EFFECTIVE TEACHING STRATEGIES TO TEACH SCIENCE CONCEPTS IN A CLASSROOM OF DIVERSE LEARNERS

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Abstract

Indian classrooms are filled with diverse learners and today's teachers are asked to educate all students using research-based strategies in inclusive science classrooms. Teachers need to be equipped with the skills that are necessary for improved student achievement in order to successfully teach and accommodate the needs of all children. Classrooms are intended to be positive, supportive environments where there is a deep understanding of students social, emotional, and physical well being. And it is important to recognize, nurture, and strengthen the talents found in each student. Keeping this in mind a detail review of literature is done on effective teaching strategies to teach science concept in a classroom of diverse learner and on the basis of literature reviewed suggesting the effective strategies to be incorporated in a class comprising of diverse learners

Introduction

All students are culturally different; each family is unique and has its own identity. Children's understanding of the physical world results naturally from their ordinary interactions with adults and other children. Knowledge of the world is constructed by each individual child within a social and cultural context, that is, through their social interactions with others. There is an important relationship between culture and education since the culture of teachers and students affect education processes in the classroom. Thus, culture includes everything that makes one group or community within a society distinctive from another: language, values, literature, worldview, food, religion, clothing, holidays, beliefs, and behavior that construct a specific group's lifestyle. Now a day's classrooms are becoming increasingly multicultural, and this leads to new challenges for teachers. Traditionally, students coming into the

multicultural classroom are at a deficit because they must learn how to navigate unfamiliar people, their cultures, and language.

Similarly science classrooms have been devoid of relevant cultural inclusion or multicultural education. Many science educators believe "science is pure" and thus escapes the influences of current pedagogy, trends, and especially cultural influences. Even though science processes are generic or "culture free," if students cannot and do not identify with information that are "processing", they may internalize the notion that they cannot perform science or are not expected to process scientific information. The process of validating and/or correcting perceived notions depends on one's culture. Thus, teachers have the added responsibility of leading students through this unfamiliar territory towards achievement. This requires specialized learning techniques, practice, and education in order to effectively accomplish. Teachers who unite classrooms with activities both inside and outside of the classroom stand a better chance at boosting student achievement and ameliorating the negative effects that have been observed in multicultural classrooms in the past.

What is sought and needed in science classrooms is a model that integrates the learning of the traditional science with the cultures within the classroom. Culturally inclusive science integrates the learner's culture into the academic and social context of the science classroom to aid and support science learning (Baptiste & Key, 1996). Student achievement is influenced by many factors, including student attitudes, interests, motivation, type of curricula, relevancy of materials, and the culture of the students.

The main aim of the study is to review the literature regarding the effective teaching strategies to teach science concept in a classroom of diverse learner and on the basis of literature reviewed suggesting the effective strategies to be incorporated in a class comprising of diverse learners

Review of studies related to inclusion and science teaching in a classroom of diverse learners

Baurhoo,Neerusha,Asghar, Anila has studied "**Using Universal Design for Learning to Construct Inclusive Science Classrooms for Diverse Learners"** in this study researcher has suggested that learning science might benefit students with learning disabilities (LD) as they "find ways to compensate for their problems by taking advantage of the interactive nature of instructional approaches in science education" The ultimate task of enabling inclusion of students with learning disability in science classrooms seems to fall mainly in the hands of inexperienced instructors who lack a deeper understanding and knowledge of the characteristics of diverse learners. In this research paper researcher, has presented an inclusive

science education framework drawn from UDL principles and evidence-based practices in science education for Using Universal Design for Learning to Construct Inclusive Science Classrooms for Diverse Learners students with LD to offer some practical ideas and tools to support academic needs of these diverse learners.

