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Promoting Discussion in Lower Secondary Science Classroom

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Abstract: With the advancing world, it is the need of the day to shift transmission mode of teaching towards conceptual understanding, where children can build their understanding by playing a central role. Discussion is one such process which can be used to help students' construct their own understanding, communication and thinking skills. Discussion can be incorporated in any of the teaching strategies. However, it is hardly practiced in classroom. Recitation remains the predominant form of interactive talk. Therefore, the aim of this study was to promote discussion in the lower secondary class of a private school. Action research methodology based on Kemmis, Mc Taggart and Retallick (2004) cyclic model was used. Data were collected through interview and classroom observation. Analysis was carried out in two steps; on-going analysis throughout the data collection and overall analysis at the completion of field work. Various teaching strategies and classroom organizations were used to promote discussion. Findings revealed that POE and discrepant events strategies and linking science with daily life encouraged children to participate in discussion. The study also highlighted facilitating factors (e.g daily life objects, proper planning, setting rules) and challenges (e.g time, completion of syllabus) faced in promoting discussion. The study has implications for science teachers as well as teacher educators in their teaching of science and professional training programmes respectively.

Keyword: discussion, recitation discussion, inquiry problem-based discussion, action research

Introduction

Science is generally perceived as a very difficult subject in our society. This often discourages children to opt for science subjects for their higher studies. Sometimes teachers find it difficult and challenging to teach certain scientific concepts. Garson (1988) considered the meaning of science to pupils and teachers as boring, repetitive, confusing and incomprehensible. Such feeling might have arisen because of their past science classroom experiences. This refers to the traditional style of teaching science, where science was considered as collection of facts. Lecture is one of the major means to transmit knowledge where the teachers tell information, mostly consist of 'facts to

memorize' and 'procedures to practice' where students 'listen carefully' and 'remember accurately' (van Zee, Iwasyk, Kurose, Simpson & Wild, 2001, p. 161). This is what Freire (1970) consider as 'banking concept' where teachers are the depositors and the students depository. Perhaps, teachers adopt transmission mode because they prefer to carefully control classroom discipline. In such a situation teacher holds an authoritative position and follows one way flow of knowledge, from teacher to students.

However, lots of emphasis has been given by the educationists to bring change in classroom dynamics: from teacher being a sole authority to an interactive mode. In recent years psychological researchers have become increasingly concerned with what Vygotsky has said, children thinking is shaped by social interaction amongst peer and by adult guidance. Vygotsky's own terms, 'intermental' activities provide a basis for 'intramental' development. For intermental and intramental development, discussion is said to be a highly interactive and powerful strategy. Discussion facilitates 'cognitive and affective' (Chiappetta, Koballa, & Colette, 1998) learning in students. Learning through discussion exposes children not only to different ideas from each other but convince them to think and relate to previous knowledge and new experiences gained. While discussion is a vital activity to promote children's learning, it is minimal, scant and almost non-existent in classrooms (Dillon, 1994). Teachers are mostly in telling mode and child participate more in listening than talking (Burns & Myhill, 2004). Hoodbhoy (1998) asserted that, science teaching is heavily dependent on textbooks and memorization and rely heavily on transmission mode of delivery. Such students appear to lack ability to solve some simple conceptual based questions (SPDC, 2002-03).

This study aimed to explore and describe the usefulness of different strategies to promote discussion for the students of lower secondary science class at a private school in Karachi. Second aim of this study was to enhance researcher's knowledge of pedagogical strategies for discussion. In this particular research two ways of discussion was studied namely; recitation discussion and inquiry problem-based discussion (Arend, 2001).

Theoretical Perspective

Discussion is a fundamental human activity. It is a unique form of oral interaction, where people join together to talk about a common concern. Dillon (1994) describes discussion as, talk consists of advancing and examining different proposals over the issue for; better understanding, wiser judgment and a firmer resolve. Arend (2001) summarizes it in the context of teaching and learning. Discussion provides a chance for teacher to view the thinking skills of their students for providing correction and feedback. On the other hand it also provides student a chance to hear their own thinking and to monitor their own thinking process. They actively build knowledge over existing knowledge. He further says, discussion is not a full-blown teaching model rather a teaching procedure for almost all teaching models. However Lewin and Leech (2006) studied the relationship between scientific knowledge and ability to engage in reasoning found that discussion requires basic knowledge, ability to identify key issue of relevance, consideration of a specific context and some understanding of basic science related to the context. Having said that, discussion is hardly practiced in classroom where as, recitation is the predominant form of interactive talk.

