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Impact of Classroom Intervention on Secondary School Students' Argumentation Skills.

Abstract

This research aimed to explore how female students of a secondary school of Pakistan can be engaged in Argumentation about a Socio-Scientific Issue. An intervention was designed and carried out using Tolmin Model of Argumentation. The intervention consisted of three consecutive lessons in a senior secondary class of a girls' government school in Karachi. Allocated time for each lesson was sixty minutes. There were 39 students in the class. A selected socio scientific issue was explicitly taught with the help of different teaching strategies based on Tolmin Model of Argumentation. The results of the study showed that there was a visible improvement in the scientific knowledge and argumentation skills of female students. This study presents significant insights into students' conceptual understanding and argumentations skills for policy and practice.

Key Words: *conceptual understanding, argumentation skills*

INTRODUCTION

One of the important outcomes of science education is to make students able to use their understanding of the science in making informed decisions about the socio-scientific issues which affect their lives (Driver, Newton, & Osborne, 2000). Further, the understanding of science also helps students to take part and contribute in public

Zaheer Abbas
Student Master of Education Cohort 2011
Aga Khan University, Institute for Educational Development, Karachi, Pakistan.
Email: abbaszaheer71@gmail.com
Muhammad Alamgeer
Student Master of Education Cohort 2011
Aga Khan University, Institute for Educational Development, Karachi, Pakistan.
Email: alamgeer.muhammad@gmail.com
Sadia Muzaffar Bhutta
Faculty Aga Khan University, Institute for Educational Development, Karachi, Pakistan.
Email: sadia.bhutta@aku.edu

Debates where science and its effects on society are discussed. For this purpose, schools should provide such environment where students can improve their skills and knowledge to cope with the socio scientific issues. Students also need to be able to find the alternative solutions, possible benefits and risks involved in those solutions and raise questions and evaluate the evidences so that informed decisions can be made (Dawson, & Venville, 2010). Similarly, they also need the skills which help them in oral discussions and argumentation about the socio scientific issues. It is a common observation that the transmission mode of teaching learning is being practiced in most of our schools that does not pave the way for the active construction of knowledge and argumentative skills of the students. For instance, Hussain (2012) finds in his research that the topics related to the concept of socio-scientific issues are taught most through lecturer methods which lead the transmission of factual knowledge about the issues. These methods do not help students to develop problem solving and argumentative skills need to understand the socio-scientific issues. An alternative approach for teaching socio-scientific concepts and development argumentative skills has been presented by Tolmin. The Tolmin Model of argumentation (2003) is an approach which helps to improve the evidence based decision making of students.

The philosophical underpinning of this approach lies in the assumption that science education encompasses the content knowledge, conceptual understanding of science and skills which are truly uphold though observation, experimentation, measurements as well as the social enterprise of science. Keeping this perspective in mind, it is strengthened that social enterprise should be based on the accepted discourse of contemporary knowledge and understanding of science education. Hence this accepted discourse, according to Sadler & Fowler (2006), should be explicitly taught within the science classrooms so that students may take part in social discourse of science and make logical arguments with profound knowledge and understanding of science. This notion leads enriching of science classrooms teaching with Tomin Model of Argumentation.

This paper deals with the three days teaching practicum during which Tolmin Model of argumentation (2003) was used with the aim to enhance argumentation skills of students on a socio scientific issue “Deforestation”. The Tolmin Model of argumentation provides the guidelines and ways to introduce the argumentation framework in classrooms. The argumentation framework contains different parts which are actually designed as teaching activities for the concept of socio-scientific issues. These activities were used in the form of writing frames with an example of socio-scientific issue of “growth in the population”. The ‘growth in the population” is relevant to the topic of “deforestation” as both the topics are socio-scientific issues and the argumentation is based on both the Tolmin Model and socio-scientific issues.

The important parts of Tolmin model of argumentation with description are presented in Table 1.

Table 1

Different parts of Tolmin's Model of Argumentation along with description

S. No.	Parts of Argumentation Model	Descriptions
1	Claim	Claim was considered to be the students' opted responses ("Yes" or "No") to the given statement.
2	Data/Warrant	Data was considered as the additional information provided by the students to support their claims. Warrant explicitly links the claim provided by students to the data but it is difficult to differentiate between data and warrant and, therefore, these two parts were considered together in one level.
3	Backing	Students' provided scientific information, about the assumptions which supported the data, was considered as backing.
4	Qualifier	Information provided by the students about the claim under which it is true was considered as qualifier.