Land Sue (2000) has studied "**Effective Teaching Practices for Students in Inclusive Classrooms,** here researcher mainly focused upon the some key points of inclusion; creating balanced classroom, training co-teaching partners, developing collaborative relationships and providing appropriate supports for students with disabilities. He found the tips for planning of teaching in an inclusive classroom through using a variety of co-teaching methods such as; Interactive teaching, alternative teaching, parallel teaching and station teaching. These methods of teaching enhance the engagement of students as well as teachers. This article provides the tips for inclusive practices that will assist general education teachers in meeting the educational needs of their students with disability. Researcher founded the tips for classroom management which involves the structured classroom, incorporating colors of classroom, provide opportunities to purposeful movement, develop classroom cues for setting down to work, getting out materials, plan for transition times and help the students to organize their materials. Tips for structuring the lessons involve the various methods and strategies according to students needs. It also involves the designing of curriculum which make it accessible and appropriate for individuals with different backgrounds, learning styles, abilities, and disabilities in widely varied learning contexts. Qualities of universal design when planning instructions; Multiple means of representing content (visual and oral strategies), multiple means of student's expression of content (writing, illustrating, speaking) and flexible means of engagement as student learn (videos, software and role-playing). Cooperative learning strategies are used such as group work, peer learning etc. and also use the instructional sequences of "I do" (teacher model), "We do" (Group practice) and "You do" (Individual practice).

Learning strategies may include organizing materials, memorizing information, taking notes, reading text, and taking tests. Use ongoing informal and formal assessment to help instruction and monitor student progress. To ensure success for students with disabilities in general education classrooms, teachers must plan collaboratively, create structured classrooms with clear rules and expectations, and teach content in meaningful and memorable ways.

Melber, L. (2004**) Inquiry for everyone: Authentic science experiences for students with special needs.** In this article all posit that quality science instruction for all students is imperative in promoting scientific literacy that extends into adulthood. Hands-on, inquiry based experiences are effective means of instruction for all students, but such experiences are

critical in creating meaningful experiences in science for students with special learning needs. This article addresses common challenges to implementing quality science experiences within the special education classroom, together with methods for overcoming these challenges.

Grumbine Rich and Brighamamden Peg (2006) have studied on **"Teaching science to students with learning disabilities",** in this study researchers emphasised on the need of training science teachers and instructors that support the unique learning needs of the students. They both stated and discussed several principles that are accompanied by examples of how a science instructor put the principle into practice. The need for such principles emerges because students with learning disability struggle with academics and of about 36% and 56% of LD students leave high school. To solve this problem six principles were presented and were developed by national science education standards to teach biology to students in different ways and various practical examples are also given to apply in real situations. The basic six principles are:-

1). Learning is enhanced when teachers recognize and teach to diverse learning styles and strategies.

2). Content learning is supported by explicit instruction in skills and strategies.

3). Learning is facilitated when instruction and assessment are clearly organised.

4). Learning is maximized when instruction and assessment are based on explicit objectives.

5). Learning is improved when teachers provide consistent feedback

6). Learning is sustained when students develop self knowledge

S. Geetanjali (2008) wrote a paper on **"Development of Strategies for Teaching School Science by Using Heuristic Method"** This paper was based on the UGC (University Grants Commission, India) Minor Research Project submitted in 2008. The main purpose of this project was to develop strategies for teaching school science by using heuristic method. Initially a suitable topic from Science textbook was identified and a rough strategy was prepared based on H.E. Armstrong's (1888-1928) approach of heuristic teaching. It was implemented on a purposive sample of 15 VII standard students and 15 VIII standard students (in two separate batches)who are having deviation I.Q. more than 129 in Group Test of Intelligence for Children by Dr. R.K.Tondon and are high achievers in Science i.e. more than 75% marks in previous examination. Those students were selected from a renowned coaching class in Kolhapur city (India) so that the students from (at least five) different high schools could be selected at a single place. During the implementation of the rough strategy the performance of the students was observed by teacher trainees in 1:1 ratio. After the qualitative analysis of the observations made and discussions with the experts in the field two new

strategies were developed and implemented on two new batches of students, one of VII standard students and the second of VIII standard students selected on the same criteria as in the implementation of rough strategy. Those two batches of the students were selected from a single high school in Kolhapur city so that effectiveness of the strategies in a normal school environment could be generalised. Again the performance of the students was observed by the same teacher trainees in 1:1 ratio. From the analysis of the observations it was found that strategies are effective for teaching school science by using heuristic method.

