

The Effect of Using Socio-Scientific Issues Approach in Teaching Environmental Issues on Improving the Students' Ability of Making Appropriate Decisions Towards These Issues

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Abstract

This study aimed to identify nature of students' decisions patterns towards environmental issues and the possibility to improve these decisions during teaching process using Socio-Scientific Issues Approach. And to achieve this, the researcher prepared and developed tools of the study represented by a test of open questions focused on socio-scientific issues in environmental subjects and a school unit about environmental issues according to Socio-Scientific Issues Approach. Validity and reliability of the study were asserted using the appropriate ways. The population of the study, which consisted of the students of Educational Sciences department in Educational Sciences Faculty in World Islamic Sciences and Education University in Jordan in the first semester in 2012/2013, was 576 male and female students. The sample of the study, which consisted of (40) male and female student, was selected purposefully. Results of the study showed using Socio-Scientific Issues approach enhanced students' ability in improving their decisions towards environmental issues and the results showed existence of four patterns of students' decisions: decisions based on wrong understanding of scientific concepts and their applications, logical linear (formal) decisions taking into account few limited dimensions, decisions on a limited level of controversy. Issuing decisions include scientific thinking takes into account the integrated comprehensive dimension.

In light of these results, the researcher recommended paying attention to Socio-Scientific Issues Approach (SSI) as an axis to teach the scientific concepts and issues at the university level and to train the teachers on using it.

Keywords: socio-scientific issues approach, environmental issues making appropriate decisions

1. Introduction

This era is distinguished by the rapid and amazing developments in the scientific knowledge and its technological applications which have a relation with ethic dimension at the moment of making decisions. So to cope with this change, it is a necessary to pay attention to the students' quality who are prepared to be educated scientifically in the modern life and have the awareness of technology developments that related to the ethical dimension. So the attitude of the scientific education is to train the students on using the science and technology in developing their lives and in the adaptation of the current changes in the society and the surrounding environment.

And if everything is done, we can say that this preparation creates citizens who are developed scientifically and technologically, active and interactive with the society and its problems and they are also more understanding to the relation of affecting and effecting between the science, technology and the society and therefore every citizen can use this knowledge in reporting and issuing the decisions in his daily life.

Sormunen and Saari (2006), Lee and Abd-El-Khalick (2006), Elliott (2005), Sadler (2004, 2005), and Zeidler (2003) showed that that the scientific social issues are open problems with multi solutions that mainly arose from the bio-technology and environmental and human genetics' problems including issues as human cloning, using human embryo as spare parts, genetically modified food, environmental pollution, climate change, radioactive wastes and ways of getting rid of them. Issues of Genetic Engineering have become one of the argumentative issues recently according to its importance in the international political level and the individual one. And because

of the importance of these issues, they were selected to study the effectiveness of the scientific social issues method in improving the students' ability of making decisions towards the scientific social issues.

The Socio-Scientific Issues have comprehensive dimension and they are exposed to unspecified situations and so there are two types of sciences: Revolutionary Science that changes thinking towards the science as a result of being exposed to situations that challenge the common situation and the second type is the Natural Science which is based on hypotheses of specific nature. And teaching science was interested in the second type in training the students to make a specific conclusion using methods of Induction of elicitation which means that the conclusion is limited and cannot be adjusted. But nowadays, and as a result of the increase in the issues of revolutionary aspect especially issues related to Biotechnology, teaching science has been affected; the view of the nature of science changed from being limited to the formal aspect to the revolutionary one and the students understood they there was no specific answer but the best assumptions were taken into account unless an evidence showed the opposite and the concentration on the revolutionary science was to fill the gap between the theory and the application (Gray & Bryce, 2006; Abd-El- Kalick, 2003).

Maloney and Simon (2005), Sandoval (2006), and Sormunen and Saari (2006) pointed out that the scientific social issues which related to ethics and argumentative situations at the same time should be the axis of teaching as they include situations that limit the ability of using the formal reasoning because they need an explanation for unfinished issues and they are driven from events which are difficult to be interpreted causing a clash of ideas because of incompleteness or the contradiction of the presented evidences which need skills of interpretation that exceed formal reasoning to informal one. Additionally, this method needs skills of criticizing, depth in interpretation, evaluation and justification. And it needs the student's involvement in the process of decision making and so he has to be trained on studying the problems comprehensively. The skills which are used in presenting the evidences about these issues are considered one of the most important elements in decision making.