Structure of Intervention

The teaching practicum consisted of three consecutive lessons in a senior secondary class of a girls' government school in Karachi. Allocated time for each lesson was sixty minutes. There were almost 60 students enrolled in the class but during the lessons maximum 39 students were present. As the medium of instruction in the school was Urdu, therefore, all the activities were planned in Urdu language. The socio-scientific issue selected for the intervention was "deforestation" while an example was also used during the teaching of argumentation that is "Growth in Population" to introduce argumentation in the class. The argumentation concept was introduced in the first class with already developed activities bases on the Tlmin model of argumentation. All the lessons were planned and delivered in a team teaching approach. The researchers were trained about the planning and developing the relevant material and teaching of argumentation with the help of socio-scientific issues before going into the classroom. Each lesson was led by one teacher while the other member was assigned the task of involving students in groups and assists them

in the group work. The roles were interchanged in each lesson. All these steps were the part of the planning of the teaching practicum.

Classroom Management and Teaching Strategies

A combination of teaching and classroom management strategies used, in all the three lessons, were presentation of content through charts, group discussions, whole class discussions, individual and group work, written models of writing frames on argumentation, unfilled writing frame with trigger for students' work and a role play by the authors. In the first lesson, deforestation and its related concepts were shared through chart presentation and then students were involved in group work so that students can make their understanding about basic science of deforestation. Further, students had not read about deforestation as the concept has been introduced in the text of the last chapters, therefore it was necessary to teach the topic of deforestation before introducing argumentation.

Lewis (2003) emphasizes that students need to have enough content knowledge so that they can be successfully engaged in argumentation. In the first lesson, therefore, content about deforestation was focused and taught through different teaching strategies. In the second lesson, three parts of argumentation (claim, data and warrant) were introduced through two writing frames filled by the teachers as models for argumentation on a socio-scientific issue. After modeling, same unfilled writing frames were provided to students in groups to write claims, and support them with evidences and warrants. The purpose of the use of these writing frames was to scaffold students' thinking and argumentation. Similarly, in the last lesson, which was the main focus, students were first provided writing frames with a trigger on deforestation and a statement (deforestation should be banned in Pakistan) individually and then in groups to write their claims, data and warrants. A scenario was developed with a question by the two teachers as trigger for the scientific issue so that students can be engaged in argumentation (appendix B). During the instruction, students were encouraged to argue and provide evidences for their arguments on scientific basis.

ANALYTICAL SCHEME AND DATA ANALYSIS

The data was collected during the intervention through field notes and students' work sheets used as writing frames. In order to analyze the data, the analytical scheme developed by Venville & Dawson (2009) was used. The scheme consisted of four levels (level 1-4) and each of the level has been differentiated on the basis of whether it contains specific parts of the argumentation model of Tolmin. For example, level 1 consisted of students' arguments containing a claim. Similarly, level 2 consisted of students' arguments containing a claim along with a data/warrant. It was difficult to

differentiate between data and warrant and, therefore, these two parts were considered together in one level. Likewise, arguments, consisted of a claim, data and backing or qualifier, were included in level 3. Lastly, level 4 consisted of a claim, data and backing and qualifier. The definitions of the parts of argumentation model are appended (appendix C).

In the first step of analysis, data was coded like "CL" for claim, "DT" for data, "WRT" for warrant, "BCK" for backing and "QLF" for qualifier. After coding, a level was allocated to each student's work using the analytical scheme. Then, number of students in each level was calculated and the number was changed into percentage to compare the frequency of students in each level. Finally, as students' work was in Urdu (national language of Pakistan), so after analyzing the data, quotes were translated into English without any changes so that these quotes can be used in the paper as examples.

FINDINGS AND DISCUSSION

The data was analyzed, first to find how many students have reached to a particular level by following the analytical scheme, and the complexity of students' arguments was also explored. The results of the analysis are presented in the figure 1and Table 1. Figure 1shows the percentages of students whose argumentations were judged to be at different level. Result shows the difference in the portrayal of women in MJC and FJC in the allotment of semantic roles.

