

Nature of science understanding level of science colleges' graduates at Najran University and its relationship to their teaching performance

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Abstract:-The study aimed to investigate the understanding level of science college graduates at Najran University of the nature of science and its relationship with their teaching performance and other demographic variables such as specialty, university rating, and methodology course. To achieve this, a test for the understanding of the nature of science was carried out (SUSSI). Observation card was also used for the sample of the study which consisted of (30) female students of physics and chemistry departments at the college of science who were enrolled the practicum course at public schools. The findings illustrated that the understanding level of science nature was low. It is significantly different from the standard criterion in education (80%). There was no statistically significant relationship between the science nature understanding and teaching performance. The nature of science understanding does not vary in accordance to variation in specialty, university rating and the course in methodology.

Keywords: understanding of the nature of science, teaching performance, Science College graduates. NajranUniversity.

I. INTRODUCTION

Comprehensive reform movement of science curricula for all stages that the beginning of 21st century of the third Millennium is witnessing seeks to build scientific visions capable of offering help to the learner in order to understand the world and living issue. It looks forward to do so in congruence with the new era orientations and the culture of society. Therefore, the educational system has totake care of the nature of science because of its importance in preparing the scientifically and technically literate individuals. In addition to its intrinsic role in the development of thinking skills, problem solving, and knowledge building Lederman, (2004).Understanding the function of the nature of science and scientific research by teachers is a pre- requisite for any hopes regarding the accomplishment of a vision for science teaching and learning agreed upon by various reform documents. Learning and teaching the issues related to science nature will improve only when we prove that prospect teachers possess conscious views of the nature of science and show their understanding at work, Ling, et al. (2008). Thus, science teaching does not only mean what science is but also how knowledge is built through varied views such as the cultural and social ones, Lederman,(1992).

Students' understanding of science in all stages is among the scientific concepts that were focused upon by reform movements' andteaching of current science, (American Association for the Advancement of Science AAAS, (1993), National Research Council NRC, (1996), and National Science Teachers Association NSTA, (1990)). The National Science Education Standards, (1996) and Benchmarks for Science Literacy (AAAS, (1993) reform documents support the necessity for children to have enough understanding about the nature of science (NOS). Also, Saudi Arabia took care of the nature of science and established a national center to develop the scientific culture. Developing the criteria for the scientific culture in a new national vision that includes various aspects like the nature of science and technology was one of its great roles and missions, Al – Ooleh, (2009). The nature of science was one of the most important aims that of science developing project at Saudi Arabia which are sought to be achieved during teaching.

Attention to the nature of science goes back to the beginning of the 20th century, in particular 1907, (Lederman, (ibid). The concept of science nature refers to Epistemology and sociology in science, values or beliefs inherited in the scientific knowledge and its development, Lederman, (ibid). It also indicates the characteristics of scientific knowledge that result by ascertaining the scientific conclusions that scientists try to develop knowledge, Lederman, et al. (2005). Despite that, there are still variations among philosophers, historians, scientists, and science teachers in accordance to stating a clear international definition of science nature, Add- El- Khalick, et al. (2000). But still it can be said that there are seven aspects of science nature controversial, general, and of relation to students' everyday lives discussed widely in studies, AAAS, (1990, 1993; Chen, (2006), Lederman, et al. (2002), Lederman, (2004), National Science Teachers Association, (2000).

these seven aspects are tentativeness of scientific knowledge, observations and inferences, subjectivity and objectivity in science, scientific methods, social and cultural embeddedness in science, creativity and rationality in science, and scientific theories and laws.

Teaching science has been connected to the extent of science teacher's understanding of the nature of science before and during experience, Hamzeh, (2010). Findings proved that the understanding of the nature of science affects the teacher's teaching behavior and his teaching practices. Wahbeh and Add- El- Khalick, (2004) emphasized the fact that an organization of a training workshop for teachers in the nature of science topic helped them develop and retain concepts of science nature, design plans to instructionally process the nature of science, build a model for a scientific and pedagogic content whose source is the science teachers. In the same year, Kurup, (2014) examined the teachers' concepts regarding the nature of science and its effect on their classroom practices. Findings proved that teachers who had clear instructions about the nature of science showed a better understanding in some aspect of the nature of science in comparison with other colleagues who were not subjected to the same instructions even though they were still suffering of difficulties in some aspects. Akerson, et al. (2012) investigated to what extent pre- service teachers will possess enough concepts of the nature of science and how they can participate in the society to support the teaching of science nature during their teaching of this concept at their training locations. It revealed that all pre- service teachers who had received training were capable of teaching the nature of science clearly in their science classes. Zaitoun, (2010) looked for the factors that affect the understanding of the nature of science and found out that the level of science nature understanding among students of science teachers was (75%) and related to their scientific attitudes. It had no relationship with their accumulative average at university, their average in science methodology course, or their average at high school.

