum policies on the relationship between teacher learning and action research implementation. Similarly, the study revealed that researchers must investigate the impact of innovation adoption as a mediator between teacher learning and action research implementation. The study concluded by recommending that researchers establish the moderating effect of management support on the relationship between teacher learning and action research implementation. The future directions of this research are essential for advancing the body of knowledge.

9.   Acknowledgments

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