Konza, D. (2008). Wrote an article on‘**’Inclusion of Students with Disabilities in New Times: Responding to the Challenge**”In this article, the education of school students with profound intellectual and multiple disabilities presents diverse challenges to practitioners, families and policymakers. These challenges are philosophically and ethically complex, and impact curriculum, assessment and pedagogy. Given the international ascendancy of both the UNESCO Policy Guidelines on inclusion in education and the principles of inclusion for people with disabilities with respect to human services policy and practice, the authors build on their previous work to advocate for renewed debate about the nature of school education for these students, and put forward four pathways to inform this debate.A significant factor in the changing of attitudes was the principle of “normalisation” – the right of people with disabilities to learning and living environments as close to normal as possible – developed by Bank-Mikkelson (1969) and Nirje (1970).

Since the mid 1970s, the policy in Australia has been to integrate students with disabilities for part or all of the day in regular classrooms wherever possible, but specialised segregated facilities remained an option for children with severe disabilities. Students who were integrated often, but not always, had some level of curriculum modification and teacher aid support. Because some children required specialised adjustments, such as ramps, modified toilets, large print or Braille materials, students with similar disabilities were often transported to a school where such resources could be centralised.

Therefore many students were not able to attend their neighbourhood school, although they may have been located in a more normalised environment. Over the past two and a half decades, the notion of “inclusion” has pushed the debate regarding the education of students with disabilities further (Forlin 1997).

Inclusion seeks to completely remove the distinction between special and regular education, and to provide an appropriate education for all students, despite their level of disability, in their local school. It involves a complete restructuring of the educational system so that all schools would havethe responsibility of providing the facilities, resources, and an appropriate

curriculum for all students irrespective of disability. It is a philosophical move away from the accommodation of students with special needs into a "normal" system, towards a full inclusion model where everyone is considered normal, and where the needs of all can be met. This trend has been supported by United Nations policies which affirm the rights of children. All state educational policies state a philosophical acceptance of inclusion and support inclusion "where possible" and "when in the best interests of the child".

Bucholz, J. L., & Sheffler, J. L. (2009). wrote an article on "**Creating a Warm and Inclusive Classroom Environment: Planning for All Children to Feel Welcome**",The purpose of this article is to cater to the classroom environment that a teacher creates and encourages can either increase or decrease a student's ability to learn and feel comfortable as a member of the class. The classroom environment should do as much to foster cooperation and acceptance as the teaching methods that the teacher uses. This article describes number of methods to help teachers plan for and create a classroom that welcomes and supports all children. At the beginning of the year teachers have the goal of establishing a classroom environment that is favourable for helping all students work cooperatively in order to learn. The classroom environment can either improve or impede a student's ability to learn and feel safe and comfortable as a member of the class. Classrooms that encourage emotional well-being create an atmosphere for both learning and emotional development. Educational research supports creating an atmosphere of mutual respect, where students feel relaxed in asking questions and expressing their thoughts and feelings.

Some areas to consider when creating an atmosphere of mutual respect are classroom design, classroom procedures, and classroom strategies. Implementing a few strategies that address these areas can help develop a strong sense of community and encourage positive interactions and cooperative learning for students with and without disabilities. A warm classroom environment can lead to increased academic achievement and a sense of pride and belonging in the school.

Sahin Mehmet, Yorek Nurettin (2009) has studied on "**Teaching Science To Visually Impaired Students: A Small-Scale Qualitative Study",**The purpose of this study is to investigate and gain insight into how teachers teach science to VI students. Teaching and learning enterprise of VI students is a very broad subject. In addition, this study is a small scale research in terms of data collection and its purpose. Therefore, this study focussed on science teaching to VI students. Since science is sometimes abstract, it is often difficult to teach, and depends mostly on visual instruction. Challenges VI students may face at schools, special settings and adaptations required in learning environments, and characteristics of VI students

were investigated. Students have long regarded science as a difficult subject because of hard and abstract concepts. Traditional science teaching has been dependend mostly on visual instruction. This makes it difficult for visually impaired (VI) or partially sighted students included in regular classrooms to learn the concepts. Blind students on the other hand, have no visual input at all. They need to learn using other senses such as touching and hearing. Classrooms should be adapted and instruction should be adjusted for better science teaching to VI students.

This study is going to investigate how teachers teach science to VI students. VI students are not necessarily learning disabled; they probably just need accommodations and more time to learn the same things as their sighted peer do. If they are given this opportunity, they can learn anything and achieve the same success as their sighted peers do. To do this, there must be relevant and enough information about teaching strategies, VI students' needs, learning environments, etc. A handicapped person may have problems in interacting with the environment due to his/her disability or impairment. A disabled person is not necessarily handicapped in all environments. A disabled person may be handicapped if the physical disability causes problems.

