

PROSPECTIVE SCIENCE TEACHERS' REFLECTIONS ON THE USE OF LEARNING STRANDS IN DEVELOPING LESSON DESIGN

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Abstract

Learning strands as a framework seem to give an alternative to the fixed way of planning and provide the needed space to the students for constructing knowledge in a classroom. In order to facilitate process of teaching-learning of science in a more flexible paradigm, prospective teachers need to be convinced that developing lesson design is an open-ended activity and there should always be space for redesigning learning experiences by observing reactions and responses of students. This will help in catering to the learning needs of diverse human potentials in classroom. In the present study, an attempt has been made to study reflections of the prospective teachers on the use of learning strands in developing lesson design in a more flexible paradigm. It is concluded that use of learning strands in developing lesson design can substitute specific objectives used in traditional form of lesson plan where rigid adherence of the processes of teaching learning with pre-conceived notions is emphasized. Teacher educators might look at the lesson planning framework in the light of using learning strands in the development of lesson design.

Keywords: Lesson Design, Learning Strands, Science Education, School Experience Program

Introduction

One of the key features of prospective teacher education is School Experience Program. The reason being, this program gives the real contextual opportunities to analyze and reflect on whatever else the pre -service teacher learns during such a program. There is no doubt to the notion that the whole school experience program weaves around the experience of teaching in the classroom, based upon certain planning known as lesson planning in common language. While there are so many different ways, in which one plans a lesson, some of the key features of traditional frameworks of planning science lessons are the following.

In the traditional frameworks, knowledge is supposed to be objective and learning testable. The testable forms of learning have underlying principle that considers reality as single layered, and unidirectional. This reality, by assumption, is same for all learners irrespective of their socio-economic, emotional, physical, aesthetic, spiritual, mental, intellectual, ethnic, and other identifiable and non-identifiable diversities. Teacher is a resource of knowledge and transmits it to learners who are passive recipient of it. Thus, the lesson plans are often deterministic in nature with the set objectives catering to the needs of surety of the outcomes. The resolution that learning is testable and it is in intangible forms is the basis of formulation of these objectives. These objectives of learning are breakable in small bits, pieces, and chunks. The instructions are therefore, arranged in a series of

perceived outcomes. In other words, learning is programmable. In order to test learners' knowledge, paper-and-pencil tests are ideal forms of assessment. It is possible to standardize this ideal form of assessment, as there is an inherent assumption of underlying uniformity in the human beings in such a classroom. The 'one size fits all' model of learning is thus the key to planning. Cognitive activity in such forms of lesson planning becomes a series of mental processes in which flexibility leads to wrong outcomes. This notion of learning and the learners give rise to the assumption that learners are like learning machines.

The vision document of education in India, National Curriculum Framework, (NCERT, 2005) observes, "Our educational practice is still based on limited 'lesson plans' aimed at achieving measurable 'behaviors'; according to this view, the child is akin to a creature that can be trained, or a computer that can be programmed. Hence, there is too much focus on 'outcomes', and presenting knowledge divided into bits of information to be memorized directly from the text or through activities after 'motivating' children, and finally on evaluating to see if children remember what they have learnt. Instead, we need to view the child as 'constructing knowledge' all the time". This emphasizes upon the need of actively engaging students in the process of construction of their knowledge through observation and inquiry. A central goal for elementary science teacher preparation is supporting prospective teachers to organize inquiry science instruction in ways that engage students in science practices, build conceptual understanding, and leverage students' resources for learning (Davis, Petish, & Smithey, 2006; Mikeska, Anderson, & Schwarz, C. V.a, 2009; Russ, Scherr, Hammer, & Mikeska, 2007; Windschitl, Thompson, & Braaten, 2009).

Teaching-learning of science should go beyond presenting the facts and principles and result of investigations. It should also show the process of achieving them and how do we arrive at understanding. Although knowledge is something personal and individual, the learners construct their knowledge through their interactions. These interactions involve interaction with the physical world, collaboratively in socio-cultural settings and linguistic environments (NCERT, 2013).

