Differentiated Instruction as a Means of Revitalising Science Classrooms

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ABSTRACT

In order to effectively acknowledge and respect the diversity of pupils, it is recommended that teachers strategically design classroom environments that foster the support and promotion of individual differences. Differentiated instruction (DI) is an instructional strategy that takes into account the individual skills of each kid. Differentiated instruction (DI) offers students access to the same material while taking into account their individual strengths and variances. Additionally, it addresses the educational requirements by utilising existing knowledge, so enhancing the teaching and learning experiences accordingly. The process of differentiating instruction entails designing learning experiences that offer students many avenues to engage with content at a level that is suitable for their individual needs. Differentiated instruction (DI) can be achieved by the differentiation of three key factors, namely content, procedure, and product. The ultimate objective of differentiated instruction (DI) is to facilitate the achievement of self-actualization among students. However, doing this would be unattainable by attempting to conform them to a rigid framework.

This paper examines the various components of Differentiated Instruction and explores solutions for its implementation in science classrooms. This study employed a phenomenological technique to investigate the beliefs, perceptions, and personal experiences of students following the adoption of individualised education. The study's findings indicate that the implementation of differentiated instruction (DI) had a beneficial effect on student accomplishment, as it led to increased student participation in the teaching and learning process. Differentiated classrooms are perceived as suitable for kids with diverse learning styles, varying learning paces, and a range of abilities and interests. Significantly, classrooms of this nature demonstrate enhanced efficacy in accommodating a diverse range of pupils compared to standardised settings. Educators inside differentiated classrooms exhibit a heightened level of attunement to their pupils, adopting a pedagogical style that emphasises the artistic dimensions of education rather than a mechanistic exercise. (Tomlinson,1999)

Introduction

In 2009, 16,000 15-year-olds from India participated in the extended version of the PISA conducted by the OECD (Organisation for Economic Cooperation and Development).Approximately 74 countries participated, with two entries from India's Himachal Pradesh and Tamil Nadu states.The outcome was disastrous, and both states placed second-to-last in the rankings. The socio-cultural disconnect was responsible for this performance. The country now intends to participate in the PISA exam in 2021, having missing the 2018 deadline.The PISA data could significantly improve educational policy planning. Additionally, curriculum and instruction must emphasise critical thinking and problem-solving abilities. In today's globalised society, these competencies are in high demand.

After the passage of the Right to Education Act, classrooms have become much more diverse, with students from diverse cultural, economic, and social backgrounds seated together. However, where equality has been accomplished, equity has yet to be achieved.

Caine & Caine (1990) state, "There can be up to a five-year difference in maturation between any two 'average' children" (p. 2). Even though in India it is now a priority to include students with special learning requirements, both advanced and struggling learners, in general education classrooms. This contributes to the diversification of classrooms, as these students spend more time with general education instructors. However, cultural differences and aptitude explain only a portion of the diversity that teachers encounter on a daily basis. Frequently, the same instruction has varying effects on various students. This raises the topic of how we can design instruction to better accommodate these differences. (Aysha,2018) In this case, differentiated instruction could be beneficial. In conjunction with assessment and grouping, it could address the requirements of diverse students and promote equity. It is not a novel idea, and every teacher employs it in some form or another in the classroom. Many consider this to be a philosophical approach, while others refer to it as pedagogical. Teachers have observed improvements in their students' academic performance, attitudes, comprehension, reading, and writing. This occurred following differentiation of the various classroom elements in terms of content, process, product, and classroom environment (Tomlinson,). These advances are a result of optimal learning conditions and equitable instruction based on the learners' individual backgrounds.