Harris, Renard; Hall, Cynthia; Hawkins, Tristan; Hartley, Megan; McCray, Willie; Sirleaf, Hammed (July 2016) has studied "**Methods and Strategies: Oral Science Stories. Using Culturally Responsive Storytelling to Teach Socioeconomically Disadvantaged Students**" in this study researchers mainly focused upon diverse students background specially socio-economically disadvantaged group. For teaching this kind of diverse groups a teacher using the culturally responsive storytelling method. Storytelling is rooted in a cultural framework and being able to identify the audience's culture and "ways of being" will allow the teacher to shape the story. Edutainment is the significant characteristic of effective storytelling as it includes both education and entertainment. Stories enhance learning creatively to do the both. Teachers will encouraged to use their imaginations, content knowledge, and physical body to deliver a story that can engage, entertain and inform students.

T.A.L.E.S., Teaching and Learning with Engaging Stories, is an alternative teaching method that focuses on enhancing learning by teaching science, math, ELA, and social studies through story. A six-week research study investigating socioeconomically disadvantaged students' responses to oral stories was conducted during an afterschool tutoring program in a Title I school. This research study consisted of six science stories, all of which were embedded in South Carolina's fourth-grade standards. The following themes emerged in this study:

(1) Students looked forward to hearing the stories each week;

(2) Students felt prepared for the formative assessment;

(3) Students used the stories as "clues" to understand the science; and

(4) Regardless of who the storyteller was, the students knew what to expect weekly. The article includes an example of one of the stories used to teach students science through storytelling.

Suggesting effective strategies to teach science in a classroom of diverse learners

By reviewing above studies we can see that the literature has identified many of the challenges that face the full and successful implementation of inclusion. It has also confirmed that successful inclusive programs exist, but that a range of conditions must be in place.

a) Instructional strategies for diverse learners at Primary level

Four clusters of instructional strategies are commonly used in elementary science classrooms:

(1) self- directed activities;

(2) small group negotiations, interactions, and tutoring;

(3) large- group verbal interactions; and

(4) expository sessions.

Expository instructional techniques are the most teacher- centered or teacher- directed pedagogical methods, while self- directed activities are the most child- centered strategies. A continuum of instructional strategies is shown in figure 1.1