Allowing the learners to ask questions that require them to relate their understanding with day-to-day life experiences and encouraging them to answer questions in their own words and from their own experiences helps them in construction of their knowledge. The structuring and restructuring of ideas are essential features as they progress in learning. Prospective science teachers need to appreciate that learning science is a continuous process of constructing explanations of natural phenomena and one of the important roles of the teachers is to facilitate the learners to construct questions and inquire to address those questions. Therefore, it is important to realize that developing lesson design is an open-ended activity and there should always be space for redesigning learning experiences by observing reactions and responses of students in order to cater to their learning needs. Prospective teachers must draw on their own experiences and knowledge base that they have acquired during their school experience programme. Their own perceptions and disposition about teaching- learning process greatly influence their subsequent understanding about it.

In this backdrop, re-examination of the pre-determined set of objectives with pre-determined outcomes for developing lesson plan, considering rigid structure of learning environment becomes imperative.

Learning strands as given by Philip Bell (Bell, Lewenstein, Shouse, & Feder, 2009) seem to give an alternative to the fixed way of planning and provide the needed space to the students for constructing knowledge. These strands of scientific proficiency representing learning objectives can be of great help to the prospective teachers for developing lesson design in science in the perspective that is not so fixed. The learning strands can empower them to take multidimensional approach in teaching-learning process and provide enough

space for flexibility considering learning needs of the learners. In the light of the above discussion, there is a need to study the views, experiences and most importantly the reflections of the prospective science teachers on the use of learning strands in developing the lesson design.

Learning Strands Framework

(Bell et al., 2009) propose 'strands of science learning' framework that articulates science specific capabilities supported by informal environment. It builds on the 'four strands' framework in the formal set-up developed for K-8 science learning in 'Taking science to school' (NRC, 2007) with the addition of two more strands. The four strands provide a framework for thinking about the elements of scientific knowledge and practice. They can be useful to educators in their efforts to plan and assess students learning in classrooms and school systems. They can also be helpful tool for identifying the science that is emphasized in a given curriculum guide, textbook, or assessment (NRC, 2007). Bell holds the opinion that there is overlapping of learning in the formal and informal set- ups. These six learning strands are closely intertwined with each other. Working on one learning strand of science strengthens the other strands. Similarly, weakness of one strand affects all other strands. The six learning strands together provide shape to science education goals.

As given below, learning strands are practices to develop proficiency in science that students should be involved with.

“Strand 1: Experience excitement, interest, and motivation to learn about phenomena in the natural and physical world.

Strand 2: Come to generate, understand, remember, and use concepts, explanations, arguments, models, and facts related to science.

Strand 3: Manipulate, test, explore, predict, question, observe, and make sense of the natural and physical world.

Strand 4: Reflect on science as a way of knowing; on processes, concepts, and institutions of science; and on their own process of learning about phenomena.

Strand 5: Participate in scientific activities and learning practices with others, using scientific language and tools.

Strand 6: Think about themselves as science learners and develop an identity as someone who knows about, uses, and sometimes contributes to science”(Bell et al., 2009).

In order to facilitate teaching-learning process in the constructivist paradigm, prospective teachers need to be convinced with the theoretical base and rationale of using the six learning strands of science as a substitute to writing traditional specific objectives in the lesson design. Unless prospective teachers develop a feel of constructivist approach of teaching-learning and multiple learning contexts in a science classroom, they would not be in a position to carry it forward. Based on this understanding, the school experience program of prospective teachers of a College of Education in Delhi was conducted with learning strands as a key to lesson design at upper primary stage (class 6-8). In an earlier study, analysis of a questionnaire administered to 723 students showed that transaction of science lessons applying learning strands provoked interest and generated curiosity among the learners to know something more beyond the textbook and class interactions and they were found more reflecting, participating, and engaged as a way of knowing and thinking. There are evidences suggesting that the inherent flexibility of the learning strands provides ample scope to address learning needs of a diverse group of learners in a science class (Prabha, Jha, & Kumar, 2012). Using the six learning strands to plan their science lessons, prospective teachers could allow more choice and control over what learners wanted to know and engage them in inquiry to learn various concepts of science (Prabha, Kumar, & Jha, 2013). In this paper the reflections of the prospective teachers on the use of learning strands is analysed.

Research Design

Research questions

1. Can learning strands be used as a substitute to traditional ways of writing specific objectives in the planning phase of teacher education program?
2. Does the use of learning strands at the planning phase of school experience program help the prospective teachers of science to transact the lesson in constructivism paradigm?
3. Are the prospective teachers able to pay attention to individual learning needs of learners if lesson is designed from the perspective of the learning strands?