Unfortunately, teachers often criticize and are reluctant to use discussion in their classroom teaching. They argue about completion of lengthy syllabus within specified time, immaturity of students opinion, not producing effective result, rise of conflict and emotion, loss of control over class and too much of noise (Brookfield & Preskill, 1999; Dillon, 1994). Often science teachers may not see group work and discussion as part of science teaching as it deals with a lot of facts (Pakinson, 2004; Willington & Osborne, 2001). In addition certain reasons make teachers suggest that discussions are doomed to fail. Such teachers lack certain managerial qualities, have unrealistic expectation, students not prepared for discussion, no ground rules and the teachers have not modeled discussion (Brookfield & Preskill, 1999).Usually in science classroom initiation-response-feedback (IRF) or recitation is found to be pervasive. Teacher's low order, close ended questions restrict students thinking and students responses remain brief and teacher framed. Teacher often uses a textbook and/or chalkboard to transmit recipe knowledge for rote learning. Such situation favors rote memorization and hinders co-construction of knowledge (Chin, 2006; Pontefract & Hardman, 2005; Parkinson, 2004; Acker &

Hardman, 2001; Osborne, Erduran, Simon & Monk, 2001). In such situation world is characterized as absolutes or right/wrong answers. In contrast to that Halai and McNicoll (2004) argue the tentative and evolving nature of science.

With all the reservations, discussion has particular specificities and acts as forum for children to check their understanding. Children share and gain knowledge and develop their thinking through the set task. Brookfield and Presskill (1999) found discussion as a critical mirror for the teacher and students. Where they question each other for reasons, evidences and experiences behind the comment each makes. Through discussion children discover, develop and scrutinize new ideas, facts and perspectives that others bring and share during discussion. It is beneficial for both individual and group. Hence, discussion is a process which develops communicative competence, promotes involvement and engagement, develops better understanding by allowing to verbalize their thinking instead of recite or memorize facts and details (Mujis & Reynolds, 2005; Larson & Kieper, 2002; Gunter, Estes & Schwab,1999; Van Zee & Minstrell, 1997; Dillon, 1994). Such scientific understanding is best assisted by a careful examination of peer group interaction and expert guidance by the teacher.

Chiapetta, Koabolla and Collette (1998) identified multifaceted uses of discussion, 'to initiate inquiry session, review material previously covered, explain or predict the results of laboratory experiment, solve problem and allow students to plan future class activities' (p. 139). Webb and Treagust (2006) hypothesized that, trained teachers could initiate and sustain discussion of an exploratory nature in their science classroom by using especially developed hands-on practical work activities, share knowledge-based prompt-poster and the ensuing discussion would have an effect on learning cognitive development. Osborne (1997) explains in 'real science' ideas are introduced and then discussed and explained through dialogue with peer, giving rise to an opportunity to elaborate and question. For complete understanding of hands-on experience it should be coupled with minds-on activity, which requires opportunity to practice using discussion. (Willington & Osborne, 2001). That's why constructivists argue that science education should start from child's understanding of natural phenomena not from the reasoning of professional scientist (Lewin, 1992).

Arend (2001) identified three approaches to conduct discussion which depend upon teacher's purpose and the nature of the students involved. First is recitation discussion, characterized by brief question and answer. It helps in motivating and checking student understands. Second, inquiry or problem-based discussion which centers around a discrepant event, that encourages discussion and help students become aware of their reasoning processes. Third, sharing-based discussion which helps students form and express independent thoughts and opinions. While Chiapetta, Koabolla and Collette (1998) describe types of discussion as; recitation, guided and reflective discussion. Van Zee, Iwasky, Kurose, Simpson and Wild (2001) mentioned different ways of speaking during science instructions including, lecture, student generated discussion and small group discussion**.**

Discussion is considered to be free floating activity by the teachers and students. Chiapetta, Koballa and Collete (1998) called it as 'freewheeling exchange of ideas with no starting or ending points' (p. 144). However, to make it a productive activity which can acquire both cognitive and affective goals, teacher should use discussion method effectively through proper planning, management skills and by creating positive learning environment. To achieve effectiveness of discussion Arend (2001) identified five phases planning syntax; explaining the aims of the lesson, focusing the discussion, holding the discussion, bringing the discussion to a conclusion and debriefing. With slight variation Dillon (1994) specified; preparation of discussion, presentation of the discussion question, initial address to the question, exchange over the question and conclusion of discussion. Alsop and Hicks (2003) argued that, initiation, maintaining and wrapping up discussion are the most demanding aspects of discussion. Whereas, critical peer discussion was generally proceeded through; focusing, exchanging, debating and closing. Out of these focusing stage was found to be important factor (Kim & Song, 2006).

Effective discussion also requires proper classroom setting. Face to face and eye contact are very essential and important features of discussion. Researchers recommended U-shaped, square shaped and circle as the best seating arrangement for discussion which ensure maximum eye-contact and verbal involvement, provide writing surface for all, avoid placing teacher in a dominant position. (Arend, 2001; Chiapetta, Koballa & Collette, 1998; Dallas, 1994). Apart from these there are some non-

recommended seating arrangements and physical environment like; rows of desk because children get out of eye contact with teacher and other children, loose circle because it provides nothing to write, hot room and the last uncomfortable or too easy chair because it induces sleep. (Dallas, 1994; Chiapetta et al, 1998). Non-evaluative and positive atmosphere enhances discussion. Children get involved in classroom interaction, if they feel secure that a wrong answer will not be criticized from the teacher or fellow pupils and there should be mutual respect (Mujis & Reynold, 2005). Furthermore, student's participation would be inhibited if the teacher is authoritative, sarcastic or dismissive. Participation is encouraged if teacher listens, shows interest and respect views expressed (Jenning, 1995 & Dillon, 1994).