On the opposite, some studies showed that teachers don't have sufficient understanding of the nature of science congruent with what reform documents have called for. They also suffer from a lack a good comprehension of what the nature of science means. Al-Najjar, (2013) illustrated that all students of science teachers at college lack a moderate understanding of the nature of science concept. 71.4% showed weak performance in teaching strategies that stimulate creative thinking. They practice teachers traditionally and by rote learning. The study recommended the importance of developing science courses and the programs of education colleges. Al- shamrani, (2012) revealed a great shortage in the perspectives of students in scientific and engineering majors at the preparatory year at King Saud University regarding the basic concepts of the nature of science. Addullah, et al. (2007) concluded that the level of understanding the science nature was low for the fourth level students at physics and biology departments at the colleges of education and science. Al-Hijri, (2006) revealed that science teachers performance at fourth to ten grades was low in comparison with the educationally accepted level (80%). Their practices of the nature of science inside the classroom environment were low, too. The study recommended holding in- service training programs and emphasizing the role of educational supervision in follow up. This might refer to the many hindrances and problems that slow down the achievement of scientific literacy. The most prominent problem is the school and university graduates' inability to comprehend and understand the main science bases because they are incapable to understand the scientific basic rules of the nature of science and its processes, Abd- Al- Majeed,(2004), Farraj, (2006), Adas, (2009), And Shehadah, (2008).

It has been noticed that most of foreign and Arab countries have paid much attention to the understanding of the nature of and study science of various aspects on different categories. It is an open aspect for research and survey. How can teachers translate the understanding of the nature of science into practical practices? What did the practical practice provided science teachers to be able to transfer their understanding into clear instruction that reflects the nature of science? To what extent can teaching show clearly and expressively the components of the nature of science about the issues that are still in need for more exploration? All these issues and more provide teachers with visions about their needs and shortages when transforming their view about the nature of science into practice, Lederman, (2007). From this perspective, the present study was to document the level of understanding of science college graduates at Najran University of the nature of science and its relationship with their teaching performance and with other variables. The study mainly focused on Najran University graduates, in particular the scientific departments, physics and chemistry. The aim was to show a scientific image about these departments' graduates who will be teachers and how much the teaching curricula are walking along with the scientific developments, teaching methods, teaching and learning theories, and educational innovations. Furthermore, to diagnose the weakness points in order to treat them and the strength ones to foster. In addition to stimulate the researchers and high studies students to conduct researches in this area, to give a comprehensive overall perspective to people of responsibility about the curricula design at the departments of physics and chemistry, about the scientific and skills level of their students, and lastly to cooperate with scientific educationists to achieve the desired objectives.

II. METHODOLOGY

1.1. Study population and sample

The study population consisted of (89) physics and chemistry students at the college of science who passed the science teaching methods course and were enrolled in the practicum course at the academic year 2013/ 2014. The study sample consisted of (30) students that constituted about (35%) of the population. All of them were randomly chosen.

1.2. Methodology and instruments

The study followed the descriptive survey method that depends on the study of the phenomenon as it exists in reality using two main instruments:

- **Test for measuring graduates' understanding of the nature of science** (*Student Understanding of Science and Scientific Inquiry (SUSSI) questionnaire*): which was prepared to evaluate the pre- service teachers' perceptions about the nature of science, Ling, et al. (2008)? The test was a dual response instrument that mixes between the items of Likert's scale and the open- ended questions. It consisted of (24) items distributed to six aspects namely, observations and inferences; scientific theories and laws; imagination and creativity; tentativeness; scientific method, and social and cultural embeddedness where each aspect had four items, then followed an open- ended question. All these aspects were chosen because of their dependence on the conceptual frame provided by the literature about the nature of science and reform documents for the latest science teaching. They were also chosen because they were deliberately prepared for pre-service teachers and its adoption of the qualitative as well as quantitative method which is considered one form of the triangulation forms. One more reason for their choice was because they provide multi ways for the study of the data validity in addition to the time of application (*about 30 minutes*) which is an appropriate time in the existence of other open- ended questions. The test developers ascertained its virtual and content validity by nine experts (seven science educators and two scientists) who were teaching NOS and/or who were knowledgeable about NOS-related research. The degree of agreement on each Likert scale item was between 78- 100%. Credibility, trustworthiness, and authenticity were achieved by modifying the existing items and analyzing data from multiple sources. Reliability of test was confirmed by the applying it on (209) students. Its internal consistency was calculated by Cronbach- Alpha which was ($\alpha= 0.69$). It was also worked out for side branches. Results revealed a good satisfaction level about the internal consistency. The researcher herself, translated the questionnaire into Arabic and checked the validity by presenting it to a set of arbitrators from the faculty at the Najran University, and on the basis of their opinions and suggestions have been modified some test items. Its reliability was also confirmed by the applying it on the sample from outside the exploratory study sample of (12) students, and its internal coefficient was calculated by Cronbach- Alpha which was ($\alpha= 0.77$).
- **Teaching performance observation card**: Teaching performance observation card is a checklist to observe the teacher student performance inside classroom. It aims to assess the teaching performance. It constitutes of aspects like planning, implementation, activities and teaching aids evaluation, and classroom management. Its content validity was ascertained by presenting it to a set of arbitrators from the experts and educators at Najran University. Its reliability was also ascertained by using Holsty coefficient for reliability among individuals and was (0.88) which indicated that it was high and appropriate.

