Practices of Science Teachers in Action Research Skills and Their Relationship with Research Ethics

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Abstract: This research examined science teacher methods in action research skills and their connection to research ethics. Two tools were prepared for the study; The first is about science teacher practices in action research skills (35 items in 5 fields): Problem identification, data collection, hypothesis formulation, data analysis and results. The second tool is on research ethics (40 items in 5 areas: Appreciation for scientists, scientific honesty and openness, scientific freedom, caution, and vigilance. Both tools were tested on a random sample of 86 teachers after verifying reliability and validity. Results found that science teachers typically practice very high levels of action research skills and 3 fields had been extremely high in this particular regard: Problem identification, data analysis results, and two fields being high level: data collection & hypothesis formulation. Research ethics in science teachers as a whole was extremely high (four fields had been extremely high): caution and vigilance, productivity, scientific freedom, and scientific integrity, and one field is at a high level, which is appreciation for scientists. The results also showed no statistically significant difference at the significance level (0.05) between the means of the estimates of the study sample members on the study tool related to the practice of science teachers in action research skills as a whole and each of its fields, as well as their estimates on the study tool related to research ethics as a whole and each of its fields attributed to the variables of gender and academic qualification. There was a positive and statistically significant relationship at the significance level (0.05) between the estimates of science teachers on the study tool related to the practice of science teachers in action research skills as a whole and their estimates on the tool related to research ethics as a whole.

Keywords: Action Research Skills, Research Ethics, Science Teacher.

1. Introduction

Many specialists and those working in the field of education have focused on training teachers and paying attention to their professional growth. Nowadays, teachers face more responsibilities than before and are required to be teacher-researchers. There are many requirements that teachers must meet to be capable of fulfilling their roles as researchers, such as being accustomed to practicing scientific research and being trained in skills that help them improve the school and effective teaching. When the characteristics of scientific research overlap with the interests of the supporting entities or with the personal interests of the researcher, or when research touches on sensitive issues related to human rights and conducting experiments on living beings, there must be ethics governing this field. These ethics contribute to the development and organization of scientific research

through laws and ethical rules that regulate researchers and research, ensuring that scientific research proceeds in the right direction and thus achieving the desired goals.

Scientific research, in its various forms from basic to applied, is considered a fundamental pillar in the professional advancement of teachers, especially in the field of education. Since the 1940s, action research has emerged as an effective tool linking theoretical knowledge with practical applications, enabling teachers to identify and address professional problems effectively [1,2]. Action research is also characterized by encouraging teachers to engage in critical thinking and improve their teaching practices through the use of a scientific methodology that enhances effectiveness and efficiency in the work environment [3,4].

Modern advancements have made teachers more responsible and also need them to become teacher-researchers who address complicated academic problems and enhance educational performance through scientific research [5]. This dynamic calls for continuous training and development of research skills for teachers to meet challenges efficiently and to attain professional and educational objectives [6,7].

With all the focus on strong professional ethics in research, ethical standards for scientific honesty and transparency have received greater attention. These ethics are considered vital to ensure the safety, respect for fair treatment, and human rights of research subjects [8,9]. Consequently, ethics gets involved in promoting trust and cooperation between teachers, researchers, and research participants to be able to attain the educational objective and desired positive change [10].

This research examines how science teachers in Jordanian schools engage in action research in developing educational procedures and addressing practical issues of students and teachers. Despite the vital role of this particular research in the development of educational performance and also the professional abilities of teachers, prior studies demonstrated reduced attention to this at the local and Arab levels. The research also indicates a deficit in training programs and academic materials that support science teachers in conducting highly effective research practices. This study discusses this issue and also suggests useful solutions to enhance the professional and educational competence of science teachers, examining research ethics together with the research methodology. Questions concerning the practice of research skills and research ethics amongst teachers and differences in these practices by gender and academic qualification will be answered.

2. Theoretical Framework

2.1. Studies Related to Action Research

Action research is relevant for academic methods and teacher professional development. Studies show its crucial role in student learning outcomes. For instance, Hillson (2008) found that teachers taking part in action research projects saw increases in students' science achievement [11].