Teacher plays several important roles to conduct discussion like, intervene into the group to challenge student's ideas for 'reflective thinking', re-focus students digression encourage participation from quiet students and identify any alternative framework. In such situations teacher play the role of teacher and leader (Mercer, Dawes, Wegerif & Sams, 2004; Arends, 2001). All these listening help teacher to follow the trend of group ideas, to detect group dynamics and to identify issues for further elaboration at class level (Mujis & Reynold, 2005; Harlen, 1996; Jenning, 1995). Vivillian and Dawson (2006) mentioned teacher's main roles as, stimulator of curiosity, challenger of ideas, resource person, senior investigator, and discussant. While, Oh (2005) defines teacher's pedagogical discursive roles including, making scientific knowledge available to students, coaching students to manage and enhance their performance and scaffolding. On the other hand a teacher should be very cautious not to show authority to correct ideas and to participate as an equal participant. However, Myhill and Warren (2005) found that, instead of acting as a support scaffold acts as straitjacket upon students learning. In such situation scaffold become mean of control rather then guidance.

Teacher questioning is a prominent feature of classroom talk (Wellington & Osborne, 2001) as teachers view it as a basic way to stimulate students' thoughts and development of knowledge (Durham, 1997). Many studies found that during teacher-led sessions 'IRF' still dominates. However, Chin (2006) analysis revealed that IRF pattern

can engage students in construction of knowledge. He found that, F-move in the IRF cycle was not just evaluative but also supportive by embedding a further question to provoke deeper thinking beyond simple recall. Hence, it engages students in more cognitively active roles. In addition, questioning in constructivist oriented lessons is open-ended and students are engaged in higher order thinking (Baird & Northfield, 1992). Teacher should start by asking simple recall questions, follow it with comprehension and analysis questions and conclude with more thought provoking synthesis and evaluative questions (Arend, 2001).

Methodology

The study was undertaken into qualitative paradigm. As it is descriptive, interpretive and takes place in naturalistic setting, researcher does not disturb the site, emergent rather than tightly prefigured and question may refined as researcher systematically reflects (Creswell, 2003). Progression and improvement was based on systemic reflection. Strategic plans were refined according to the emergent needs. It facilitated in gaining wider, holistic and context specific picture of the phenomena under study (Glesne, 1999; Bogdam & Biklin, 1998).

The underlined assumption was to implement discussion in the classroom with a rationale to improve students' participation during classroom teaching, enhance reasoning skills, inculcate inquisitive attitude towards scientific phenomenon, and to some extent make them independent learners. The study also aimed to improve my practices as a teacher.

Kemmis, McTaggart and Retallick (2004) self reflective participatory spiral model of action research was employed. Koshy (2005) asserted that quality of educational experience provided to students depend upon teacher's ability to stand back, question and reflect to make the necessary change. Hence, it is about empowerment. The whole process integrates teaching and teacher developement (Elliot, 1991). That is why Cohen, Manion and Morison (2000) called action research a powerful tool for change and improvement at a local level. I worked as teacher-researcher and as a 'participant-observer' (Glesne, 1999; Frankel & Wallen, 1993). As a participant observer I was constantly analyzing my actions for meaning. I was instrumental to the research goal as I

implemented and helped children to extend discussion.

This short study of seven weeks was a part of two year M.Ed programme. It was conducted at boys' section of a private English medium school. Grade seven students were selected. Science teacher of the class helped me in writing descriptive notes of my teaching enthusiastically, considering it a great learning opportunity. The school administration and teacher were taken into confidence by assuring confidentiality and anonymity. Hence, voluntary written consent was taken.

Semi-structured interviews of the science teacher and a group of representative six students of mixed ability were taken before and after intervention. In addition, informal talk, classroom observation, classroom teaching notes and reflective diary were also used for data collection. Data were analyzed in two steps. Initially during teaching sessions to improve the planning and classroom teaching. Later on coding, clustering of similar codes under one category and extracting of major themes (Miles & Huberman, 1994) was done when all the data were gathered.

Findings, Interpretations and Analysis

Snapshots of the existing practices revealed that the science teaching and learning was predominantly teacher centered where students have no part to play except as a recipient of knowledge. They memorize the content and reproduce to get good marks in the exams. Beicher and Dobey (1994) said teacher is looked upon as authority figure and children memorize the facts given by the teacher. In such situation teacher placed herself in a commanding position. Being the central element in the child learning the teacher controls the content, direction and pace of teaching. It is considered as transmission mode of teaching (Marilyn, 1995). It was also noted that teacher missed excellent opportunities by following a recipe of practical steps instead of making students predict and discuss the demonstration lesson. The insight gained through interview and classroom observations helped to plan for the intervention phase.