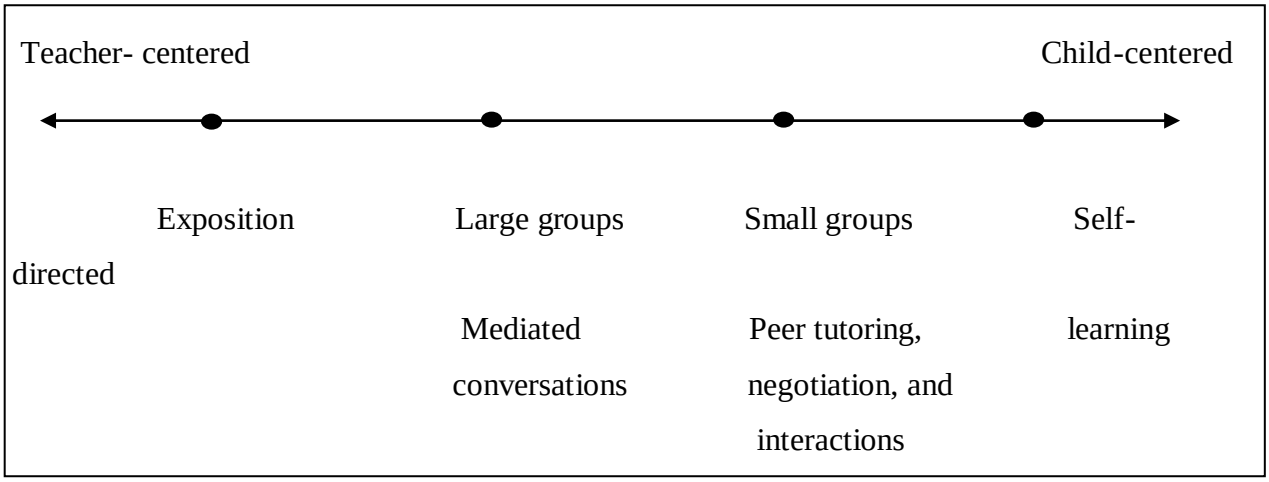

Figure 1.1 Continuum of instructional strategies

1.Self- directed Learning

Self- directed learning or individualized learning is most effective when it is child-initiated rather than teacher- initiated. A child working alone in the class- room completing a teacher-made ditto page is not an example of self- directed learning. Self- directed learning is self-motivated learning; it is the self- initiated act of a child who wants to explore a portion of the world alone. Teachers can support and nurture this type of learning, but it should be controlled

by the child and not mandated by an adult. Time for self- initiated activities can be formally or informally provided by the teacher.

Physical resources in the form of library books, mini- museum, interactive bulletin boards, computer workstations, and learning centre's need to be provided in each classroom for students to engage in self- directed learning. Finally, teachers need to encourage students to continue learning after the formal instructional period ended.

2.Small Group Learning

Small groups or cooperative groups are environments in which negotiations, interactions, and peer tutoring provide support for the learning of each child. For many culturally diverse children, working in a group in the classroom closely resembles working with family members or extended family groups that they have encountered in setting outside school. Group learning provides a culturally harmonious supportive environment for the child.

In the small group environment, children have the opportunity to "try out" their ideas within a supportive, nurturing environment. A group is a place of sharing, a place in which an individual has the capacity to externalize and share with other members of his/ her social group his/ her understanding of their shared experience. Learning is a social process: a child's knowledge of the world is derived from social interactions with others. Children solve practical tasks with the help of their speech, as well as eyes and hands. Groups provide places in which children can (1) negotiate meaning, (2) engage in social interactions, and (3) give and receive peer tutoring.

2.1Negotiated meaning

The small group environment is a place where children interact with peers in an attempt to make sense of the world. Group work group fosters reflective learning and articulation. Within the social context of the small group, children should reflect on what they have learned and on the applications of the learning. Meaning of the ideas and objects is achieved by the speakers and/ or listeners through a process of collaboration and negotiation.

2.2Social interactions

A second function of the small group environment is to provide social interactions for children. Within the small group, the child has the opportunity to (1) develop social interaction skills (e.g., active lsistening and responding), (2) build self esteem, (3) develop efficacy in the use of the English language and (4) learn leadership skills.

3 Peer tutoring

A third function of small group instructional settings is to provide an opportunity for peer tutoring. Both the tutor and tutee benefit when peer tutoring is used in the classroom. Every

child can function as a tutor or a tutee in a group, depending on what is being taught and what is being learned. Peer-tutoring has shown to be very successful in supporting students with cognitive disorders.

3. Large group interactions

Large group verbal interactions between teachers and students have long been used as an appropriate pedagogical technique in science instructions. Too frequently, large group discussions are actually lectures interspersed with review questions. In a true discussion, the students should talk as much and preferably more than the teacher. Five types of large group verbal interactions are commonly used in elementary school: (1) socratic teaching, (2) demonstration, (3) formal debate, (4) review sessions, and (5) mediated conversations.

4. Exposition

Expositions or expository instructional strategies maybe operationally defined as both pedagogical techniques according to which some authority (e.g., teachers, textbooks, computer programs, filmstrips, or videotapes) present oral and/ or verbal information to students without active verbal interactions occurring between the students and the authority figure. Extended use of expository instructional techniques is usually viewed as being inappropriate for use with elementary- age children in the science classroom (1) because verbal presentation are difficult for children to understand, (2) children have a limited attention span and thus tend to become restless, (3) children tend to be passive learners when expository techniques are used, and (4) what is said is not always what is heard or interpreted (Wolfinger, 1984). In addition, children are typically not coached in schools to assimilate and accommodate information presented orally or verbally.

b) Instructional strategies for diverse learners at Secondary level

1. Universal Design in Science Learning

In the universal design framework, physical, social, and learning environments are created so that learner diversity—including cultural, socioeconomic, ethnic background, gender, and ability level—promotes powerful possibilities for teaching and learning. The implementation of universal design goes beyond programming of accommodations and modifications for individual learners. Because the aim of universal design is to make educational environments seamlessly and inherently functional for the widest number of learners, the need for individualization is minimized. Three core UDL principles focus on (1) providing multiple means of presentation, (2) providing multiple means of action and expression, and (3) providing multiple means of engagement.

