International Journal of Educational Research and Development
www.journalofeducation.in
Online ISSN: 2664-7095, Print ISSN: 2664-7087, Impact Factor: RJIF 5.26
Received: 18-01-2021, Accepted: 06-02-2021, Published: 31-03-2021
Volume 3, Issue 1, 2021, Page No. 20-24

Constructivist classroom in teacher education programme- A reflection

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Abstract
A small initiative was taken to implement 5' E model in teaching concepts of physical science in secondary schools of Berhampur by the student teachers of DPIASE. Results from a project conducted through the school internship programme revealed that 5E teaching model to be an effective alternative approach in learning science. After developing conceptual clarity on the 5E model, the students' teachers delivered lesson following the model. During school internship the student teachers engaged to work in team undertaking classroom and learner's observations, interactions and projects in science course. The peer evaluation and the experience of the learners point to positive perceptions of classroom activities and quality of learning.

Keywords: 5E model, school internship, classroom activities, lesson and quality of learning etc

Introduction

Constructivist Approach to Learning

Constructivist philosophy believes that learning occurs in construction of knowledge. Learner does actively construct his/her knowledge by connecting new ideas to the already existing ones. Teacher creates facilitating conditions for children to discuss with each other while relating what they are learning in school with the things happening outside the school. Such activities encourage the learners to narrate the experiences in their own words and form their own experience rather than simply memorizing and getting answers right in just one way to happening in understanding (NCERT, 2005) [4]. Constructivist emphasizes that both content and pedagogy connecting knowledge to life beyond classroom and encourages students to become more autonomous learners. In one study learners were given freedom to feel as if they were in control of their own learning when teachers engaged in such behaviour as giving students time to work on a task, in their own ways, giving learners the opportunity to talk, encouraging them to complete tasks, listening to them and being responsive to the learners questions resulting in higher degrees of participation of learners in collaborative activities (Reeve&Jang, 2006) [6].

Some consider constructivism as an umbrella term encompassing several views of learning that share common claims such as prior knowledge, multiple perspectives, self-regulation and authentic learning (Loyens, Rikers &Schmidt,2007; Rikers, van Gog & Pass, 2008; Tobias and Duffy, 2009) [7]. These claims are more pronounced in the basic premises of constructivism:

- Meaningful learning is the active creation of knowledge structures from personal experiences: constructivists view the learner as an active agent in the construction of knowledge. Each learner constructs a personal view of the world by using existing knowledge, interests, attitudes, goals and the line to select and interpret the information she encounters. This assumption highlights the importance of what educational psychologist call prior knowledge-the previously learned knowledge and skill that students bring to the classroom.
- Social interaction and negotiation of understanding with others can help learners construct knowledge: one person's knowledge can be never be identical to another person's, because knowledge is the result of a personal interpretation of experience, which is influenced by such factors as the learner's age, gender, race, ethnic background and knowledge base. By interacting with others, learners have the opportunity to gain a perspective different from either own. Thus, the additions to, deletions from or modification of individuals knowledge structures result from the sharing of multiple perspectives, systematic, open minded discussions and debates are instrumental in helping individuals create personal views (Azevedo,2009) [1].
- Self –regulation by learners is a key to successful learning: self-regulated learning occurs when a person generates and controls thoughts, feelings and actions in an effort to achieve a learning goal. Constructivist view learners not as passive recipients of new information, but as active agents who use their prior knowledge and experiences to engage their environments (including other people) to enhance their existing knowledge structures (Piaget's concept of assimilation) and to build new knowledge structure (i.e. accommodation).Self- regulation skills allow learners to take charge; to function as the agents of their own learning rather than objects of instruction.
- Authentic problems provide realistic context that contribute to the construction and transfer of knowledge: when learners encounters problems that are realistic, they are able to use what they already know about the problem situation (Driscoll, 2005). For example, imagine that a secondary grade learners needs to learn how to use principles of science to make predictions of an experiment like, a glass of water is kept on a side of a smooth table and half of a piece of paper is kept under that glass of water if the free half of a piece of paper is kept under that glass of water and other half is left free. What would happen to the glass of water if the free half

of paper is pulled suddenly straight? They generate their predictions using prior knowledge before experiments and match the prediction to the real happenings after experiments. Another way to approach the task would be to pose a question: "what might be the possible reasons of large scale child mortality in Nagada of Jajpur District." Such a question provides rich opportunities for students to identify and work with possible reasons related child mortality; malnutrition, water pollution, unhygienic living conditions, inadequate health facilities, irregular health check-up, poverty, illiteracy etc. Learners' research question might include: how do we find out the information? How do the factors cause the mortality? How do we measure the factors?