Strategies for Promoting Discussion

Considering the results of feasibility analysis, intervention was done in two phases. First, to make students talk and then to encourage peer interaction through group

work to verbalize their thinking in small groups and whole class.

Phase I: Initiate Discussion

Classroom discussion was initiated as a whole class setting characterized by teacher led 'recitation discussion'. Though recitation is not considered to be a true discussion strategy rather, 'quasi discussion' (Chiapette, Koabolla & Collette, 1999). It was preferred to start intervention with it and to progress the students' involvement in the classroom teaching gradually from the passive recipient of knowledge to more interactive knowledge seeker. Arend (2001) recitation discussion was adopted as a mean of checking students' understanding as well as motivating them. Recitation also helped to determine students' preparedness for 'problem based discussion'.

Visual Aids

Observation is one of the effective science process skills. Children have keen observation power and picture captures student attention at once (Webb & Treagust, 2006). Therefore, two different posters were used to help students observe and talk about the structural details, differences and similarities. Teacher's role was to ask simple question and direct students attention towards the visible differences

T. (instruction) there are two diagrams shown in these posters. Observe very carefully and then tell me what are the differences or similarities between them.

St . (pointing towards diagram drawn on left poster) rectangular in shape.

T. Good(pointing towards diagram on the right poster) what is the basic shape of this diagram?

St . It's like a circle

T. Yes, you are right. Any one wants to add.

St . It has nucleus in the corner

T. Exactly, (paraphrased) it has nucleus at one corner. What else?

St. 4. Rectangular cell has large size structure in the centre while the circular shape does not have it.

T. (nodding head). Excellent answer.

(teacher-student talk, 6-2-07)

This interaction did not occur at once automatically. Rather, induced through verbal motivators (good, excellent, you are right) or through gestures (nodding head, passing smile, hum-hum) and by acknowledging students responses. In order to instill inquiry skill, students were asked to prepare slides of animal and plant cells in groups of four. Children observed the slides and asked some simple questions to each other. Children justified their answers on the basis of the prior knowledge gained. The following excerpt of group talk from the class shows that,

St. 1 (inquired) Tanzeel, is it animal cell or plant cell?

St. 2 Of course this is animal cell because we have prepared it from cheeck cells.

St. 1 What are the other characteristics?

St. 3 It is irregular in shape. Nucleus is situated in the centre.

St. 1(asked) Does it have a cell wall?

St. 2 (quick response) No

(student-student talk, 7-2-07)

This phase progressed from where the students were (recipient of knowledge) to simple participation in classroom talk. Students were given task to recall their previous knowledge and to answer some knowledge based questions.

Phase II: Sustained Interactive-Discussion

In the previous phase, students were motivated to talk in the classroom but there was a little movement from knowledge based recitation to sharing based discussion. Children moved from knowledge to comprehension level of cognitive domain. Next step was carefully planned and executed to engage students in high order thinking to improve the quality of talk. Predict-observe-explain (POE) and discrepant events strategies through problem-based discussion were implemented (Arend, 2001).

Predict-Observe-Explain (POE)

After recitation discussion it was necessary to apply attention seeking approach to enable them to think beyond knowledge level of cognitive domain by applying knowledge gained (density of any substance depends upon mass and volume) in the previous lesson. POE probes understanding of children in three distinct steps; predict outcome of the event and justify prediction, observe and describe what they see and finally reconcile difference between prediction and observation (White & Gunstone, 1992). Students sat in semi circles near the demonstration table (Arend, 2001).

T. what will happen if I add this orange in water?

St 1. The water will come up [raised]

T. Hum hum, any one else

St 2. It [orange] will go to the bottom

T. O. K why do you think so?

St 3. It [orange] has larger mass.

St. 4 It is heavy and denser then water

T. (addressing the whole class). Do you agree or is there any other answer.

(The whole class said it will sink).

I demonstrated the activity and the prediction was wrong. I put the orange in water and it did not sink.

T. Did it sink?

St. (chorus) No

T. Think for the possible reason. Recall your previous knowledge and then tell me, why this orange is floating?

(teacher-student talk, 21-2-07).

Such conflict in opinion and observational outcome put students in a state where they tried to find genuine reason pertinent to the situation. At this point the students

decided what reasoning to apply. Through probing questions and guiding their thought students were brought towards right concept and build correct understanding. After giving time to think, students were asked

T. why orange floats instead of sinking?

St 1. It has large volume then mass

St 2. Orange is lighter and water is denser.

T. Good. I can see you are applying knowledge and thinking.

(teacher-students talk, 21-2-07)

Leaving the explanation at this stage was not enough, so the concept of lighter and denser was reinforced by continuing the activity further. For better conceptual understanding, I made a conscious effort by enabling the learner to construct and reconstruct concept for deeper understanding (Harcombe, 2001).

T. I will peel and put this orange again in the water. Tell me, what will happen?

St. 1 It will sink

T. How many of you think it will sink

(the whole class raised their hands)

T. Tell me why

St. 3 Volume has decreases

T. O. K What has happened to the density?

St. 5 It (density) has increased.