Objective of study

1. To help the prospective teachers in using the six learning strands of science in the planning phase of lesson design for transacting it in constructivism paradigm.
2. To inquire whether prospective teachers are able to pay individual attention to learning needs of the learners when transacting the lesson from the six learning strands perspectives.
3. To analyze the reflections of the prospective teachers on the use of learning strands of science in developing lesson design.

Method, Sample, Tools and Techniques

We chose twenty prospective teachers studying in a College of Education placed in Delhi for the study. In the first phase of the study, prospective teachers were acquainted with the use of six learning strands at the planning phase of designing teaching-learning experiences of science for the learners at upper primary stage.

The researchers discussed with them about intertwined nature of the learning strands, how these strands could help them to facilitate construction of knowledge of learners considering learning needs of the students, and development of lesson design on various concepts of science using learning strands.

Each prospective teacher transacted at least 20 lessons in different schools over a period of six weeks. In all more than 400 lessons were transacted incorporating learning strands in their lesson design.

Reflective journal, unstructured interview, and classroom observations were the tools used in the study. Prospective teachers were suggested to maintain a reflective journal to write down their reflections on the use of six learning strands in the lesson design. An unstructured interview with them revealed their ideas about use of the six learning strands in the teaching - learning process of science in class 6-8. The researchers observed a number of lessons over a period of six weeks.

During their school experience program, the prospective teachers experienced teaching in two subjects. Therefore, in addition to science, these teachers were having one more teaching subjects such as Mathematics or English. In the other teaching subject, the prospective teachers were planning their lessons according to traditional approach based on the Bloom's Taxonomy. This helped them to make anticipated comparison between the two approaches of developing the lesson.

Data collection

Twenty prospective teachers were suggested to write their reflections on the use of learning strands in the lesson design. Nineteen of them participated in the study. Following themes emerged from the analysis of their responses. For the analysis, pseudo names have been used for the prospective teachers to maintain their identity. As English was their second language, their responses are moderately edited to keep up the flavor.

Theme 1: Thinking beyond the textbook and classroom boundary and connecting the concepts with daily life

Suresh – I understand that students are now able to think beyond their textbooks. They are connecting themselves with other students and environment.

Nidhi- Through learning strands I am able to connect the topic with their day- to- day life.....through these strands they are more able to explore the physical and natural world.

Anju- Learning strands give us a chance to go beyond the textbooks and student-teachers; and students experience more things.

Asha - Because it provides broad area of learning without limits, we can use anything to make it (the lesson) live.

Salma - By using learning strands, students can easily explore themselves in different dimensions according to their daily life experiences.

Suman - Learning strands are effective because it covers broader aspects of learning areas whereas in traditional way of writing specific objectives there is no scope of comprehensive learning beyond classroom teaching.

Soma - There is much scope of learning beyond the classroom learning by using learning strands.

Shreeja - Learning strands provide us a broad spectrum and cover all areas of learning with activities. We can think more on the topic and can relate with daily life.

Jalil - Learning strands enable the students to observe their own experiences related to the activities and class.

Rajkumari- Learning strands give us broader idea about the topic.

Nidhi - Learning strands help students to collect knowledge/information from their natural world i.e. surroundings.

Discussions

It has been an undisputed contention of educators around the world that education cannot be confined to the boundaries of the classroom. How to plan science lessons from this continuum has been a challenge. The perception of prospective teachers supports the idea that learning strands framework helps in planning lessons beyond the boundaries of classroom and textbooks. They perceive learning strands to be flexible as against making lesson plan using specific objectives based on the Bloom's taxonomy. Moreover, they view learning strands as holistic in giving them opportunities to plan for the learners' explorations of physical and natural world. The perception that learning strands framework allows for planning beyond the textbook in classroom has emerged from the responses of 57.89% prospective teachers. Using learning strands as a way to lesson design helped them to reflect that relating learners' classroom experiences with outside the classroom experiences through various activities was important to enhance the learning process. This finding is in consonance of one of the guiding principles of the National Curriculum Framework-2005 (NCERT, 2005) that is, connecting knowledge to life outside the school.