A study from Colin et al. (2010) confirms this understanding by demonstrating exactly how designing educational activities within the context of action research can help teachers evaluate and improve students 'understanding of science's nature. This highlights that action research offers concrete tools for creating effective and interactive teaching methods [12].

Conversely, research has addressed the cognitive consequences of action research on teachers and students. The theoretical understanding of mathematics teachers and students following training in action research got better in Adam's (2010) study, indicating its professional and educational value [13].

In the context of building action research skills amongst teachers, the research of Al-Mazrou and Al-Muzaini (2012) explains the way a proposed instruction can help create these skills and boost understanding of science education among in-service science instructors in Riyadh. The study utilized a training program created for this purpose, and pre and post-tests measured the program's effect on a randomly selected group of sixteen teachers. Results confirmed substantial improvement and statistically significant distinction between performance before and after training in the areas of action research understanding, critical thinking, and planning abilities [14].

These results are consistent with results from Madbouli's (2013) research in the Ras Al Khaimah academic area concerning the dynamics of the connection between teachers' practice of

action research and their professional growth. Using a descriptive approach and a questionnaire as research tools, and 106 teachers as samples, specialization, years of experience, and educational qualification were not related to clarity of the concept of action research among teachers. The study revealed a decline in the conception and practice of action research on a personal level amongst sample members along with a need to enhance such methods within educational institutions [15].

In contrast, Abu Ali and Tarawneh (2020) checked out how science teachers in Jordanian schools practiced action research skills. Using a descriptive approach and a detailed questionnaire consisting of 36 items distributed more than five main action research skills, the level of practice of these skills was moderate among teachers. Results additionally suggest that gender didn't impact the difference in the level of practice whereas academic qualification demonstrated a much better degree of practice for bachelor's and doctorate students [16].

Results from Sayed & Al-Omari (2015) reveal that the majority of teachers have not yet mastered action research skills. This highlights the need for systematic and ongoing training to enhance these skills for the education processes [17].

2.2. Studies Related to Research Ethics

Research ethics is a hot topic for promoting integrity and honesty in academic circles. The study of Ado Gyamfi & Okech (2010) outlined standards for the ethics of scientific research and the need to follow an ethical code that bolsters research quality in mathematics education [18].

Al Awad (2012) examined the academic role of faculty members in promoting scientific integrity among female graduate students and discovered that faculty members had been usually supportive of the educational part in the ethical element [19]. In comparison, research ethics among students of the humanities colleges at King Saud University are highly valued without any statistically significant gender or academic ranking differences, based on Al Habib and Abu Kareem (2012) [20].

Al-Harithi (2015) found moderate awareness of research ethics among graduate students, especially in application methods and data collection [21]. Nevertheless, Abahussain (2018) confirmed that female graduate students in education adhere closely to research ethics and advocate continued coordination between universities and institutions to enhance religious inspiration and ethical values [22].

These studies indicate the demand for creating and enforcing stringent ethical standards in scientific research and also the need for constant education and direction in promoting these ethics in the academic environment. The research examines how action research might be applied to improve the researchers' very own ethics. Investigating the relation between action research practice and teacher professional development, the report discusses the interaction between research skills development and ethics enhancement in training and research practice. This is a first step to finding out how educational and research excellence can be attained from the continuous and practical application of action research. Hence, action research is placed as a vital tool in the improvement of education and the professional and ethical abilities of teachers to be able to raise the education level and the quality of learning in schools.

3. Methodology

The study utilized the descriptive correlational technique to examine science teacher practices in the fields of action research and researcher ethics and discover their relationship. The study population comprised 483 teachers in public schools under the Directorate of Education for the Kasbah Irbid District for the 2020-2021 academic year to attain the study objectives. The teachers represented science areas like physics, chemistry, biology, and earth sciences.

A randomly selected group of eighty-six teachers from grades nine to 12th grade was chosen. Specially designed questionnaires were distributed for data collection after directorate approval. Questionnaires have been constructed based on theoretical literature and prior studies regarding action research and research ethics.

The first was a questionnaire measuring science teacher practice in the fields of action research (35 items across 5 primary axes): Problem identification & hypothesis formulation, data collection and data analysis, and conclusion. Each axis was derived from studies like Abu Omar and Tarawneh (2018) [16].