(I put the peeled orange in the beaker. It sank to the base)

T. Can any body tell the difference in the density of peeled and unpeeled orange?

St. 6 Volume of the peeled orange is less and its mass is more as compared to the unpeeled orange.

T. Exactly, (I explained). Now the density has increased as compare to the unpeeled orange. There is space between orange and its skin. Air in the spaces make it lighter, that's why it floated

(teacher-student talk, 21-2-07)

This time prediction was right because students' based their prediction on the knowledge and the most recent observation and explanation. Students came out of conflict phase but the concept was further addressed by recalling the whole process to overcome any gap between the knowledge and experience. Reinforcement of knowledge through daily life experience made them think more

T. Have you noticed that people use tube or air filled jackets to help young children swim? Why?

St. Teacher, to prevent from drowning

T. You are absolutely right but why they do not get drowned?

St. Air has less density. Air in the tube make them lighter and protect them from drowning.

(teacher-student talk, 21-2-07)

Surprisingly, activity enabled student to extend their thinking beyond classroom teaching.

St. 1 Teacher, we can float by holding a big size ball

St. 2 During swimming I go deep to the base of the pool and leave my body loose, water push us upward

A child asked, "How do submarine go to bottom and again comes on surface?"

(students giving examples, 21-2-07)

Before I responded to this question another student responded.

St. Submarine has special chamber when it is to come on surface water is expelled out of it and when it has to go to the bottom water enters into the chambers.

St. (who asked the question) Now I understand

(student-student talk, 21-2-07)

This reinforced my notion, “Do not underestimate children’s knowledge. We as teachers have to channel the thinking in appropriate direction. Discussion is an appropriate channel to build new knowledge over existing knowledge.” (Ref. Jr, 21-2-07).

By analyzing the students comments, reasons shared and their ability to apply knowledge to out of class context, it was decided to put them into a challenging situation to make them think independently through a simple inquiry task. At this moment I wanted to challenge my ability to facilitate students’ group task as well. I wrote the task on the board.

Task: How to make an egg (which sinks in water) float on the surface of water.

Fifteen minutes were given to all fives groups. Each group got required material like beaker, spoon, water, an egg and salt. It was the first inquiry task for them so I purposely gave them limited material to prevent distraction. Verbal instruction was given to; predict, perform and then discuss the result. Following classroom excerpt presents ‘discussion’ which was held in one of the group.

St. 1 (Predict) what will happen if I put this egg in water

St. 2 It will not sink

St. 3 No, It will sink

St. 3 It is written in the task’s title, definitely it will sink

(I quietly sat near the group to see how they were progressing. One child put the egg in the beaker half filled with water. The egg sank).

St. 3 Why the egg sinks in water?

St. 1 It has less volume

St. 3 (Surprised) egg is quite big.

St. 3 (Argued) if it has more volume then it should have floated on water.

St. 2 How to make it float?

St. 1 I will add more water

(student-student, 1-3-07)

A child added more water but still egg did not float. Children seemed to be perplexed. They were trying to think of a possible reason. All their attention was on density of the egg and was not paying attention on the surrounding water. Now I intervened to give them a clue. I brought a picture of dead sea where a man was lying and reading a magazine.

T. Can you guess how this man is floating?

(To my surprise they knew the answer. During informal talk geography teacher said, they have read it in geography).

St. This is dead sea and its water is very saltish.

(The picture gave them the clue)

St. 1 (This child was very eager to share his response) teacher we will add salt into the water and egg will float

T. I think you should do it and see the effect. Luckily we have salt with us

(teacher-student talk, 1-3-07)

(Child added salt into the water, mixed and put the egg into the 'salty water'. The egg floated). This activity served two purposes, first it made the students think and they tried to give logical reasons which were not so evident first but after getting the clue they argued to relate the daily life example to the classroom activity. Secondly, I practiced giving clues and scaffold their thinking. I did not try to hold the floor by giving right answer.

Discrepant Events

To generate the internal desire to know more, discrepant event 'raise the raisins' was used. Discrepant event is attention seeking approach for initiating inquiry. It puzzles

the observer to wonder why the event occurred (Chiapetta, Koballa & Colette, 1998).

Creating the scene and trying to capture students' attention I pretended to be a magician who had ordered for magical water from the fairy land. I asked science teacher to hand over the bottle (like assistant of magician). As soon as the teacher gave the bottle in my hand I started muttering some magical spell. Children started laughing.

After a few seconds, I added few raisins in the drink. Within a second they started moving up and down just like dancing in water. I said, "My magical spell is making them dance." This added humor to my lesson. Children were surprised to see and even they started pointing the raisin as they were moving up or down. Children were engrossed in the activity.

> St. (children said in surprise) Wow!, "Look! it is dancing" and " Is main kuch mila hova hay [some thing is mixed in it]".

They were enjoying, laughing, looking at the bottle with interest. Leaning towards the bottle was an indication that they are showing interest and are enjoying.

St. 3 (Keen observation) "teacher nechay karain roshini par rahi hay tikh nahi raha. [Teacher lower it down I can not see, light is reflecting on it]".