Theme-2 Conducive to peer learning and more participation in the class

Suresh - Learning strands motivate students to participate in activities as much as possible.

Asha - Students can develop their own view out of the textbook.

Jatin - Students can make arguments with others if they learn the topic well. From the learning strands, students can explore themselves and predict questions. Both students and teachers can participate in the activities.

Salma - Learning strands are more effective as students are more involved in the classroom. These strands give proper independence to students to think and explore

themselves and help students to make conclusion of the concept freely by their own thinking.

Richa - Students are not bound to the teacher’s instructions. They can perform the activities and understand the topic in their own view and by their own perspective. They are free to learn in their own way.

Soma - Students learn more and reflect on the topic after doing activities according to their age group.

Shreya - Students think more and reflect more.

Jalil - Sharing of experiences is a good effect of this approach.

Discussions

In the perceptions of about 47.36% prospective teachers, it emerged that learning strands allowed students to design opportunities for independent (self) learning, share their experiences, generate arguments and conclude from observations. In this context, interview with the student teachers revealed that students started to discuss the concepts learnt in the classroom with their peers and friends.

Theme 3- Develops interest and scientific attitude

Suresh - By using learning strands students are more interested and excited to know more about what is happening.

Nidhi - This helps in creating excitement among the learners.

Anju - Students get chance to develop their interest in knowing about different facts related to science.

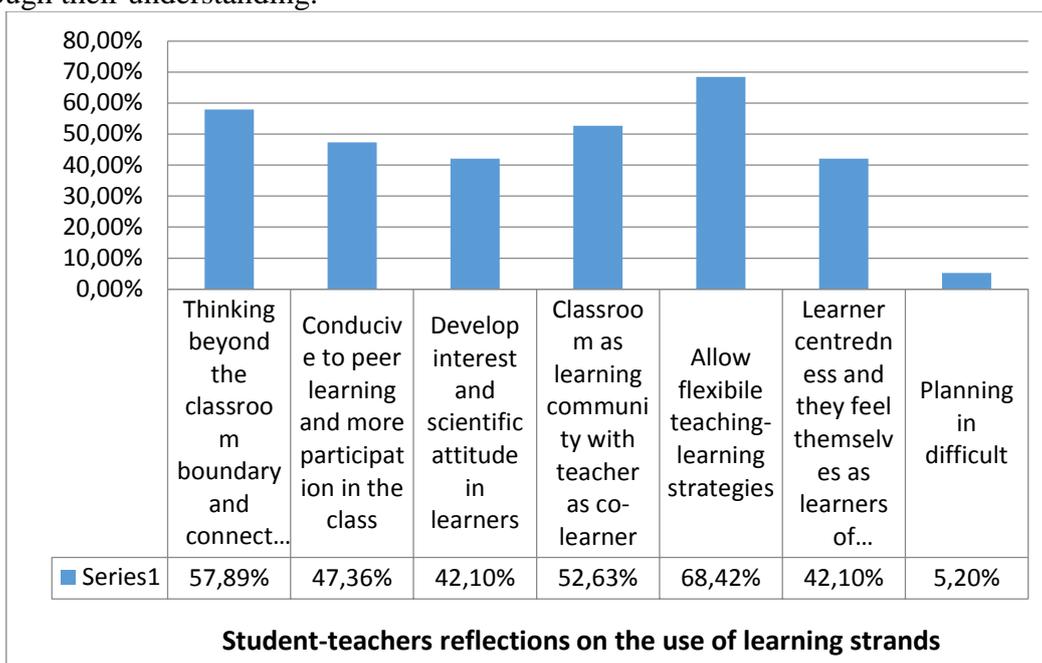
Asha - Students develop their own views and interest out of the textbook.

Anubhuti - Students take interest in knowing various facts related to concepts.

Salma - Students are more interested.

Soma - Learning strands help us to make their learning more interesting.

Jalil - By using learning strands students are able to analyze the topic critically. The strands help them to take interest in the classroom activities and observe their own experiences related to activity and the class. The most significant part of this approach is that it creates scientific attitude. Students are able to use scientific language and tools and express it through their understanding.