2. Inquiry-based science education for students with special needs

Students with a focal point of support in learning and/or social and emotional development face several challenges in the science classroom. For example, science textbooks «are often written 2 or 3 years above the actual reading levels of students with disabilities« (Steele, 2004, p. 20). Science vocabulary can be hard to understand and to use. Class discussions or lectures can be difficult to follow and the presented information hard to reproduce. Mnemonic strategies have to be developed with the students. Attention and concentration can be fast overburdened. The students can also be challenged to organize their notes or materials, e.g., while planning or conducting an experiment. Students with cognitive disorders often perform better in specific tasks than in situations where generalisation and transfer are needed (Steele, 2004). Scruggs and Mastropieri (2007) found that the psychometric IQ was a strong predictor for drawing inductive conclusions. Additionally,negative attitudes can also create difficulties for students with special needs. Because of their cycle of frustration and failure, they may have trouble staying motivated and focused on a task» (Steele, 2004, p. 20). This can have effects on them establishing reliable relationships. Social skills are a developmental area which can affect group work (Steele, 2004). These deficits are the reasons why students with special needs are often regarded as incapable of doing inquiry.

2.1 Mnemonic strategies

Teaching mnemonic strategies is effective as students can recall vocabulary and thus have more capacity to learn science concepts (Scruggs & Mastropieri, 2000; Scruggs et al., 2008; Therrien et al., 2011).

2.2 Graphic Organizers

Graphic organizers improve the factual comprehension and vocabulary knowledge of intermediate and secondary students with LD [learning disability] in science

2.3 Multi-sensory Learning

There are innovative ways in which science could be made accessible to students with visual impairments. One such technique is multi sensory learning technique which can be used by the teachers to teach science to visually impaired child in science classroom. The visually impaired student could use this tactile scale to practice measuring objects. Tactile modifications of preserved specimens and humanely prepared living organisms (e. g., live Cray fish with rubber tubings carefully placed over their pincers) could form excellent hands-on specimens in biology Science educators should explore ways in which new technologies could be utilized to improve access to science instruction for students with visual impairments. Technological resources for the visually impaired include Braille generating software, scanners, Braille

printers and embossers, screen-reader software, speech synthesizers, and closed circuit television.

Conclusion:

The science teacher who uses reading and writing as the sole means of instruction will give all of his or her children a handicap. Normal children & children with handicapping conditions both suffer from one dimensional teaching. The teacher who uses a full range of multisensory techniques in the regular classroom will be responding to some of the special needs that exceptional children may have. Science teachers need to make conscious efforts to catalyze the integration of students with disabilities in science classrooms and make necessary accommodations for them to excel in science. Science teachers should realize the student-oriented benefits of science learning and make every effort to accommodate students from diverse background. Unless science teachers will not stress on the individual needs of the students in their science teacher education programs, and if they will not make necessary efforts to accommodate them in their instruction, it is extremely difficult for students with diverse background to gain an equitable exposure to science education. Full participation in science by diverse background learners, as well as students with other disabilities, will be beneficial for all students, and a rewarding experience for teachers.

References

- Hines, S. M. (Ed.). (2005). Multicultural science Education: Theory, Practice, and Promise (Vol. 120). New York, U.S.A: Peter Lang.
- Lee, O. (2003). Equity for Linguistically and Culturally Diverse Students in Science Education. Teachers College Record , 105 (3)
- Lynch, S. J. (2000). Equity and Science Education Reform. Mahwah, NJ: LawrenceErlbaum Associates, Inc
- Department of Education (2003). Inclusive Education Scheme (Draft). New Delhi: MHRD, GOI.
- Subrahmanian, R. (2003). "Right to Education: Opportunities and Challenges", Education Dialogue, 1 (1):
- Newsome, J. G. & Lederman, N. G. (Eds.) (1999), Examining Pedagogical Content Knowledge: The Construct and its Implications for Science Education. Kluwer Academic Publishers, The Netherlands
- Sears, J. and Sorensen, P. (Eds.). (2000) Issues in Science Teaching. Routledge Falmer, The Netherlands