I kept on muttering the spell. Here comes the turning point when a child challenged my magical power and said,

> St. 1This is no magic it is science!.
>
> St. 2 O. K if its magic then order it to sit down instead of dancing.
>
> St. 1 "It is not simple water nor magical power. It is 7-up because bubbles are coming out of it"

(students ideas, 22-2-07)

That was the right time to disclose that, yes that was not magic but scientific phenomena. I asked children to think of the possible reasons but students were unable to give right answer. Such discrepancy put students in cognitive dissonance. Through probing questions and guiding their thought, I was able to bring students towards right

concept and build correct understanding. Hence, I acted as catalyst in promoting discussion (Hogan, Nastasi & Pressley, 2000). Students figured out the discrepancy. After knowing the right reason they established cognitive equilibrium at a new cognitive level (Chiapetta, Koballa & Colette, 1998).

After giving enough time to think, I started taking the answers.

T. What happened first and why?

St1. Raisins were moving up and down because of gas

T. (inquired further) Can you explain 'because of gas'.

St 3. Gas is lighter and is making raisins jump up and down.

T. What do you mean, Is gas making it to jump up and down?

St. (chorus) yes

St. 4. Gas is pushing it

(teacher brought the bottle close to them and said, look where is gas).

St. 5 Air bubbles are attached to the raisins skin.

T. What is making this raisin to rise?

(No response to me, but they were discussing among themselves).

St. 6(seeking help) miss hint day dain [Teacher please give hint]

T. (hint) Raisins have wrinkled surface and air molecules can adhere to it and raisin gets lighter.

(Hint has given them some direction to think because they again started the discussion).

St.7 Gas bubble gets stick on the surface of the raisin. When gas bubbles are coming up they are bringing raisins with them. Air molecules make them rise.

St. 6. Teacher, please tell the answer

(teacher-student talk, 22-2-07)

The child now wanted to know the 'correct answer'. Most probably he wanted to get out of dissonance quickly by knowing the right answer or was curious to know the right answer, which they were habitual of, the teacher telling the right answer of every thing. But the other child did not want to give up, he still wanted to think of the possible reasons

St. (Snub) ruko to soochney do. [Stop it let me think].

T. (encouraging tone) you people are getting there.

St. Air gets attached to the surface of the raisin makes it lighter to rise

T. (directing their thinking) After reaching the surface why raisin came back to the base?

St.8 Gas bubble escapes and raisins become heavier therefore come to the base

T. Good

(teacher-student talk, 22-2-07)

I summed up the whole discussion. Air molecules get attached with the raisins make it lighter, rise to the surface. On surface gas bubble escapes to the air, raisins again become heavier and settle down on the base.

POE and Discrepent event were used successfully to stimulate students' curiosity and interest, which helped me to promote higher level thinking and meaningful learning (Chiapette, Koabola and Colette, 1998) and helped in better recall of previous knowledge, application of knowledge and retention of information for longer time hopefully. These activities also helped to develop communication skills and confidence to participate in classroom task without a fear of being wrong. Such discrepant events were handled effectively through problem-based discussion (Arend, 2001).

Promoting Discussion: Facilitating Factors

Daily Life Objects and Clear Instructions

Construction of knowledge takes place when it is built on previous knowledge. Daily life objects helped children in the construction of knowledge. Simple thought

provoking questions helped to relate the object, daily experiences and scientific knowledge. material (stone, wood, egg) helped to build interest, to extend thinking towards other related phenomenon. Chiapetta, Koabolla and Collette (1998) call such substances as attention grabbers. As a result, they came up with many daily life examples. It also helped me to put students in cognitive dissonance where they were eager to know more. Students learnt to relate content with daily life experiences. This is an evidence of learning.

Proper Planning and Implementation

Proper planning is a key to manage discussion in the classroom (Arend, 2001). All the phases and all lessons within each phase were properly planned and implemented While planning, the goal of each phase and objectives of each lesson were considered. All the activities selected were appropriate with the content and the level of students. There were logical connections between activities within each lesson and there were progression within phases. In a way I did not set any unrealistic expectations.

Setting Rules and Teaching Social Skills

Improving classroom discipline was the first target set during reconnaissance phase. Rules were not imposed but formulated along with children (Brookfield & Presskill, 1999; Mercer & Wegeriff, 1999). This strategy helped to control discipline and ensured social skills but still reminders were needed. Sometimes I used some signal like raising hand, clap or flicking fingers to reinforce rules. They were aware of these cues and followed them. It did not happen at once but as we moved further the discipline improved. Motivators were designed to encourage good group work like ‘best group’ and ‘best child’ were found to be very effective.

Promoting Discussion: Challenges I Encountered

TIME

Through this study, I realized that discussion is a time consuming activity (Dillon, 1994) as compared to the ‘normal practice’ where teacher reads and translates or explains. Lack of time was an issue, especially in the first phase and generally through out the action. Though, with proper planning I managed to handle the situation but still it

was difficult to answer some students own generated questions. Answering such questions with the regular teaching plan needed time. At times such questions were very crucial to discuss and could not be ignored. Just because of less time I had to end the lesson abruptly without proper closure. Completing all the stages of discussion with in a class was a tough task to achieve.