The second tool is a research ethics questionnaire (40 items on five axes: Appreciation for scientists, scientific honesty, openness, scientific freedom, caution, and vigilance. This particular tool is derived from literature and earlier research such as (Al-Attar, 2013; Al-Hajriya, 2011) [23,24].

The collected data were analyzed to disclose levels of action research practice and ethics amongst teachers and correlational relationships between these two. This descriptive correlational approach enables us to understand how research practices and ethics impact scientific education in schools.

4. Results and Discussion

The current study investigated science teachers 'practice of action research skills and their relationship to research ethics. Results answering the study questions are given below in order of sequence.

4.1. First Research Question: (RQ1)

"How well do science teachers practice action research skills?" This question asked how the means and standard deviations of the estimations of study sample members on the items of the study tool associated with science teachers' practice of action research abilities in general and each of its fields were computed. Results in Table (1) suggest a very high mean and standard deviation for science teachers' practice of action research skills.

Problem identification (mean 4.26) topped the list indicating their ability to develop research problems clearly and correctly. This reflects an awareness of the practical and theoretical foundations in identifying research questions to answer. The ability to conclude came in 2nd with a mean of 4.25, indicating the teachers' ability to justifiably and objectively connect the result to the analysis concerns and also to describe outcomes obtained.

Data collection skill (mean 4.18) demonstrated mastery of this particular skill despite challenges in gathering information from different sources. This shows that they can work with various methods and sources to gather the knowledge required for research. Data analysis skills (mean 4.22) demonstrate that the teachers can interpret information using proper statistical approaches and draw reasonable conclusions.

Finally, the skill of hypothesis formulation (mean 4.16) came last, reflecting some difficulty in converting research questions into ideal hypotheses. This suggests the importance of enhancing this ability through particular training which improves teachers' ability to form more accurate and impactful hypotheses.

These results confirm that science teachers are competent in various action research areas and highlight areas for further development and support.

Table 1. The Means and Standard Deviations of the Estimates of the Study Sample Members on the Items of the Study Tool Related to Science Teachers' Practice of Action Research Skills as a Whole, and Each of Its Fields, Ordered Descendingly According to the Means

Field No.	Field	Means	Standard Deviation	Rank	Level
1	Problem Identification	4.26	0.50	4	Very High
5	Results	4.25	0.57	3	Very High

4	Analyzing Data	4.22	0.65	2	Very High
3	Collecting Data	4.18	0.52	5	High
2	Hypotheses Formulation	4.16	0.49	1	High
	Science Teachers' Practice of Action Research Skills as a Whole	4.21	0.48		Very High

*For each field, the minimum score is (1) and the maximum score is (5).

4.2. Second Research Question:(RQ2)

This question states: "Are there statistically significant differences at the significance level (0.05) between the means of the estimates of the study sample members on the items of the study tool related to the practice of science teachers of action research skills as a whole and each of its fields attributed to the variables of gender and academic qualification?" To answer this question, the means and standard deviations of the estimates of the study sample members on the items of the study tool related to the practice of science teachers of action research skills as a whole were calculated according to the variables of gender and academic qualification, as shown in Table (2).

Table 2. Means and Standard Deviations of the Estimates of the Study Sample Members on the Items of the Study Tool as a Whole Related to the Practice of Science Teachers of Action Research Skills According to the Variables (Gender and Academic Qualification).

Variable	Level/ Category	Means	Standard Deviation
Gender	Male	4.21	0.45
	Female	4.22	0.51
	Total	4.21	0.48
Academic Qualification	Bachelor	4.21	0.49
	Master Degree	4.23	0.34
	Total	4.21	0.48

The results in Table (2) related to the question "Are there statistically significant differences at the significance level (0.05) between the means of the estimates of the study sample members on the items of the study tool related to the practice of science teachers of action research skills as a whole and each of its fields attributed to the variables of gender and academic qualification?" indicated no statistically significant differences attributed to the gender variable in the estimates of the study sample members regarding the practice of science teachers' action research skills as a whole. This result can be explained by the similarity in the qualification and training programs that both male and female teachers undergo in Jordanian universities and the courses offered by the Jordanian Ministry of Education during service. Additionally, the uniformity in the conditions and resources available in public schools for both genders contribute to this result.