In addition to allowing learners to engage their prior knowledge, authentic tasks often provide opportunities for learners to work collaboratively, thus providing opportunities for social interaction and negotiation of meaning through multiple perspectives (Kordaki, 2009).

Characteristics of a constructivist Classroom

Some of the typical characteristics that can be observed in a constructivist classroom are as follows:

- Teaching and learning starts from a learner's current understanding of a subject. Therefore teacher needs to determine what learners currently know and what relevant experiences they have had with key topics.
- Teachers help learners in creating realistic learning experiences that will lead them to elaboration and restructure current knowledge. Teachers believe that meaningful learning involves discovering, questioning, analyzing, synthesizing and evaluating information.
- Learners frequently engage in complex, meaningful, problem based activities whose content and goals are negotiated with the teacher.
- Learners have frequent opportunities to debate and discuss substantive issues.
- A primary goal of instruction for learners is to learn to think for themselves. Consequently, teachers use a variety of indirect teaching methods, such as modelling the thinking processes they want learners to use, providing prompts, probes and suggestions; providing heuristics and use technology to organize and represent information.
- Learners engage in such high level cognitive processes as explaining ideas, interpreting texts, predicting phenomena and constructing argument based on evidence.
- In addition to assessing learning with written tasks, teachers also require learners to write research reports, make oral presentations, build models, and engage in problem solving activities.
- Learner's progress (and the effectiveness of learning environment) is assessed continually rather than just at the end of unit and end of semester.
- Subject matter discipline and knowledge base need revision continually.

In the context of constructivist classroom transaction approaches, it is worthwhile to discuss the 5 E model which is now being Increasingly used in the classroom transactions particularly in secondary schools.

Why 5E Model?

The NCF-2005 has given emphasis on bringing the world around the learners closer to the classroom transaction. Everything that is transacted in the classroom needs to be meaningful for the learner. The child needs to realise why he/she is studying, how his/her syllabus is linked with real life situation. This is how he/she takes interest in teaching learning process.

The efficacy of constructivist paradigm, like any other educational theory, lies in its applicability in the appropriate educational setting. The Biological Science Curriculum study (BSCS, 1997) team along with its principal investigator Roger Bybee developed an

Instructional model for constructivism, called the "FIVE Es". This model is generally recommended for science teaching. In this model the process is explained by employing five Es; they are: Engage, Explore, Explain, Elaborate and Evaluate. In this model conceptual change can be achieved by using those five distinct but interconnected phases. The five Es (5E) model is an attempt in transporting constructivist paradigm into classroom. The objective of the model like all other models of constructivist framework when implemented is to help the learner construct any concept in a way the teacher expects him/her to construct. The paradigm of the 5E models in terms of the of the expected teacher and student behaviours is presented in the table below.

Table 1: Expected Teacher and Students Behaviour as per the 5E Model

5E Definition	Teacher Behaviour	Student Behaviour
Engage		
▪ Generate interest ▪ Access prior knowledge ▪ Connect to past knowledge ▪ Set parameters of the focus ▪ Frame the idea	▪ Motivates ▪ Creates interest ▪ Taps into what students know or think about the topic ▪ Raises questions and encourages responses	▪ Attentive in listening ▪ Ask questions ▪ Demonstrates interest in the lesson ▪ Responds to questions demonstrating their own entry point of understanding
Explore		
▪ Experience key concept ▪ Discover new skills ▪ Probe, inquire and question experience ▪ Examine their thinking ▪ Establish relationships and understanding	▪ Acts as a facilitator ▪ Observes and listen to students as they interacts ▪ Asks good inquiry-oriented questions ▪ Provides time for students to think and reflect ▪ Encourages cooperative learning	▪ Conducts activities, predicts and forms hypotheses or makes generalizations ▪ Becomes a good listener ▪ Shares ideas and suspends judgements ▪ Records observations and generalization ▪ Discuss tentative alternatives