Differentiated Instruction

It is a pedagogical approach to the process of teaching -learning and based on student's unique abilities ,readiness and learning modalities. Differentiated instruction is "the process of matching learning targets, tasks, activities, resources, and learning support to individual learners' needs, styles, and rates of learning" (Stradling and Saunders (1993) p. 129).DI can be thought of a means to achieve equity and equality in a diverse classroom. It achieves this by designing learning opportunities keeping in mind learning profiles. Learning profiles are designed on the basis of their learning styles, intelligence ,culture and even skills the learner possesses. "Differentiated classrooms feel right to students who learn in different ways and at different rates and who bring to school different talents and interests. More significantly, such classrooms work better for a full range of students than do one-size-fits-all settings. Teachers in differentiated classrooms are more in touch with their students and approach teaching more as an art than as a mechanical exercise." (Tomlinson,1999)

The conceptual framework for differentiated instruction implemented in this study were comprised of four theories

1. **Vygotsky (1978) Zone of Proximal Development**

This concept was introduced but not fully developed by Psychologist Lev Vygotsky. He gave the term "Zone of Proximal Development" which in simpler term meant the difference between what the Learners can and Cannot do.This study supported the relation between classroom instruction and ZPD. It meant that when applying Vygotsky's theory to instructional activities ,it should be complex enough to be above students developmental and readiness level. Vygotsky's often-quoted definition of zone of proximal development presents it as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers."

2. **Howard Gardner's theory of Multiple Intelligence** advocated the need of planning instruction in such a way so as to match the learning styles of the student to their multiple intelligence. The eight intelligences were   identified as: (1) Logical/Mathematics; (2) Interpersonal; (3) Intrapersonal; (4) Spatial; (5) Verbal; (6) Auditory; (7) Naturalist; (8) Musical (Gardner,2011)

3. **Learning Profiles :**This concept given by Carol Ann Tomlinson was of the concept that every student has a unique learning style by which they process and take in information. She believed that the teachers should plan and meet the needs of learners keeping in mind their Culture ,Gender, Learning styles and Multiple Intelligence (Tomlinson,2012)

4. **The Theory of Differentiated Instruction** also given by Tomlinson was of the view that instruction based on different learning profiles resulted in Differentiated Instruction thus helping students strengthen themselves as learners. It was derived from the philosophy of each child's unique strengths and weakness which needs to be fulfilled for students to have an enriching learning experience inside the classroom.

DI takes the concept the concept of constructivism a bit further. This is because when differentiating the teacher begins her lessons where students are and builds upon that knowledge. This modification of lesson according to a student's prior knowledge and instead of teaching to the middle ,as is the norm ensures greater engagement in the classroom. The interest , level of readiness and learning profile is kept in mind when planning lessons. It provides access to the same curriculum but with the recognition of student's strengths and differences and catering the learning accordingly, thus leveraging of student's prior knowledge

Elements of Differentiated Instruction

One of the element which is common to all studies on differentiation is "Scaffolding -providing learners with greater support during the early phases of learning and then gradually reducing support as their competencies and ability to assume responsibility increase"(Parkay & Hass,2000).It is similar to the process when a child learns to skate for the first time. The process is a bit difficult and often time the child stumbles, but as time wears on and with practice as well as encouragement, the child's competency increases until he can skate as easily as walk. Scaffolding provided by the teachers in the classrooms can help the student achieve competency in the subject matter with a bit of support and encouragement.