Figure 1

Argumentation level frequencies

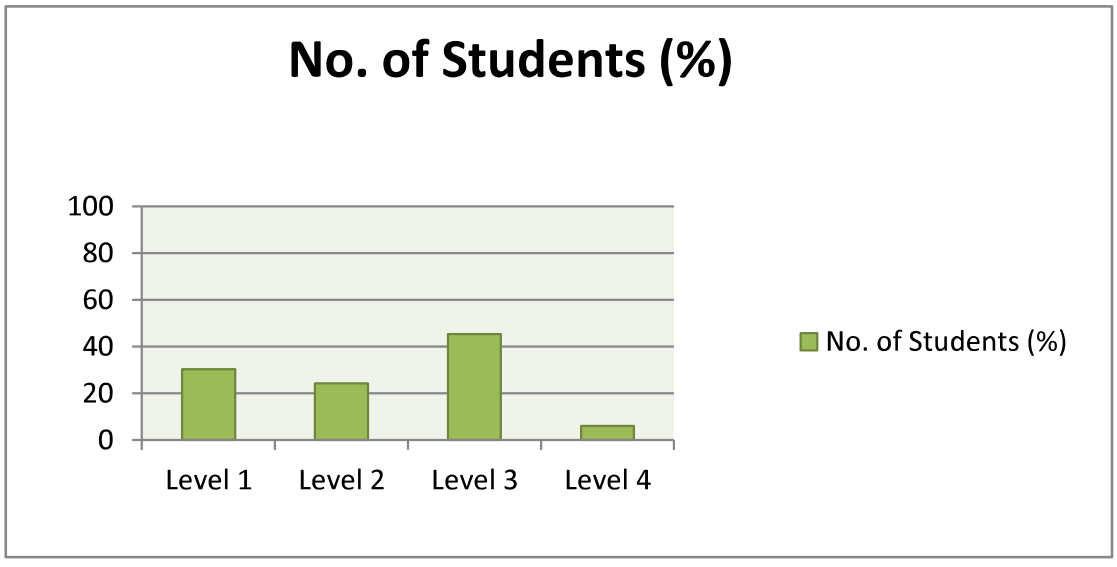

Figure 1 shows that 30% (n = 10) of the total students (n = 33) were judged to be at Level 1 as they provided only claims. Further, when the data of all these students were again analyzed to see how many of them are at Level 2, i.e. whether they have provided evidences (data/warrant) for their claims, it was found that almost 24% (n = 8) of them were at Level 2. Similarly, 46% (n = 15) of students were judged to be at Level 3 which means that they were able to provide backing or qualifier along with claims and evidences (data/warrant). Finally, 6% (n = 2) of the total number of students was judged to be at Level 4 as they provided claims, evidences (data/warrant), backing and qualifier. Figure 1 also displays the frequencies of each argumentation level. For instance, from the figure it is evident that majority of students were judged to be at Level 3 followed by Level 1, Level 2 and Level 4. It means that students have showed comparatively better understanding the argumentation after three days intervention. Further, it also shows the complexities of students argumentation as majority of students has reached up to Level 3. It might be due to that students were explicitly taught argumentation and its components and then engaged them in whole class and group argumentation about the socio-scientific issue during the intervention. Likewise, the improvement in the argumentation of students may be the result of the use of writing frames adapted and designed by the teachers to support students' argumentation.

Chase (2011), in a study on the analysis of the argumentative writing skills of academically underprepared college students, has demonstrated that students engagement in writing argumentation tasks, combine with the demographic characteristics of the writer, significantly contribute to their overall argumentation. Further, it may be the understanding of students about the topic which influenced the quality and complexity of students' arguments (Sadler, 2004). These findings are consistent with the findings of the quantitative study of Venville and Dawson (2010), in which they also found improvement in grade 10 students' argumentation after a three lessons intervention about a socio-scientific issue. Moreover, to analyze students' argumentation; it is necessary to see how students have articulated their arguments and used scientific knowledge (Dowson & Venville, 2008). For this purpose, Table 1 presents results of the analysis where the description of four levels and examples from students' work are given.

In their most part of discussion about women, male journalists create a picture of women in which they are facing some unwanted actions like violence, gender inequality, social, physical and medical situations. The second more frequent role in MJC is beneficiary, which is 21%, in which women are shown as a receiver of painless or pleasing action. In the extracts given below some beneficiary role in MJC are shown:

Table 1: Levels, Description and Examples from Students' Work

Level	Description	Examples from Students Work
Level 1	Claim (statement, conclusion, proposition only)	Yes No
Level 2	Claim, data (evidence supporting the claim) and/or warrant (relationship between claim and data)	• Yes (claim). If there will be no forests then we cannot get many types of herbs for medicines and fruits (data/warrant). • Yes (claim). Forests keep safe us from speedy winds and storms.
Level 3	Claim, data/warrant, backing (assumptions to support warrant) or qualifier (conditions under which claims are true)	• Yes (claim). Air pollution is increasing due to deforestation (data/warrant) because forest [trees] absorb CO_2 from air and if forests are cut then the rate [level] of CO_2 will increase in the air (backing) and air will be polluted. • Yes (Claim). If forest will be cut, then environment will be polluted (data/warrant), due to which there will be many diseases (data/warrant) and the earth will also be affected. • Yes (claim). Forests provide food for organisms (data/warrant). Animals and different birds living in forests become homeless (data/warrant). Different types of trees, plants and herbs are found in the forests which are sources of food for organisms (data/warrant). If forests will be [are] cut then these animals will become homeless and their reproduction will also become less (backing).
Level 4	Claim, data/warrant, backing and qualifier	• Yes (claim). If forests will be cut then environment will be polluted (data/warrant) because the smoke which comes from the factories, it has carbon dioxide which the organisms not so much need and forests absorb it [CO_2] due to which the environment becomes safe from being polluted (backing). If forests are cut then there should be planning so that the organisms living there will not be affected (qualifier).