2. Problem of the Study and Questions

Depending on the researcher's experience in teaching the course "Environmental Education" in World Islamic Sciences & Education University and his observation of the students' weakness in discussing environmental issues which were highlighted in the course, the researcher was motivated to conduct this study to investigate the impact of using scientific social issues' methods in teaching the environmental issues on the students' ability on making appropriate decisions towards Socio-Scientific Issues of the Educational sciences Faculty's students in World Islamic Sciences & Education University. And this study tries to identify the nature of the decisions patterns which the students make towards the environmental issues and the ability of improving these decisions using Socio-Scientific Issues' methods as a basic for teaching these issues. Therefore, the study aims to answer the following questions:

- 1) What are the patterns of decisions taken by the students towards the environmental Socio-Scientific Issues?
- 2) What is the impact of using the Socio-Scientific Issues Approach as a basis in teaching the environmental issues for the university level on improving the students' ability on making decisions concerning the environmental issues?

3. Significance of the Study

The significance of the study lies in the information it presented regarding the students' ability to make decisions towards the environmental issues and this information will increase the degree of our understanding of these issues. The significance of the study lies also in the lack of environmental studies and therefore the Arabic Library will be enriched by this amount of scientific information.

4. Limitations of the Study

The study is limited to the following:

- 1) Spatial and human limits: the results of this study related to the students of Educational sciences faculty in World Islamic Sciences & Education University in Jordan.
- 2) Time limit: results of this study are limited to the period of time when this study was conducted which was the academic year 2012/2013.

5. Procedural Definitions

Method of Socio-scientific Issues (SSI): using the Socio-scientific contexts as an axis for teaching methods' activities where informal methodological activities' contexts were used. The objective of this method is to improve the ability of making the appropriate decisions towards the issues discussed and which were produced

as a result of the scientific progress and they are related to ethics.

Environmental issues: the environmental problems with open end which were resulted because of the interaction between the scientific concepts, technological applications and the social dimensions.

Making decisions: the ability of the sample of the study to make the appropriate decisions towards the environmental issues.

6. Theoretical Frame and Previous Studies

The accelerated progress in technology and which is linked with the progress of the scientific knowledge and which was the basis of the social luxury in the mid of the twentieth century make the advocators of methods of teaching science guided by the national institution of teaching science in USA (NARST) establish a movement of science, technology and society known by STS. And this educational method tried to integrate the scientific concepts and their technical applications and their social effect as well when presenting the science curricula in the basic and secondary stages. And this movement appeared at the beginning as a mean to achieve the objectives Science Education Reform by focusing on the authentic life issues (Sadler, 2004; Yager, 1996; Pedretti & Hodson, 1995). The reports of the educational literature pointed to the efficiency of STS method in developing the students' abilities in the curricula based on this method through the enjoyment of learning the science and the realizing the relation between the sciences and the society (Birkenhead, 1994; Solbes & Vilches, 1997; Tsai, 2000; Rye & Rubba, 2000).

But there were many disadvantages about the limitations of the dimensions of this attitude. (Sadler, 2004; Sadler & Zeidler, 2005) stated that although of the wide spread of STS movement, it failed in developing the skills of making decisions towards the scientific social issues which is considered a basic feature in the scientific education and because the educational literature lacks any reports that asserted the improvement of the ability of making decisions regarding the ethical dimensions about the scientific social issues and this shortage in literature attracted the educationalists' attention in the developed countries as USA and UK towards the importance of inserting the ethical and value dimensions during the process of making decisions towards the scientific social issues. Three elements appeared as basic requirements to the quality of making decisions: the previous knowledge of the content (subject), understanding the nature of the science, realizing the moral and the ethical dimensions. The limitation of STS method was its concentration on the information and the previous knowledge compared to less concentration on the understanding the nature of science in addition to its failure in taking the ethical and moral dimensions into account in most of the curricula based on the STS method.