Explain		
▪ Connect prior knowledge and background to new discoveries ▪ Communicate new understanding ▪ Connect informal language to formal language	▪ Encourages students to explain their observations and findings in their own words ▪ Provides definition, new words and explanations ▪ Listen and builds upon discussion form students ▪ Asks for clarification and justification ▪ Accepts all reasonable responses	▪ Explains, listens, defines and questions ▪ Uses previous observations and findings ▪ Provides reasonable responses to questions ▪ Interacts in a positive, supportive manner
Elaborate		
▪ Apply new learning to a new or similar situation ▪ Extend and explain concept being explored ▪ Communicate new understanding with formal language	▪ Uses previously learned information as a vehicle to enhance additional learning ▪ Encourages students to apply or extend the new concepts and skills ▪ Encourages students to use terms and definitions previously acquired	▪ Applies new terms and definitions ▪ Uses previous information to probe, ask questions and makes reasonable judgements ▪ Provides reasonable conclusions and solutions ▪ Records observations explanations and solutions
Evaluate		
▪ Access understanding(self, peer and teacher evaluation) ▪ Demonstrate understanding of new concept by observation or open ended responses ▪ Apply within problem situation ▪ Show evidence of accomplishment	▪ Observes students bahaviors as they explore and apply new concepts and skills ▪ Encourages students to asses their own learning ▪ Asks open ended questions	▪ Demonsrates an understanding or knowledge of concepts and skills ▪ Evaluate his /her own progress ▪ Answers open ended questions ▪ Provides reasonable responses and explanations to events or phenomena

Source: Barufaldi (2002).

Practicing With 5E Model

In recent times, the 5E model is being used in the classroom transactions especially at the secondary level in odisha. The training model developed for the teachers of the secondary schools through the interventions of the Rashtriya Madhyamika Sikhsha Abhiyan (RMSA), odisha have widely used the 5E model in the all the curricular subjects since 2011. This model has also been included in the 2-year B.Ed programme in all the Universities of the state since 2015-16 and as such the students teachers in this course are expected not only have through theoretical grounding on the model, but in practice it in the classroom transaction during school internship programmes.

In the 2-year B.Ed. programme, emphasis has been given to plan and transact the classroom teaching-learning activities in all the school subjects following constructivist approach including the 5E model. Students –teachers in the B.Ed. classes are encouraged to work in teams observing classroom interactions and conducting projects across diverse courses. After each group activity, group presentations are made. During school internship students-teacher teach within flexible formats, larger frames of units of study, concepts web charts and maintain reflective journals.

A small into the efficacy of the 5E model was carried out along with the regular curricular activities of the B.Ed. programme to study the adaptability of the model by the students- teacher in the real classroom situations during their school internship programme. Demonstration lesson based on the 5E model was followed by practice lesson by the students teachers using the model closely accompanied with group discussions. The peer observations by the students- teachers and perceptions by the learners on the classroom transaction were recorded and analysed. The concept of constructivist approaches and 5E teaching model, especially for science subjects, were discussed with the students-teachers in the first year of the B.Ed programme of 2015-16 academic sessions in the DPIASE, Berhampur, Odisha. The students- teachers opting for pedagogy of Physical science were engaged in the study. The stages of 5E teaching model were discussed elaborately with examples in the class. The researcher demonstrated the lesson on “Newton’s first law of Motion” with sixteen class IX students. The lesson was observed by the student-teacher along with the faculty members. Each student teacher was provided with observation scheduled and instructed to fill up the format during the process of demonstration. The observation scheduled contained ten aspects of teaching –learning process (Table 2).

The demonstrated lesson on content “Newton’s first Law of Motion’ of class IX is described below along with the theoretical input on 5E teaching model:-

- **Engage:** in this stage, the students’ first encounter and identify the instructional task. They need to be engaged and focused on the learning task by asking questions, defining a problem, showing a surprising event and acting out on problematic situation.