The examples, given in the Table 1, show different levels where students have reached as well as the content knowledge which they have used while making their arguments. For example, the first example in Level 2 indicates that the student has supported her claim with the evidence that if there will be no forests then we will not be able to get fruits and different kinds of herbs which are used in medicines. It means that student has given the scientific information about the use of herbs in medicines and the effect of deforestation on these herbs. Similarly, from the analysis, it is clear that students have shown, to some extent, encouraging scientific knowledge and understanding. There might be many reasons for this encouraging understanding of deforestation. Firstly, it might be possible that the three days intervention impacted students understanding and knowledge of deforestation positively as different strategies were used to first give the content knowledge about the deforestation and

then students were engaged in argumentation. Similarly, it is also possible that students existing knowledge about deforestation matched with the knowledge learnt during the intervention and resulted in the improvement of scientific knowledge about deforestation (Westwood, 2004).

Further, the encouraging understating of students might also be due to students' existing knowledge which was strong enough to build on their existing knowledge easily (Oortwijn, 2008).Moreover, it also seems that the argumentation process helped students in improving their content knowledge about deforestation as the process included different strategies like use of writing frames, group discussions as well as teachers' role in helping students in argumentation (Cross, Taasoob, Hendricks & Hickey, 2008). Hence, the relationship between the argumentation and conceptual understanding of students about a topic seems two directional as both argumentation and conceptual understanding might have effected each other. These findings of the study are consistent with the findings of the study of Zohar and Nemet (2002) which examined learning within a unit in which explicit teaching of argumentation skills was merged into the teaching of human genetics. The study found that integrating explicit teaching of argumentation into the teaching of dilemmas in human genetics enhances performance in both biological knowledge and argumentation.

CONCLUSION

In this study, three consecutive lessons were taught in a public school of Karachi, Pakistan. Data was gathered through writing frames designed the teachers and group discussions. Analysis of the data shows that majority of students reached up to the Level 3 of argumentation followed by Level 1, Level 2 and Level 4. Similarly, majority of students' arguments were based on scientific content knowledge of the topic. From the results of the study, it is evident that when the argumentation is explicitly taught by integrating it with the socio-scientific issues; students' argumentation skills as well as the content knowledge of the topic both enhance (Sadler & Fowler, 2006). Some important factors which might have resulted in encouraging argumentation and content knowledge of students are nature of socio-scientific issue, students' content knowledge of the issue and teachers' role in facilitating argumentation because these factors can their role in motivating students towards argumentation. Therefore, it becomes important for teachers to carefully select the issue according to the interest of students. Similarly, teacher's role in the facilitation of argumentation in the classroom is also important as s/he can foster students' skills by different strategies like encouraging, talking, listening and monitoring the group discussions (Dawson, & Venville, 2008).

During the intervention, some challenges were also faced. For example, during the group discussion of students, when my colleague approached to different groups, students became silent but when we moved away from them, they started discussing. It might be because of their unfamiliarity with such activities in the class. In such situation, we had to be careful and encourage them to discuss. Similarly, in the first lesson, it was observed that students were not making arguments on the basis of scientific knowledge. It was also a challenging task to help them in making scientific arguments. It might be because of the effect of their daily life argumentation where arguments are not made on scientific basis. To cope up with this challenge, first we encouraged them to bring scientific knowledge and we also provided them scientific content about the selected topic through different strategies.

The conclusions which have been drawn are subjected to several limitations. For example, there were no comparison groups i.e. students who were taught argumentation explicitly and those who were taught without argumentation. It would be more informative to gain comparative information and to explore whether the improvement in argumentation and content knowledge is significant. Similarly, the total time spent on teaching argumentation might not be enough for all students to comprehend the argumentation skills and content knowledge. Lastly, the context of the argumentation may also have affected students' argumentation because the nature of the socio scientific was not very related to their daily life. Hence this specific property of the context of the present intervention must caution us against making unproven generalizations from the findings. In a different context students' argumentation patterns might have been different. So, additional studies are needed to inspect students' classroom argumentation in other contexts.

Hence, it can be recommended that first, individual teachers should be trained enough to bring and facilitate socio-scientific issues and argumentation in the classroom so that the argumentation can act as a tool to relate students content knowledge with the outside school experiences. For this purpose, professional teaching activities should be tailored to science teachers according to their content knowledge and the experience of using socio scientific issues and argumentation. Similarly, classroom based research should be conducted to explore different teaching strategies which can add in the development of students' argumentation.

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