Sadler and Zeidler (2005) explained that STS method, which has prevailed since the 1980s, could not fill moral leisure towards the great progress in the sciences especially the environmental developments, biological issues and information technology. Although the progress in the science of physics and chemistry in the nineteenth century till the last end of the twentieth century necessitated the overlapping between moral dimension and the cognitive one in making decisions but the decisions, which were taken regarding the spread of nuclear and chemical weapons, were in the international or regional level and the ethical dimension was not given enough attention; very few students were ready to be scientists and decision makers in these levels and because the scientific progress was felt everywhere by everyone, it was necessary to help the members of the society to face and solve the problematic issues created by the progress in the means of information and technology. Taking into account the moral dimension during making decisions, the individual should have a strong informational network and therefore the theorists of the curricula called to have the objectives of teaching science based on building a moral and comprehensive scientific culture in a way that enable the student to make right decisions that based on an integrated holistic knowledge moved toward the moral objective.

The appearance of the moral and ethical dimensions in teaching the sciences is due to the philosophical view towards science as social and human phenomena. And this philosophical view is attributed to the many reasons as: the ethical conflicts between the scientific and Capitalism values of free business and bad use and management of scientific research and its results in addition to disagreement of the rules and the standards that should govern the applications of science especially the technological one (Raznik, 2005; Anderson, 2004).

Raznik (2005) sees that "the ethical studies and discussions should be motivated in science because the science is the cooperative activity occurs inside a bigger social and political context. The scientists cannot run away from life's ethical obstacles and issues. So the science of positivism is a legend for who ran away from the controversial issues" (pp. 18-19).

Making decisions based on ethics indicates that the decisions which are taken should generalize the benefits with the least degree of harm. There is a need to understand the nature of the sciences in terms of its starting as a

result of the scientific ethical social interlacement. And there are many incentives that promoted the process of re-evaluation of the nature of science and the method that should be used to learn science; one of them is to know the purpose of teaching sciences and the possibility to be the basis in preparing the individuals to make decisions in the future and be aware of their future regarding dealing with the scientific social issues (Kind & Taber, 2005; Gray & Bryce, 2006).

Therefore, Roznik (2005) and others (Gray & Bryce, 2006; Maloney & Simon, 2006; Lee & Abd-El-Khalick, 2006; Sandoval, 2005; Sadler, 2003) assert the importance and the necessity of designing the curricula of sciences on ethical basis; the curricula includes controversial ethical issues and teaching them to students and supplying them with ethical frameworks that enable the students have the suitable tools to take part in the controversy and the necessary skills to make decisions towards these issues.

Teaching the students the process of getting involved in the discussion and use the scientific evidences in these discussions is considered a very important issue for the future of decision making process especially the scientific social issues (Ratcliffe & Grace, 2003) and therefore teaching the sciences plays a crucial role in the developing countries which need, in future, citizens who have these skills (Osborne, 2000; Turner, 2000). And because the school is more permanent than laws and theories, it will enhance the idea that the Science is an absolute right to the individuals and using science to make decisions will remain legal thing to do (Maloney & Simon, 2006). The report of HCSTC (2002) stressed on the importance of teaching modern science especially with regard to scientific social issues in a direct and explicit way. And the reports pointed out the necessity of providing the opportunities for the students that enable them to discuss their daily social life and its scientific linkages instead of concentrating on the sciences themselves as it was before 50 or 100 years ago.

Recently, the researches about the scientific social issues have showed the students' confusion in explaining and expressing their attitudes towards these issues and this may attribute to lack of discussing these issues directly at schools through seminars of dialogue, discussions and activities which requires making decisions related to these issues (Zeidler, 2003).

And the teachers' keenness to avoid facing any political interests or the social values makes addressing these issues nonsense (Hudson, 1998). A study by Levinson and Koulouris and Turner (2000) pointed out that the science teachers in England and Wales are unable to discuss the issues related to the moral dimension with their students in the classes.

The ability of issuing judgments and making decisions about the controversial issues requires thinking scientifically and developing the skill of making decisions and the students have to learn the way of evaluating the alternatives and weighing the evidences efficiently. In other words, developing the learners' ability to participate in the discussion in the open-ended issues is important (Maloney & Simon, 2006). And Oulton, Dillon, and Grace (2004) pointed to the importance of having critical thinking in teaching controversial issue and they criticized the idea "The teachers should be neutral when they are teaching these issues", considering the best teaching method of sciences is by motivating students to work as possible and encourage exchanging opinions between the students' themselves and showing them the method that helps them during their discussions and controversy to make their decisions towards the issues they discussed. And Hudson (1998) asserted using the results of critical thinking in changing the attitudes and the behaviours represented by the process of making the decisions.