Discussions

Developing the culture of science in a science classroom is a challenge in front of every science educator. In the perceptions of more than 42.10%, prospective teachers it emerged that planning in learning strands framework helped them in developing this culture. Prospective teachers provided feedback that many students started visiting websites relevant to the concepts. They also tried to perform same or similar activities performed in the class to validate their knowledge, like checking whether a magnet can attract an aluminum box or a door handle. Learners tried to verify observations themselves and justify their statements in the light of their observations. It shows that students developed interest in learning science and their thinking about the concepts continued even after the classroom process was over.

Theme 4-Classroom as learning community with teacher as co- learner

Suresh - Learning strands is helpful for students and for us to know more and more ...

Leela - Learning strands help to explore thinking of the student and to know more about learners.

Anubhuti - These strands help to understand what a learner wants.

Jatin - Students participate in the activities and learn from each other. Students can explore themselves to predict and ask questions.

Salma - Learning strands give proper independence to students to think. They can easily explore themselves in different dimensions according to their daily life experiences. Overall, learning strands help both student- teachers and students to understand the concepts and make conclusion of the concepts freely by their own thinking.

Suman - There is scope of new thinking to check the changing concepts of learners, which is not present in traditional specific objectives.

Shrija - We can think how to know students more and which type of theory we can use so that students will learn more.

Jalil - This approach thinks about students.

Neha - Use of learning strands helps us to know more about the students.

Nidhi - In this, we can share our experiences with them.

Discussions

In the perception of 52.63% of the prospective teachers, it emerged that learning strands framework helped in developing a learning community of the teacher and the learners where teacher gets more opportunities to understand the learners' thinking and process of their conceptual development with their changing performance in the classroom. The learners participate in the learning community actively. The prospective teachers felt themselves as co-learners. They could generate multiple learning contexts to facilitate learning. Prospective teachers were self-motivated to carry on the activities in the process of transaction of various concepts of science in the classroom as they found their students to be interactive. This emerged as a positive outcome of the study. Generally, activity based teaching- learning is not taken with enthusiasm by the practising teachers due to stress of covering the syllabus. In this respect, science teacher preparation program, emphasizing on constructivist approach from learning strand framework can enrich science education in India.

Theme 5- Allows flexible teaching- learning strategies

Nidhi - Learning strands help to create excitement among students.

Anju - Learning strands do not bound us to use a particular and pre-determined strategy.

Leela - These strands help us to explore the thinking of students.

Sanju - I just feel there is more degree of freedom to teachers. Scope of learning is more.

Rishika - Scope of activities and learning are more. Learning strands help us to explore thinking of students. These are more flexible.

Asha - Because it covers broad area of learning, we can use anything to make it livelier. Learning strands cover almost all areas of learning.

Richa - Students can perform activities and understand the topic from their own view and by their own perspectives. They are not strictly bound by teacher's instructions. They are free to learn in their own way.

Suman - There is flexibility for student-teachers in learning strands. Creative elements and freedom for student-teacher and students both make better learning and effective teaching. There is scope of new thinking.

Soma - Learning strands are more flexible than Bloom's taxonomy.

Shreeja - These are more flexible than Bloom's taxonomy. Using the learning strands gives more opportunities of activities to students.

Neha - Learning strands are more flexible and we can use whatever strands we want to use.

Rajkumari - We can think about different aspects of the topic, whereas in the specific objective framework, there is no scope of flexibility and we have to work in an imposed direction.

Nidhi - Learning strands provide flexibility in teaching-learning. We can use any strand in different ways.

Discussions

68.42% of the prospective teachers expressed in one way or the other that learning strands framework provided them the necessary flexibility as against Bloom's taxonomy framework. Although, the study was not aimed at any comparison, the prospective teachers made a comparison; as in the other teaching subject, they were developing their lesson plan using Bloom's taxonomy. They perceived that learning through learning strands framework did not bind them to a particular strategy of teaching-learning. They could change and adapt strategies as per learning needs and context of their learners. They could design various learning experiences/opportunities for learners in different areas catering to the needs of creativity, interests, motivation, and excitement. Moreover, the prospective teachers found scope for creativity in developing their lesson designs.

Theme 6- Learner -centeredness and learners feel themselves as learners of science

Rishika - Focusing is on concepts.

Anubhuti - Learning strands help me to understand what a learner wants. Using these strands, I can set my objectives by taking learners at the center. I can set different activities for them. Therefore, I try my best to give them some other related concepts and activities to them.