Similarly, the results also indicated no statistically significant differences attributed to the academic qualification variable. This result reflects the effectiveness of the educational qualification programs and courses related to training students in scientific research methods and techniques offered by Jordanian universities, which equally contribute to enabling science teachers of various

academic degrees to acquire action research skills with comparable proficiency. These results align with the findings of Madbouli's (2013) and Sayed and Al-Omari's (2015) studies [15,17], which indicated no statistically significant differences in the mean scores of the sample members in the skills test based on academic qualification.

These results confirm the equality in educational and training opportunities provided to science teachers in Jordan, contributing to equal opportunities in developing professional skills regardless of gender or academic level.

4.3. *Third Research Question:(RQ3)*

This question states: "What is the level of research ethics among science teachers?" To answer this question, the means and standard deviations of the estimates of the study sample members on the items of the study tool related to the research ethics of science teachers as a whole, and each of its fields—appreciation of scientists, scientific integrity, productivity, scientific freedom, and caution and vigilance—were calculated. Table (3) shows this.

Table 3. Means and Standard Deviations of the Estimates of the Study Sample Members on the Items of the Study Tool Related to the Research Ethics of Science Teachers as a Whole, and Each of Its Fields, Ordered Descendingly According to the Means.

Field No.	Field	Means	Standard Deviation	Rank	Level
5	Caution and Vigilance Productivity Scientific Freedom Scientific Integrity Appreciation of Scientists	4.48	0.45	1	Very High
3	Caution and Vigilance Productivity Scientific Freedom Scientific Integrity Appreciation of Scientists	4.41	0.44	2	Very High
4	Caution and Vigilance Productivity Scientific Freedom Scientific Integrity Appreciation of Scientists	4.37	0.45	3	Very High
2	Caution and Vigilance Productivity Scientific Freedom Scientific Integrity Appreciation of Scientists	4.33	0.49	4	Very High
1	Caution and Vigilance Productivity Scientific Freedom	4.09	0.59	5	High

	Scientific Integrity Appreciation of Scientists				
Research Ethics among Science Teachers as a Whole		4.34	0.38		Very High

*For each field, the minimum score is (1) and the maximum score is (5).

This question asks how engaged science teachers are with research ethics. Results from Table (3) suggest a very high research ethics level among science teachers (mean 4.34, standard deviation 0.38). The highest mean of 4.48 belongs to caution and vigilance, among the most prominent areas where science teachers excel. This particular outcome might be ascribed to better attention to detail and precision when handling information and data throughout research.

Next is productivity with a mean of 4.41, suggesting that science teachers can conduct productive research effectively. This shows their readiness to contribute scientifically.

The field of scientific freedom (reflecting independence in thinking and research) also scored very high with a mean of 4.37. This suggests that science teachers are flexible enough to investigate new concepts without being bound to prevailing models alone.

Regarding scientific integrity, high scores were also recorded (4.33), indicating honesty and openness in presenting and interpreting results. This demonstrates an appreciation for the need for integrity in the research process.

Lastly, the field of appreciation of scientists was captured as the lowest with a mean of 4.09, still substantial but suggesting the need to boost recognition of the contributions of other people to knowledge making. This might be attributed to not fully appreciating the effect of earlier works on new research.

From this analysis, science teachers maintain high research ethics, verifying the suitability of training and qualification programs to enhance these ethical dimensions in the educational and research environment.

4.4. Fourth Research Question:(RQ4)

It asks if statistically significant differences occur in research ethics amongst science teachers according to gender and academic qualification. The information extracted and presented in Table (4) suggests that gender variables do not statistically vary between female and male science teachers in research ethics. This particular result indicates that female and male teachers are similarly dedicated and serious about following research ethics, reflecting their awareness of the ethics 'importance and positive influence on quality and integrity in scientific research.

There are also no statistically significant differences for the academic qualification variable. This particular result means the academic qualification (diploma, bachelor's, master's, or doctorate) does not substantially impact the way research ethics are practiced among teachers. This is because of the standardization of training and ethical practices of the Ministry of Education who make sure that all teachers of any academic level get the required assistance and education to meet the highest standards of scientific research.