The elements by which differentiation instruction is planned are Content , Process , Product and Classroom Environment.(Tomlinson,)
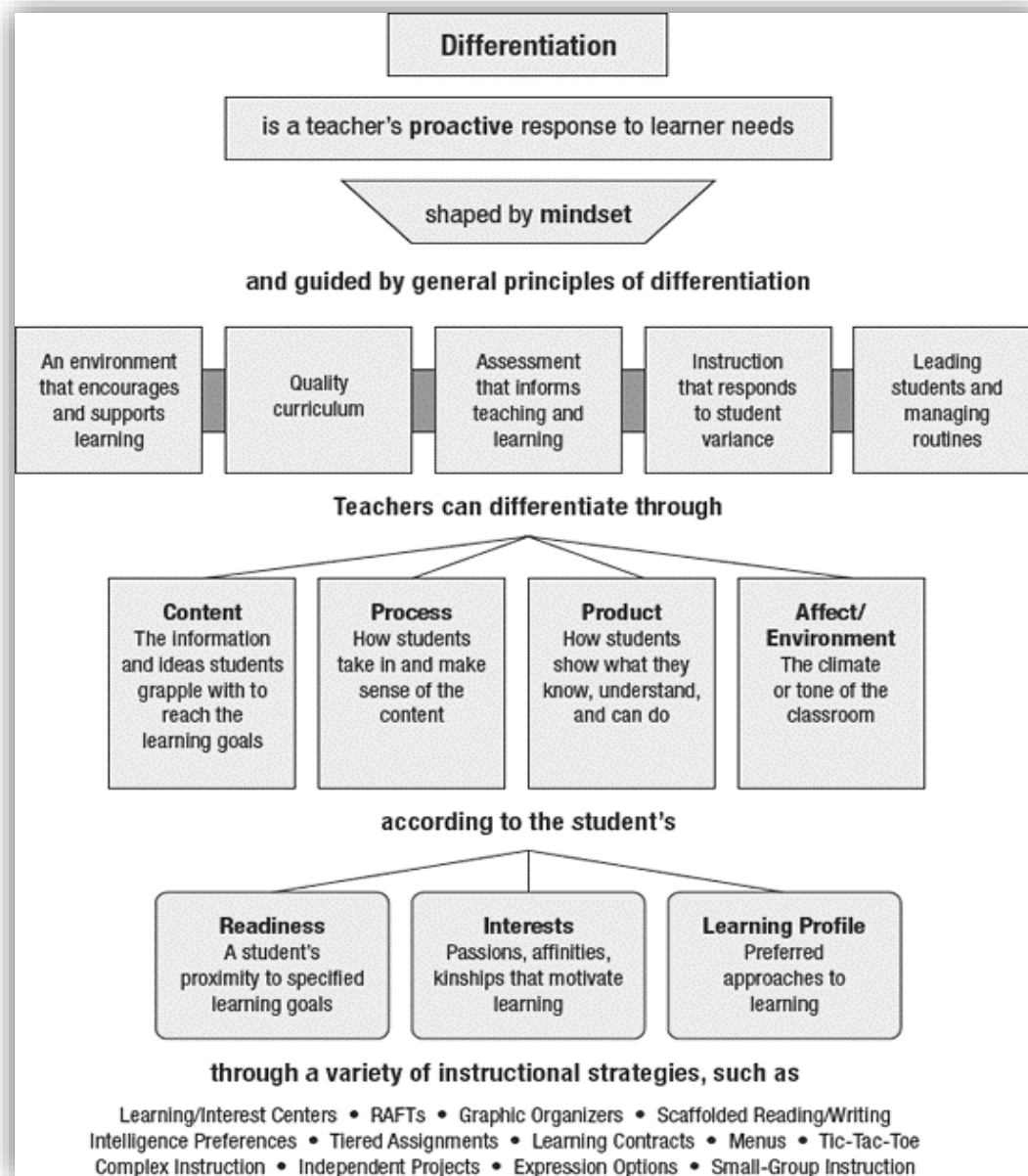
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- **Content**

Content is the topic the teacher plans to teach in the classroom. It could be a topic or a concept. In simpler terms it's also called the "What" of teaching. The teacher based on learning profile of the student plans to differentiate the way the content is taught. It is dependent on student's prior knowledge

- **Process**

Process is the method by which the teacher would teach. It is the "How" of teaching. After determining the content to be taught, the student's .E.g. if the lesson is planned using intelligence as a preferred mode, then the teacher could differentiate using videos , audios ,flipped classroom among other techniques to teach.

- **Product**

The end result of differentiation is the product which is the representation of what the students have learnt after differentiating both the content and process. The task for assessment could vary from building a model ,to writing a song and even debating for those whose communication skills are their strongest forte. It is the end product of differentiation.