Salma - Learning strands help students to generate facts and concepts related to that topic. I feel them as independent learner and as a science student. Student- teachers can use their experiences in their understanding about the concepts.

Richa - By using learning strands students have their own thinking and they are free to learn by their own way.

Jalil - Learning strands approach gives them opportunity to think, understand and create the various schemas in their mind. This approach thinks about students.

Neha - Learning strands are very good for learners. They help us to know more about learners and their own views about their daily learning.

Swati - We try to think the topic from the point of view of students, as well as their level of understanding.

Nidhi- Learning strands help us to set objectives in accordance to the learners. These are totally learner- centered and help us to know more about the students learning process, their view of learning and how students learn through different methods and how they want to learn and take/collect knowledge/information from their natural world/surroundings.

Discussions

In the perceptions shared by about 42.10% of the prospective teachers, it emerged that use of the learning strands helped them to maintain a learner- centered classroom. The prospective teachers felt that with learning strands framework, they could plan activities and processes related to learners' concept formation as per their needs, views, and preferred ways of learning. They could realize that learning objectives could not be conceived as fixed and final. These emerged out of ongoing interactive teaching-learning experiences and evolved around the learners' experiences and curiosity.

Theme7- Planning is difficult

Suresh - I think, sometimes it becomes difficult to develop lesson design using learning strands and write rationale for using them. However, it happens occasionally.

Discussions

Developing lesson design in learning strands framework demanded more creativity and understanding of learners' existing ideas. One prospective teacher found developing lesson design in learning strands framework difficult. He used the word 'irritating... Occasionally'. This indicates that he might not be inclined to take up this challenge head-on.

From an unstructured interview, it came out that the prospective teachers started to consult a number of reference books of science in addition to the science textbook, as students were asking many questions beyond the textbook. It helped them to enrich their content knowledge.

Classroom observation done by the observers showed that students were very actively participating in the teaching -learning process. They were not sitting quietly on their seats as in the traditional classroom. The learning environment created by the prospective teachers encouraged them to raise questions whatever coming to their mind. Some of those questions were, 'how does an electron look like?' 'Do the elephants have bigger cells in their body?' 'Do animals have cells like human body?'

Prospective teachers were using students' existing knowledge as a resource to teach. They were found to encourage students to ask questions. Students were able to relate the concept with their everyday experiences.

Conclusion

The current study shows that the prospective science teachers were found to be receptive of the use of learning strands in the teaching-learning process of science. Use of the six learning strands of science in developing lesson design facilitated them to engage the learners in teaching-learning process in view of constructivist paradigm. Analysis of their responses indicates that learning strands framework of lesson design can help in bridging the gap between theory and practice. Learning strands offer scope to the teachers to go back to the planning stage and modify the learning strands as per the individual learning needs

facilitating teaching-learning activities. Use of learning strands empowered the prospective teachers to design and generate multiple learning contexts. It can be concluded that use of learning strands in developing lesson design can substitute specific objective used in traditional form of lesson plan where rigid adherence of the pre-planned processes of teaching learning is emphasized. Teacher educators need to look at the lesson planning framework in the light of using learning strands in the development of lesson design. Learning strands can facilitate a modern, forward-looking prospective teacher education program in constructivist paradigm where every learner is valued.

However, this study is only a preliminary attempt and need further work on a larger and varied sample. (Lederman & Lederman, 2014) observe that ‘studies of science teacher education have a focus on some aspects of teacher preparation or professional development. Only having implications for science teacher education is not enough. There must be significant attention to one or more of various mechanism that promote change in teachers, knowledge, beliefs and /or practices. We are not saying that studies must be “experiments”. Connections between various forms of teacher education and teachers’ knowledge, beliefs, and/or practices can be made in studies adopting virtually any design and/or paradigm’. Various studies on the beliefs and practices of prospective science teachers can be taken.

A follow up study may be undertaken to study how these teachers carry forward learning strands framework in their future classrooms to get information about the efficacy of teacher preparation programme on their teaching practices. A comparative study of the effect of the use of learning strands in developing lesson design and use of Bloom’s Taxonomy in making lesson plan in teaching- learning practices can shed some more light on the effectiveness of the learning strand framework of lesson design.

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