A warm up activity was conducted in the class relating to the new concept. In this context the students were asked, “what are the objects you have seen around moving?” “How these are moving?”. It is the stage to motivate students, stimulates their involvement to connect their past and present learning experiences and lay a ground work for activities.

- **Explore:** in this stage, the student’s experiences cognitive disequilibrium through experiences and concrete materials. This stage provides opportunities for students explore objects and phenomena directly through all senses and

develop all experiences from hands on activities. This process helps learners construct new knowledge to account for their observation. The students are allowed to work together mostly in small groups and build a base of common experience which assist them in the process of sharing and communicating. During exploration the student's enquiry process drives the instruction.

- **Explain:** Teacher interacts with students to discover their ideas and understanding of concepts and processes of the given task, communication occurs between peers, teacher or within learner. Common language enhance the sharing and communication, language provides motivating for sequencing event into logical format, New concepts and skills are introduced as conceptual clarity and cohesion are sought.

But in actual classroom situation these two stages-exploration and explanation go simultaneously. In this context a number of learning activities (here five) were given to four groups of students (comprising 4 students in each group) along with questions cards. While doing activity and conducting experiments the teacher helped the students to construct. After every single activity performed appropriately as described above, the teacher consolidated the new sub- concepts and wrote on the black board. For example after first activity with textbook language- the new concept was static object remains static until an external imbalance force is given, after second activity-" A moving object moves in a straight line until an external imbalance force given " finally after the fifth learning activity (in this context) the main objective of the lesson on 'Newton's First Law of Motion' was explored and explained by the students as 'An object remains static if it is static and moves in a straight line if it is moving until an external imbalance force is given. The learning was consolidated by the teacher after group discussion and whole class consensus agreement.

Elaboration

In this phase the students are engaged in divergent problem solving. The students are allowed to expand extend and verify their correctly learned concepts in other similar contexts and apply their understanding to the real life situations. The teacher who acts as facilitators helps the students develop their ideas through additional physical and mental activities.

In this stage the students cited certain related examples of incident basing upon this concept 'Newton's First Laws of Motion' from their real life experiences which ultimately helped creating understanding and strengthening new concept.

Evaluate

This is the last stage and fifth "E". It is an ongoing diagnostic process that allows the teacher to determine if the students have attained understanding of concept and knowledge. Opportunity given students assess their knowledge, skills and abilities. Mostly enquiry based and reflective questions are asked.

Here, in the demonstration class, some examples of the questions asked are like 'why the fast bowler starts running from a distance to throw the ball?, " Why should the driver use the safety belt while driving a car? And "Is it assessment of learning? Besides, during the process of transaction, continuous assessment was undertaken by the teacher educator in every learning activity. For example: Why does the book move one place to her on the table when you push it from one side? The methods of assessment as learning was used during the stages of 'Explore and Explain' of the 5E model while teaching Newton's First Law of Motion.

After demonstration lesson, the theory and practice related to 5E model were discussed in detail. It was found that the classroom teaching learning process was activity based (both individual and group activity) combined with the processes of experimentation, observation, participatory, challenging and interesting. The techniques like interacting, debating, negotiating, peer coaching and facilitation as applied in demonstration lesson were also used and discussed. The experience acquired from the demonstration lesson and the follow up discussion were carried over to the practice lesson delivered during the school internship programme.

As a part of the process based teacher education curriculum framework, school internship prepares students teachers within flexible formats, larger frames of unit study, concept web charts and maintain a reflective journal instead of practice teaching of isolated lessons, planned in standardised formats with little or no reflection on the practice of teaching. Students encouraged working in teams undertaking classroom and learners observations, interactions and projects across diverse course. Group presentation must be encouraged. (NCFTE-2009).

Each student teacher having physical Science as method paper was required to transact twenty lessons in the subjects with the students of secondary schools using 5E model. The students-teachers were divided into groups of five. While one students teacher was transacting the lesson, others in the group were observing the class with the help of the observation scheduled with 10 items in a three point scale (most of the time, sometime, occasionally), on different aspects of the 5E Model. The responses of 60 student teachers have been tabulated below (Table 2).