Kolstø (2001) and Hudson (1998) believe that if the students are able to use the critical thinking which leads to make appropriate decisions about the scientific social issues and generalize them in all situations in life, they have to acquire the necessary knowledge about these issues. And the knowledge itself must be update because the issues themselves are changing so it is important to decision-makers update their information towards the issues continuously to treat the issues in their authentic context. And the teachers have to present strong evidences to make sure of their students' skills development of reading and understanding the scientific context because this is considered a basic thing to do in developing the students' scientific knowledge and subjectivity should be used in dealing with the controversial issues and scientific culture acquisition and this is helpful in the scientific literacy of the teacher and the student as well; the teachers' reading about these issues will affect his professional growth and accordingly it will affect the students' progress in the process of making decisions.

Zeidler, Walker, Acket, and Simmons (2002) stressed on the importance of updating the teachers' knowledge through programs of the professional development and they also asserted following different and new ways in these programs as: giving opportunity to learn new knowledge and explore the nature of the science and its relation with the society and the environment and the need to teach these issues with specific methods of teaching.

Sadler and Donnelly(2006) stated that most of the educational practices depend on teaching the students the scientific subjects because the teachers believe that they are important for them while transferring knowledge and learning outside the school is totally missing in the teachers' practices and one of these negative practices using the logical linear method which takes into account few limited dimensions when making decisions about controversial issues in the scientific social context or on other words addressing sciences in traditional way without activating its comprehensive (revolutionary) dimension. And Bell (2003) warned that it should be taken into account many elements as: the students' understanding the nature of science, values and morals that addressed the scientific social issues in their spatial and time context and taking into account the students' personal experiences in order to improve the students' process of decision-making and apply in other related situations.

Yang (2005) also asserted that students may have the ability to think scientifically in the schools' context but they varied in their abilities in facing authentic situations and this indicates that the skills of thinking, interpretations and making decisions need understanding of the contexts of multi-scientific ideas. And to develop the skills of making decisions about the controversial issues, the teachers have to provide activities to the students that simulate the contexts of the issues' historical development and at the same time, the students are motivated to make decisions in the context of these activities. And this was obvious in many researches which discussed teaching controversial social sciences' issues in USA and UK (Walker & Zeidler, 2007; Maloney & Simon, 2006; Lee & Abd-EI-Khalick, 2006).

Sormunen and Saari (2006), Lee and Abd-EI-Khalick (2006) see that the teacher has to ensure the students' involvement in the dialogue, the discussion and the controversy of the issues facing them. Based on the ideas which the students got during discussion, the information if school's cooks are implemented and so the students acquire the skill of making decisions towards scientific social issues and the ability of generalization on other similar situations representing the features of the modern scientific society and the teacher, during teaching scientific social issues, should take into account generalizing these issues on personal and social contexts of the students in addition to the system of the ethical values and the students' previous knowledge which justify the students' decisions towards these issues.

7. Methodology of the Study

The researcher used semi experimental approach of one group for its suitability for such types of studies.

7.1 Population of the Study

The population of the study consisted of 576 male and female student representing the students of Educational Sciences Faculty in World Islamic Sciences and Education University in Jordan in the first semester for the academic year 2012/2013.

7.2 Sample of the Study

The sample of the study, which consisted of 40 male and female students, was chosen purposefully from the students enrolled in Course of "Environmental Education" which the researcher taught.

7.3 Tools of the Study

An open-ended questions' test

An open-ended questions' test consisted of seven scientific environmental social issues and the questions focused on different issues as: using and producing alcohol, Nuclear power and its waste, using of hormones, Pesticides, Firewood trees as fuel and Fossil fuels. Test was built after reviewing the related educational literature to the subject. And the Test was enhanced by semi organized interview with the sample of the study according their decisions and justifications regarding the issues mentioned in the Test so as to be sure of the students' argumentative ability towards their decisions and the their justifications as well. It is worth mentioning that the items of the interview and its questions were extracted from the Test itself.

And to verify the validity of the Test, the arbitrators' validity was used and their views and comments were taken into consideration and so some items were adjusted and to verify its readability, it was presented to a sample of the students, who were out of the sample, to answer its questions and later they were interviewed to check the Test's reliability through comparing their answers in the interview with their written ones and a high percentage was found in the answers. The estimated time for the test ranged (50-60) min.