2. Study results and discussion

- 2.1. Results related to the first question:** *What is the level of understanding of science college graduates of the nature of science?* To answer the above question, means and standard deviations for students' answers on the understanding of the nature of science test were calculated. T. test was also used for one sample. Table one illustrates the results.

Table 1: means, standard deviations, T-test for the difference between the means of graduates' responses

Items	N	Least degree	Highest degree	Mean	Std.	Mean %	T. Value	Sig.	Eta Square
Understanding the nature of science	30	18	22.75	20.31	1.158	67%	-17.43	0.000	0.913
Accepted educationally	30	-	-	24	-	-	-	-	-

(80%)*									
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*Mastery criteria as determined by many studies, (Millman, 1979)

Table one above shows that the extent of the nature of science understanding among Najran University graduates ranged between (18) and (22.75) out of the total degree (30) on the nature on science understanding test. It was in fact a low level in comparison with the educationally accepted one (24 out of 30 or 80%). This indicates that there was a statistically significant difference. This difference might refer to the teaching programs and courses that do not focus on the scientific aspects of the nature of science and how it can be employed in the first place. In the second place it might be because of the use of scientific laboratories as places of knowledge consumption as well as confirmatory. In the third place it might be because of the focus of scientific departments on teaching the theoretical cognitive sides and inevitable issues significantly without taking into consideration the embedding of the nature of science concepts within university plans and adopting teaching strategies that enhance contextual understanding of the nature of science. Which enhance result validity, the big effect size that explains (91.3%) of the result. Such a result is, on one hand in agreement with Al- Shamrani, (2012), Al- Hijri, (2006), and Abdullah, et al. (2006). It, on the other hand disagrees with Al- Najjar, (2013) and Zaitoun, (2010).

2.2. Results related to the second question: *Does the nature of science understanding level of science college graduates differ by specialty chemistry or physics?* To answer this question, means and standard deviations for the responses of students were calculated. T. test was also used for independent samples. Table two below illustrates these results.

Table 2: Means, standard deviations, and T. test for the significance of difference between the levels of science nature understanding with regard to specialty.

Specialty	N	Mean	Std. dev.	DF	F. ratio	Sig.
Physics	16	20.13	1.136	28	-1.118	0.273
Chemistry	14	20.31	1.178			
Total	30	20.31	1.158			

Table two above shows that the mean score of nature understanding of Najran University physics graduates was lower than the understanding level of chemistry graduates. T. Value for the difference between means indicates that the observed difference is not statistically significant. This may be explained by the fact that physics and chemistry curricula lack the training of students on the understanding of the nature of science and its components, whereas they focus on the theoretical aspects and confirmatory issues. This result is seen in agreement with what Abdullah, et al. (2006) concluded.

2.3. Results related to the third question: *Does the nature of science understanding level of science college graduates differ by their university rating, excellent, very good, good, ...etc ?* To answer this question means, standard deviations for student's responses were calculated. Findings are illustrated in table three below.

Table 3: Means and standard deviations of the level of students' understanding of the nature of science according to university rating.

University rating	N	Mean	Std. Dev.
Excellent	7	20.66	0.995
Very good	10	20.43	1.157
Good and below	13	20.11	1.277
Total	30	20.34	1.160

It is clear as shown in the above table that the means of understanding levels of Najran University graduates students whose ratings are excellent are higher than their colleagues. Those graduates whose ratings are good and below good are disarranged more than their colleagues who in turn indicate that there are observed differences between the means. To test these differences ANOVA was used. Findings are illustrated in table four below.