Table 2: Frequency of occurrences of different aspects of classroom transaction: N=60)

SL. No	Aspects	Most of the time	Some times	Rarely
1	Students are engaged in the learning process	55	4	1
2	Students experienced are used for learning	44	15	1
3	Students are asking questions to clear doubts/express their views	34	24	2
4	Students are interacting, debating and explaining ideas within the group	40	18	2
5	TLMs are used appropriately	48	11	1
6	The activities used by the student teacher is appropriate to achieve the objectives	49	8	3
7	The students teacher gives example beyond textbooks connecting knowledge to the life of the students	30	23	7
8	The students teacher encourages students to think, explore,compare,analyse and consolidate	42	15	3
9	Students teachers work like a co-learner/facilitator in the learning process	48	11	1
10	Assesment is integrated in the learning process and feedback is given to the sudents	40	19	1

It is found from the above table that almost all (98.3%) observed that all the students(learners) in the class were engaged in the learning process and their experiences were used in the transacted for acquisition of new experiences. More than 90% of the respondents agreed that the students, in varying degrees were engaged in interaction in groups and performing different activities in the classroom. In majority of cases 95% of the students were observed in exploring through asking probing questions and being encouraged by the teacher. During the process the students interacted and shared their knowledge with peers in groups. Students teacher try to connect the knowledge to the life of the students. While handling the materials and doing experiments themselves the students are more interested to know and understand the concept clearly. The student teacher helps the students during group work and discussion before consolidation. In the overall analysis it is observed that the students were engaged actively and participated in all kind of relevant activities in groups, shared their thoughts and experiences and made deliberate efforts to improve their knowledge and understanding. Feedback sheets, each containing 6 objective type questions(yes/No) to estimate the perception of the learners regarding the quality of classroom transactions based on 5E model were distributed among the students (class VI to IX) of 9 practicing schools after 18 lessons (out of 20 delivered). For brevity, data collected from the student's class VIII of only 3 schools were analysed as it is considered as crucial stage as it is the terminal grade of elementary level and provides basis for the secondary level (Table-2).

Table 3: Students perceptions of the classroom transaction with 5E Model

SL. No	Questions	Sch. I(N=83)	Sch. I(N=49)	Sch. I(N=58)	Total (N=190)
1	Do you like this method of teaching	83	49	58	190 (100.00)
2	Do you lik\e to learn in group in collaboration with peers?	77	47	54	178 (93.68)
3	Are you more active in eaching learning process than earlier teaching?	75	45	53	173 (91.5)
4	Are you inrested to learn more while handling apparatus and materials?	83	49	58	190 (100.o)
5	Do the teachers relate your experience with new learning?	69	42	49	160 (84.21)
6	Is there any scope of using this new knowledge in your everyday life?	71	41	52	164 (86.32)

It can be seen from the above table that all the 190 sampled students of three schools have positive perceptions of the methods adopted in classroom. It is observed that 94% of the students liked to learn in group in collaboration with their peers, 91% felt more active during his process of classroom transaction and all the respondents expressed that they learn better through the handling of the apparatus and teaching learning materials by themselves. It can also be observed that nearly 84% of students have realised that their experiences have often been related to the new learning. More than 86% students have felt that the possibilities of acquiring new knowledge from daily life experiences are higher with the experiences gathered through the new method of classroom interaction in which equal emphasis is given on engagement in exploring new sources and possibilities for novel experiences along with developing the abilities to explain, elaborate and evaluate one's own activities and experiences.

In summary, it is observed in this study that there are high probabilities that

- The students engaged in learning process through the 5E model can enhance their understanding by learning through active participation and group work.
- They learn in collaboration with their peers through discussion, dialogue and negotiation without any fear of failure.
- Activities and manipulating contextual learning materials help in understanding the concept better
- Students' classroom learning becomes more meaningful and sustainable when those are connected to real life experiences.

Learning in the company of others helps in interacting with each other and also through learning task at hand. Emphasizing and practicing with the 5Es i.e. Engaging, Exploring, Explaining, Elaborating and Evaluating with appropriate variations in theoretical and contextual experiences within and beyond the confines of the classroom can help the learners in construction of meaningful learning experiences collaboratively and individually.

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