The method of analyzing the test followed the following steps:

- 1) Students' answers were read separately of the pre and post tests and the meaning was extracted from their answers.

2) Every student's answers were read separately and were linked with his answers in the interview so as to build a classification system using deductive analysis method that includes similar patterns in the cognitive background and the nature of the scientific knowledge.

3) After constructing the classification system, the students' answer were read again and every group has a similar pattern in its cognitive background and the nature of the scientific knowledge in addition to the ethical considerations in one box in order to understand the reasons that lead to make decisions.

4) Calculating frequencies and the percent of every category.

To check the reliability of the analysis, the analysis its self was repeated after two weeks and the results of both analyses were compared and a high match was found with 85% and this indicates the analysis's high degree of stability.

Educational unit

Having its concepts consistent with the environmental issues, an educational unit was designed and the issues mentioned in the course of "Environmental Issues" which the students study were analyzed taking into consideration the information, applications and the values' dimensions which related to these issues through the following:

1) Identify the argumentative situations in the environmental issues and make them the basis of teaching and dialogue by reviewing the educational literature related to the argumentative situations and their development.

2) Analyze the pre concepts needed to have constructive dialogue based on the conceptual sequences in the discussion and evaluate the objections that prevent accepting or rejecting the idea.

3) Insert the "nature of science" as a basic element in teaching where the students address the social problem that led to the scientific questioning followed by a hypothesis that helps in solving the problem and creating the scientific concept.

4) Present the ethical dimension as an important axis in judging the way of getting benefit of the scientific outcomes of the educational course. And presenting the ethical dimension was integrated with achieving high levels of the emotional goals(organizing values) and with achieving high cognitive goals as possessing met cognitive skills by aware of the idea and its weakness and shortage to build more comprehensive idea in environmental issues and the related ones.

Designing the educational unit and its components was done by reviewing the literature and the previous studies and selecting issues based on their importance and their relation to Jordanian social life especially the students' ones. To check the validity of unit content, it was presented to a specialized group of arbitrators to express their views of unit's content and its suitability to its goal. Some simple adjustments and additions were done.

8. Results and Discussion

8.1 Results of the First Question

"What are the students' decisions' patterns towards the environmental scientific and social issues?"

To answer this question, the students' answers were analyzed revealing the following four patterns of students' decisions:

1) Making decisions based on wrong understanding of the scientific concepts and their applications.

2) Making logical linear decisions taking into account very limited dimensions.

3) Making decisions:

3a) Making decisions in limited scope of argument;

3b) Making decisions including scientific thinking taking into account comprehensive integrated dimension.

The following presentation showed the pattern used by the students in making decisions towards the environmental controversial issues and a sample of the students' answers:

First Pattern: Making decisions based on wrong understanding to the scientific concepts and their applications.

The results of the analysis process showed that most of decisions of this type focused on nuclear power and the pesticides. For example, (issue of using pesticides) Khaled says: "*it is good to use pesticides to get rid of insects, they are useful not harmful*". And Ahmad showed an alternative understanding to the concepts of nuclear waste and the waste during commenting on the programs of nuclear waste for food and energy: "*Nuclear waste and the waste provide us with food and energy and we get rid of them by recycling them*".

The possible logical interpretation to this answer or opinion lies in the lack of students' information around the different dimensions of these issues and so their explanation is based on their little amount of information about the issue or illogical assumptions. A study by Mean and Voss (1996) addressed the content and the argumentation towards the scientific social issues relation showed that content's knowledge is linked with the unique patterns in the argumentation of the issues so whenever the students' cognitive system gets wider, the quality of his decisions increases. On the other hand, this can be explained by the students' alternative thinking about some of these issues as believing that nuclear energy is always considered a clean renewable energy.

Second Pattern: Making logical linear decisions taking into account limited few dimensions.

The results of the analysis showed that most decision of this type focused on pesticides, establishing nuclear facility for peaceful purposes, programs of nuclear waste for food and energy, and industries based on fossil fuel. For example, Lila's answer about the using pesticides was: "*It is good to use pesticides to protect the plants from the harmful insect*". And regarding the issue of establishing nuclear facility for peaceful purposes, Mohammad says: "*Nuclear facility is a good thing because it will provide an alternative to fossil fuel*". And Fatima's answer about programs of nuclear waste for food and energy was: "*these programs will provide a source of income to the poor country*". And concerning the issue of depending on industries based on fossil fuel, Sami's answer was: "*this dependence will develop developing countries economically*".