This particular conclusion is validated by outcomes from comparable studies including the one by Al Habib and Abu Kareem (2012) [20] which also did not discover statistically significant differences because of gender in research ethics practice. This particular consistency in outcomes across research shows that almost all teachers in educational environments have equal opportunities and treatment concerning compliance with research requirements.

These results therefore confirm that research ethics are an ingrained value in all science teachers and boosts ethical awareness and practice no matter gender or academic background.

Variable	Level/ Category	Means	Standard Deviation
Gender	Male	4.37	0.37
	Female	4.30	0.39
	Total	4.34	0.38
Academic Qualifica-tion	Bachelor	4.34	0.38
	Master Degree	4.31	0.41
	Total	4.34	0.38

4.5. *Fifth Research Question:(RQ5)*

This particular issue looks at whether the practice of action research skills by science teachers correlated with observance of research ethics in a statistically significant way. To respond to the question, the correlation coefficients of science teachers 'estimates of their practice of action research abilities and their estimations of research ethics have been analyzed (Table (5).

Results demonstrated a positive statistical significance between the two variables. Improved teachers' action research abilities are related to better adherence to research ethics. This particular result confirms the conclusion that teachers with developed research abilities are apt to keep high ethical standards in their research.

This correlation is explained by the contribution of proficiency in action research to a knowledge of research ethical obligations. Effective action research requires an understanding of data handling and the impacts of results on science and community. Consequently, teachers who enhance their research abilities see the crucial need to stick to the very best standards of accuracy and honesty in their work.

These results highlight the need for continuous training and professional education in the fields of action research and ethics for teachers 'professional development. Enhanced research capabilities improve their educational competencies in addition to their ethical commitment which positively influences the quality of educational research and its uses in education process.

Because of these results, educational institutions and entities offering training and education should not only offer research abilities but also make research ethics much more known and enforced amongst teachers. Such holistic methods will promote more effective professional development for teachers in the educational arena.

Table 5. Correlation Coefficients Between Science Teachers' Estimates on the Study Tool Related to Their Practice of Action Research Skills and Their Estimates on the Tool Related to Research Ethics.

Field	Appreciation of Scientists	Scientific Integrity	Productivity	Scientific Freedom	Caution and Vigilance	Research Ethics as a Whole
Problem Identification	0.027	0.085	0.216*	0.191	0.266*	0.178
Hypothesis Formulation	0.031	0.181	0.124	0.192	0.187	0.175
Data Collection	0.013	0.124	0.175	0.145	0.167	0.150
Data Analysis	0.088	0.170	0.252*	0.226*	0.255*	0.243*
Results	0.056	0.159	0.275*	0.250*	0.221*	0.230*
Practice of Action Research Skills as a Whole	0.051	0.162	0.424*	0.229*	0.253*	0.266*

*Statistically significant at the significance level (α = 0.05)

5. Recommendations and Suggestions

According to the results of this particular research specific suggestions concerning the ethical condition of researchers in the educational field could be made focusing particularly on research standards. First, the results demonstrate the need for sweeping research of ethics in research throughout the Kingdom to spotlight best practices and common ground regarding how to fix flaws and honest mistakes. Setting clear standards for research ethics and creating training programs to encourage adherence to these standards are recommended.

Second, the study suggests the need to make the theoretical framework and previous studies fundamentals of any scientific research. Resources and workshops addressing how to integrate these fundamentals into educational research are needed to establish rigorous, impactful research.

Third, evaluative studies should investigate just how well science teachers adhere to research ethics and whether training courses influence adherence. These studies ought to include indicators of how training programs encourage ethical practice.

Studies must be conducted in a manner that identifies the gap and also proposes appropriate solutions to determine the impact and identify gaps.

Fourth, more research is suggested on action research and its effects on teachers' educational behaviors and school academic levels. This kind of study ought to include analyses of how action research interacts with various educational factors.

Lastly, because of the intense need to help teachers in conquering educational challenges, the establishment of specialized departments for action research in the Directorates of Education within the Ministry of Education in most governorates is proposed. Such departments should be centers of excellence that help teachers devise methods for addressing tough educational problems.

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