Completion of Syllabus: A Realistic Pressure

Syllabus pressure is found to be a common reason for teacher's indisposition towards discussion (Dillon, 1994). I had to juggle the time and syllabus pressure especially, in the first phase where students were transforming themselves towards discussion style. It was very tricky to complete the topic of the week on time but I managed all these successfully. During entry negotiation I selected topics to be taught according to my action time table.

Conclusion

Classroom discussion is central to classroom teaching and can be used effectively with any teaching strategy. Careful thinking is required to plan discussion. In other words teacher should have a clear plan to start, sustain and end discussion. This implies that activities and content should be appropriate for the age level. Moreover, teacher should start from 'where the students are' and then progress along the continum gradually. The result of this intervention gave a better understanding of the stance and improved my pedagogy as science teacher. Action research cycle: plan, act, reflect gave a frame work for implementation. Reflection was the key element for improvement. I hope it will motivate the readers particularly science teachers to explore opportunities to adopt discussion in their classroom teaching.

True efforts were made to work within school context without disturbing normal routine and following the syllabus strictly. Low cost and no cost materials, simple activities and daily life examples helped to generate discussion. Students were able to relate these examples of scientific content and can see the link between some abstract concepts of science and daily life. Sequence of relevant activities and gradual increase in complexity helped in building conceptual understanding hence I followed the

constructivist philosophy. Hence, students' participation during classroom teaching was improved and reasoning skill and inquisitive attitude towards scientific phenomena was inculcated. Most probably, shift from teacher centered to student centered teaching approach was achieved.

Findings revealed that 'discrepent events' and 'predict-observe-explain' (POE) were two strategies which enhanced students' engagement and better learning. Perhaps it is 'cognitive dissonance' which encouraged students to ask questions seek clarification and interact with the teacher and peer to find a solution. Providing conducive non threatening environment, probing their understanding further and rewarding students' effort lessen the fear of being right or wrong.

While, discussion-based teaching encourages students' participation and involvement it requires lots of time for preparation and implementation of the plan. Teachers need to develop skills of conducting discussion in the classroom. Children's participation is a central element of 'discussion-based' teaching, however, keeping noise to an optimum level is an issue. Having said that, developing classroom rules along with students help to minimize discipline related issues. Children take ownership for and responsibility of maintaining classroom rules when they are involved in setting these rules.

Implication as Teacher and Teacher Educator

Science teachers should change their role from transmitter of knowledge to constructor of knowledge. To achieve this they have to apply interactive ways of teaching. The purpose of science teaching should be to nurture students learning by providing an environment, where they can interact with each other and with teacher. There is also a need to shift theoretical paradigm of teaching to more practicum mode at the teacher training institutes. Teacher educators should be taught how to handle discussion in the classroom.

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References

Ackers, J., & Hardman, F. (2001). Classroom interaction in Kenyan primary schools. *Compare, 31*(1), 245-261.

Alsop, S., & Hicks, K. (2003). *Teaching science; A Handbook for primary and secondary teachers.* New Delhi: Kogan Page

Arends, R. I. (2001). *Learning to teach.* Singfapore: Mc Graw Hill.

Baired, J. R., & Northfield, J. R. (1992). *Learning from the PEEL experience.* Melborne: Monash University Printing.

Beicher, R. J., & Dobey, D. C. (1994). *Essential of classroom teaching elementary science.* Boston: Allyn and Bacon.

Bogdan, R. C., & Biklen, S. K. (1998). *Qualitative research for education: An introduction to theory and methods.* Boston: Allyn and Bacon.

Brookfield, S.D. & Preskill, S. (1999). *Discussion as a way of teaching.* Society for Research into Higher Education & Open University Press.

Burns, C., & Myhill, D. (2004). Interactive or inactive? A consideration of the nature of interaction in whole class teaching. *Cambridge Journal of Education,* (1), 35-49.

Chiappetta, E. L., Koballa, R. T., & Colette, A. T. (1998). *Science instruction; in the middle and secondary schools.* Columbus: Merill.

Chin, C. (2006). Classroom interaction in science: Teacher questioning and feedback to students' responses. *International Journal of Science Education, 28*(11), 1315-1346.

Cohin, L., Manion, L., & Morrison, K. (2000). *Research method in education.* London & New York: Routledge Falmer.

Cresswell, J. W. (2003). *Research design: qualitative and quantitative approach* (2nd ed.). London: Sage

Dallas, D. (1994). A variety of methods. In R. Levinson (Ed.), *Teaching science.* London: Routledge.

Dillon, J. T. (1994). *Using discussion in classroom.* Buckingham: Open University Press.

Durham, M. E. (1997). Secondary science teachers' responses to student questions. *Journal of Science Teacher Education, 8*(4), 257-267.

Elliot, J. (1991). *Action research for educational change.* Philadelphia: Open University Press.