This result can be explained that these decisions are natural extension to the educational practices which both the teachers and the students use and these practices are mainly characterized by focusing on low cognitive levels as remembering and understanding and so students' thinking skills are restricted within logical formal/ linear frame during discussing issues that need high thinking skills as analysis, synthesis and evaluation which enable them to make informal decisions towards scientific social issues. And this agrees with what Sandoval (2005) pointed to that these issues need elements and skills of thinking and interpreting that exceed the formal thinking to the informal one that includes skills of criticism and evaluation in addition to the skills of logical interpretation. And this result also is consistent with the study of McNeil, Lizotte, Krajcik, and Marx (2006) which showed that the shortage in the students' conceptual model about justifying the decisions related to the scientific social issues lead the students to present formal linear interpretations with specified dimensions to their decisions because they lack having a comprehensive model unified the different phenomena.

Third Pattern: Making decisions within limited scope of argument.

The results of the analysis showed that most decisions of this type focused on using trees as a source of fuel, using fossil fuel and the programs of nuclear waste. For example, Khalel's answer of using trees as a fuel to face the crisis of raising the fuels was: "*This raise will ease expenses but it will damage the little plant wealth in Jordan*". And according using fossil fuel, Saed says: "*I do not recommend using it because it will increase the pollution percent in water and air*". And Mona's answer concerning the programs of nuclear waste was: "*they do not pollute the soil and the air and they may cause diseases to people*".

And this may attribute in general to the students' low practice of controversial skills because of curricula basic dependence on narrating method used in presenting the educational content and because of lack of interest in developing thinking skills including argumentative thinking skill and making decisions. And this agrees Al-Sheikh's (2001) study which showed that the curricula paid little attention to high thinking skills' development including skills of making skills and argue about them.

And this result can be interpreted by the teachers' fear of facing any problems related to social values, jurisprudential aspects and the controversy between the scientists and so developing the students' skills of argumentation is not encouraged and this result is consistent with the study of Hudson (1998) which indicated the teachers' keenness to avoid facing any political interests or social values which discouraged developing the students' controversy skills and this totally agrees with the study of Hudson (1998) which indicated that the teachers' keenness to avoid facing any political interests or social values makes addressing these issues in the class nonsense.

Fourth Pattern: Making decisions that include scientific thinking and take into account the integrated comprehensive dimension.

The results of the analysis indicated that making decisions of this type was limited and focused on programs of nuclear waste and the industries based on the fossil fuel. For example, Moneer's answer about the programs of nuclear waste was: "*No, they do not produce any rays that affect people's life and cause diseases as cancer in the future and they also pollute the water, the soil and the air*". And regarding using the industries based on the fossil fuel, Hala answered: "*No, because they will increase percent of CO₂ which cause Global warming and*

they are costly”.

The students’ weakness in making decisions of this type can be attributed.

To interaction a set of reasons:

- 1) The traditional teaching does not usually encourage searching for meaning but for accomplishing the task with the least amount of employing types of thinking.
- 2) The student’s negative mission depends on receiving what the teacher and the curricula present to him and he depends on memorizing without understanding.
- 3) Learning and teaching are test oriented not task oriented and so whenever the students are asked to make decisions towards missions or issues, he dealt with them using the ways he used to use which means he used the surface approach in solving the missions giving much attention to information and concepts without finding any logical relations between these concepts and his concepts by employing the scientific thinking.
- 4) The teacher’s focus on the low cognitive levels motivates the students to pay much attention to them. For example, if one of classifications of these levels as Bloom’s Pyramid , we find most of the teaching practices focused on the low levels of the pyramid as remembering, understanding and application while the high levels of the pyramid are missing as analysis ,synthesis and evaluation.

8.2 Second: Results of the Second Question

“What is the impact of using scientific social issues as an axis in teaching the environmental issues to the academic level on improving the students’ ability of making the decisions towards the environmental issues?”

To answer this question, frequencies and the percentages of the patterns of the students’ decisions towards environmental issues existed in the test of open-ended questions were calculated for the pre and post tests.