Table 4: ANOVA results for the significance of differences between graduates' understating levels of the nature of science

Source of variation	Sum of squares	DF	Mean of squares	F. ratio	Sig.	Eta Square
Between groups	1.486	2	0.743	0.534	0.592	0.038
Within groups	37.547	27	1.391			
total	39,034	29				

The above table shows that the observed difference in the levels of graduates understanding of the nature of science according to the university rating is not statistically significant. This may be due to the fact that university rating is the accumulative result of various variables and academic as well as educational courses. Among these variable those which a student like and which she doesn't like. Teaching methods course does not pay much attention to the nature of science and its components. This finding is in congruence with what Zaitoun, (2010) found out.

2.4. Results related to the fourth question: *Does the nature of science understanding level of science college graduates differ by their grades in science teaching methods course (354 curriculum 3)?* To answer this question means and standard deviations of students 'responses were calculated. Findings are shown in table five below.

Table 5: Means, standard deviations, and standard errors of the level of students' understanding of the nature of science according to science teaching methods.

Student's grade in (354 curr. 3	N	Mean	Std. dev.
A	9	20.63	0.872
B	9	20.37	0.893
C	7	20.90	1.502
D	5	20.14	1.704
Total	30	20.31	1.160

Table five above makes it clear that graduates' performance who has got (D) in the teaching methods course were disarranged more than other colleagues. In other words, there are observable differences between their means. ANOVA was applied and results' summary is presented in table six below.

Table 6: ANOVA results for the differences between means of graduates' understanding level of nature of science in relation to their grades in methodology course.

Source of variation	Sum of squares	DF	Mean of squares	F. ratio	Sig.	Eta Square
Between groups	1.433	3	0.478	0.33	0.803	0.037
Within groups	37.601	26	1.446			
Total	39.034	29				

Table six above indicates that the observable difference in the levels of graduates' understanding of the nature of science at Najran University regarding their grades in the methodology course is not significant. This may explained by the fact that this methodology course does not care much about the nature of science. One course in teaching methodology does not allow variance in the level of science nature understanding between participants to come up. In such a finding, the present study does not go further from what zaitoun, (2010) found.

2.5. Results related to the fifth question: *Is there any relationship between graduates' level of understanding of science nature and their teaching performance?* Pearson Coefficient correlation was calculated and results are presented in table seven below.

Table 7: Pearson coefficient correlation of graduates understanding of science nature

Understanding nature of science	Teaching performance	
	Pearson coefficient	-0.251
	Significance	0.180
	Participants 'number	30

Table seven before reveals that Pearson correlation coefficient is not statistically significant. That is, there is no relationship between the graduates' understanding level of the science nature and their teaching performance. Such a finding can be explained by the fact that university teaching programs do not focus on the way of employing the nature of science during teaching and laboratory work. Furthermore, supervisors do not focus on the use of the nature of science by the teacher student as the teaching performance evaluation checklist lacks the

bond that belongs to measuring the student's understanding level of the nature of science. This, of course, proves that the view of science is still situational and the supervisors have not changed their beliefs about science to fit the modern philosophies such as the realism, scientific, and constructivism. This finding is in agreement with what Al- Najjar, (2013) mentioned whereas, it disagrees with the finding of Kurup (2014), Wahbeh and Abd-El-khalick (2014), Akerson, et al. (2012). All these mentioned studies emphasized that the focus on the science nature through training workshops in the teachers' pre- service stage can improve their teaching performance.

III. CONCLUSIONS

The main aim of the present study was to identify the level of understanding of Najran university graduates of the nature of science and its relationship to some demographic variables. The study findings have led to these conclusions.

1. Level of understanding of the nature of science of Najran university graduates is low.
2. There is no relationship between the level of understanding of the nature of science and the level of Najran university graduate students' teaching performance.
3. The level of understanding of the nature of science is not associated with the following demographic variables: specialization, university grading, teaching methods course.

IV. RECOMMENDATIONS

In light of all the previous findings, the researcher recommends people in charge of education at Najran University to focus on the educational and scientific applications, particularly in the methods of teaching courses. They are also recommended to adopt plans that concentrate on the nature of science and ways of development. In addition, they should enrich the teachers' knowledge by the professional and self development.

V. SUGGESTIONS

The researcher has suggested conducting similar studies but on wider samples which can be more preventative. Different ways such as the use of the quantitative method that relies on the analysis of individuals' responses is suggested by the researcher to be used by researchers of similar studies in the future

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