Frankel, J. R., & Wallen, N. E. (1993). *How to design and evaluate research in Education* (2nd ed.) Toronto: McGraw-Hill.

Freire, P. (1970). *Pedagogy of oppressed.* London: Penguin.

Garson, Y. (1988). *Science in the primary school.* London: Routledge.

Glesne, C. (1999). *Becoming qualitative researcher an introduction.* New York: Longman

Gunter, M. A., Estes, T. H., & Schwab, J. (1999). *Instruction a models approach.* Boston: Allyn and Bacon.

Halai, N., & McNicoll, J. (2004). Teachers' conception of the nature of science: a comparative study from Pakistan and England. *School Science Review, 86*(314), 93-99.

Harcombe, E. S. (2001). *Science teaching / science learning. Constructivist learning in urban classroom.* New York: Teachers College Press.

Harlen, W. (1996). *The teaching of science in primary school.* London: David Fulton Publishers.

Hogan, K., Nastasi, B. K., & Pressley, M. (2000). Discourse pattern and collaborative scientific reasoning in per and teacher-guided discussions. *Cognition and Instruction, 17*(4), 379-432.

Hoodbhoy, P. (1998). Pakistan Universities-which way out? In P. Hoodbhoy (Ed.). *Education and the state: Fifty years of Pakistan.* Karachi: Oxford University Press.

Jennings, A. (1995). Discussion. In J. Frost. (Ed.), *Teaching Science* .London: The Woburn Press

Kemmis, S., McTaggart, R., & Retallick, J. (2004). *The action research planner.* Karachi: Aga Khan University Institute for educational Development.

Kim, H. & Song, J. (2006). The features of peer argumentation in middle school students' scientific inquiry. *Research in Science Education, 36,* 211-233.

Koshy, V. (2005). *Action research for improving practice- A reflective guide.* London: Paul Chapman Publishing.

Larson, B. E., and Keiper, T. A. (2002). Classroom discussion and threaded electronic discussion: Learning in two arenas. *Contemporary Issues in Technology and Teacher Education, 2*(1), 45-61.

Lewin, K. M. (1992). *Science Education in Developing Countries: Issues and Perspectives for Planner.* Paris: UNESCO International Institute for Educational Planning.

Lewis, J., & Leach, J. (2006). Discussion of socio-scientific issues: The role of science knowledge. *International Journal of Science Education, 28*(11), 1267-1287.

Marilyn, F. (1995). Approaches to teaching and learning in science. In S. Atkinson & M. Fleer. (Eds.), *Science with reason.* London: Hodder and Stoughton.

Mercer, N., Dawes, L., Wegerif, R., & Sama, C. (2004). Reasoning as a scientific ways of helping children to use language to learn science. *British Educational Research Journal, 30*(3), 360-377.

Mercer, N., Wegeriff, R., & Dawes, L. (1999). Children's talk and development of reasoning in the classroom. *British Educational Research Journal, 25*(10), 95-111.

Miles, M., & Huberman, M. (1984). *Qualitative data analysis.* Beverly Hills, CA: Sage Publication.

Muijs, D., & Reynolds, D. (2005). *Effective teaching evidence and practice.* London: Sage Publications.

Myhill, D., and Warren, P. (2005). Scaffolds or straitjackets? Critical moments in classroom discourse. *Educational Review, 57*(1), 55-69.

Oh, P. S. (2005). Discursive roles of the teacher during class sessions for students presenting their science investigations. *International Journal of Science Education, 27*(15), 1825-1857.

Osborne, J. (1997). Practical alternatives. *School Science Review, 78*(285), 61-66.

Osborne, J., Erduran, S., Simon, S., & Monk, M. (2001). Enhancing the quality of argument in school science. *School Science Review, 82*(301), 63-70.

Parkinson, J. (2004). *Improving secondary science teaching.* London: Routledge Falmer.

Pontefract, C., & Hardmen, F. (2005). The discourse of classroom interaction in Kenyan primary schools. *Comparative Education, 41*(1), 87-106.

Social Policy and Development Centre (SPDC). 2002-2003. *State of science education annual review.* Social Development in Pakistan. 130-153.

Van Zee, E. H., and Minstrell, J. (1997). Using questioning to guide students thinking. *The Journal of Learning Science, 6*, 229-271.

Van Zee, E. H., Iwasyk, M., Kurose, A., Simpson, D., & Wild, J. (2001). Student and teacher questioning during conversations about science. *Journal of Research in Science Teaching, 38*(2), 159-190.

Venvilli, G., & Dawson, V. (2006). *The art of teaching science.* Chennai: Allen & Unwin

Webb, P., & Treagust, D. F. (2006). Using exploratory talk to enhance problem-solving and reasoning skills in grade-7 science classrooms. *Research in Science Education, 36,* 381-401.

White, R., & Gunstone, R. (1992). *Probing understanding.* London: The Farmer Press.

Wellington, J., & Osborne, J. (2001). *Language and literacy in science education.* Buckingham: Open University Press.

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