The pre-test’s results revealed the following:

- 1) There are five students out of twelfth students who make ethical decisions about the applications depending on wrong information of some subjects of genetics and genetic engineering.
- 2) There are six students who make wrong linear decisions taking into a count one or few limited dimensions showed in general the shortage of information and the bad connection between the available information.
- 3) There is a student makes ethical decisions at limited scope of controversy showed weakness in the comprehensive view to these issues.

While the results of the analysis of the post-test showed the group’s vertical mobility regarding their decisions on the categories of the classification as follows:

- 1) One student makes decisions about the application depending on wrong information with (8.3%).
- 2) Three students make logical linear decisions taking into account one dimension or few limited ones.
- 3) Four students make ethical decisions at narrow and limited scope of controversy.
- 4) One student makes decisions include scientific thinking linked the scientific content with the procedural dimension in integrated comprehensive manner.

And Table 1 illustrates the results of frequencies and the percentages of the students’ decisions’ patterns towards environmental issues on the pre and post tests.

It is noted by comparing the results of the pre and post tests that teaching using scientific social issues’ method enhanced the students’ ability to improve their decisions towards the environmental issues. And this result can be attributed to the interaction of many basic reasons:

- 1) The teacher’s (researcher) understanding of developing the scientific ideas enable him to identify the conceptual difficulties facing the students in understanding the changing ideas which makes him more likely to share his students the ideas , to help his students to discuss the Controversial issues, to change their concepts, to deal with any difficulty facing the students at accepting new ideas, to help them criticize and evaluate the scientific ideas and their applications in life, to enhance their controversy skills about these applications and to help them to adopt decisions towards controversial issues.
- 2) The group discussion and exchanging ideas in this method are good means allowed the students exchanging their views in between so the student himself is no longer the class-centred so he listens to others’ opinions and realizes that the personal view is not always correct and consequently the students’ decisions’ quality was improved.

3) This method aims to improve the students' reflexive thinking abilities towards the controversial issues relying on teaching the scientists' skepticism view towards the scientific knowledge and showing the social and moral knowledge contexts by which knowledge was found and so the students' ability of controversy and the skill of making decisions was affected where the students learnt how to evaluate the alternatives and take part in the discussions in these controversial issues.

4) Teaching the scientific content in an environmental social context helps in forming the ideas related to the environmental and social problems which were raised by science and technology based on their dimensions' overlapping with more depth and analysis and this helped in developing the skills of interpretation and the informal reasoning of the students who studied according to the method of scientific social issues which helped in developing the skills of controversy about these issues and therefore their ability of making decisions was improved better.

5) Taking into account the ethical and the moral considerations with more integration with the applied and informatics dimensions helped much in improving the students' decisions towards the controversial issues. And it was noted that many of the students' decisions followed the ethical logic and the morals in general and may this due to the strong impact of Islam(our religion)on our ethics and morals on the contrary of the Western societies where the religious aspect is less influential in the ethical and moral considerations about the scientific social issues and this totally agrees with the results of Hasanin's (2009) study which showed that the most common principals is the religious principal and the least common is the utilitarian principle. It was noted during analyzing the students' answers on the post test of the open-ended questions' test that the students made decisions which are compatible with the rule of generalizing the benefit with the least harm so it is possible to say that the students' answers are affect by the ethical and social scientific overlapping.

6) Teaching by using the method of the scientific social issues aims at involving the students in the process of decision making , showing them the importance of their decisions and training them to study comprehensively the issues and the problems; to study the issues in terms of their moral ,applied and informatics' dimensions and all of this enhance the understanding of the social issues and their technological and scientific interaction and develop the skills of discussion about these issues and ways of using the scientific evidences in addition to build the knowledge (Vygostsky method). And as a result of this, the students' ability to make decisions about the controversial issues will be improved and this result agrees with the study of Oulton, Dillon, and Grace (2004) that stated the best teaching of sciences is represented by motivating the students to exchange ideas and opinions and discuss the issues in order to make decisions towards them.

9. Recommendations

In light of the previous results, the researcher recommended the necessity of taking care of the Socio-Scientific Issues (SSI) as an axis of teaching the scientific concepts and issues in the academic level, training the teachers of using it. And the researcher also recommended conducting further studies investigate the effect of using scientific social issues method in teaching other subjects as physics or chemistry and for other age levels.

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