- **Classroom Environment**

The feel or climate of classroom is one of the most important elements of differentiated instruction. The setting of the furniture, availability of materials or resources and a safe learning environment are some of the key factors to be considered when planning DI

Strategies implemented in Differentiated Science Classroom

Some of the strategies implemented in the classroom were

- **Tiered lessons** :When task is planned according to different level of complexity, it could lead to tiered lessons. It could mean teaching the same topic but keeping in mind the different learning needs of students

- **Problem Based Learning** :The students must work in group to find solution to everyday problems.

- **Design Based Learning**: The students are divided into groups to create prototypes of solutions to practical issues.

- **Curriculum Compacting :**The topics to be taught can be modified based on student's prior knowledge and their readiness.

- **Flipped Classroom :** A type of blended learning where the traditional learning environment is reversed. This is achieved by delivering content online for students to access at their leisure and convenience. Thus, activities which are considered conventionally can be moved into the classroom.

Phenomenological Approach

Phenomenological approach is a type of qualitative research which aims to describes a experiences pertaining to a phenomenon. It has its roots in philosophical work of Edmund Husserl. Creswell (2002) defined a phenomenological study as "one that tells the significance of lived experiences surrounding a concept or a phenomenon" (p. 151) In this study the phenomenological approach was a preferred mode of data collection as it works to reveal , interpret the perspective and individual perceptions about a specific phenomenon. This allows the researcher freedom to put forward their perspectives, assumptions, prejudices better than other qualitative research approach. It allows to understand student's perspective much more deeply. Data for this phenomenon was collected using open ended questionnaire, structured interviews and classroom observations

Research Question

1. What do students think about implementation of DI ?

2. How do students perceive Differentiated Instructions and its relation to academic achievement ?

Setting

This study took place in a South-East Delhi Government school. The classroom selected was grade 11 biology classroom. Around 120 students were handed out questionnaire over three sections. Around 50 students were then interviewed through the semi structured interview. The classrooms were also observed to further enhance the data collection.

Data Collection and Analysis

Three methods of data collection were utilized, thus satisfying the need for triangulation. An open-ended questionnaire ,observations and a semi structured interview were utilized. Data collection began with an open-ended questionnaire, in which student's history ,prior knowledge and their views on differentiated instruction were sought.

The data were then analyzed using phenomenological reduction (Moustakas, 1994) and horizonalization (Merriam, 2009; Moustakas, 1994). of the significant statements revealed through were then enumerated and assigned a value. Both the process of horizonalization and phenomenological reduction helped integrate and triangulate the data about the phenomenon of differentiated Instruction and thus reveal the essence of the student's experience. It revealed the importance of DI in individualizing instruction according to the needs of the students and thus motivating their participation in the classroom.

Result and Conclusion

After collecting the data through the open-ended questionnaire ,semi structured interview and classroom observation, the triangulation and coding of data were done. Since it was a phenomenological study-phenomenological reduction and Horizonalization were utilized to make sense of the data. Various themes were recurrent and are listed below. There were many other themes but based on relevance they were eliminated. After analysis of the data ,the following themes were revealed:

Themes	Description
1.Pre-Assessment **2.Student Data**	Students learning profile were developed which included multiple intelligences ,learning styles and their prior knowledge. This helped implement DI in an effective manner

3.Individualized Instruction	Students felt much aware of their strengths and felt that differentiated instruction helped in learning the content effortlessly.
4.Classroom Environment	They felt that classroom environment is very important as usually they are not allowed to speak out or ask too many doubts as it can be considered as a form of harassment by the students and they are then disciplined
5.Teacher's Attitude	The students felt that the attitude of teachers needs to be improved as it was a major deterrent to an enjoyable and motivating classroom environment. The teachers were of the opinion that the students were not interested to learn.

The students reported better understanding of the concepts and topics of the topic taught using DI.The students data created helped create the learning Profile. This made it easier for the teacher in organizing the classroom instruction, assessments and grouping, thus allowing students to use their preferred mode of information processing while taking up information.

Discussion

There is a need to replicate the study across all grade levels to understand students views on differentiated instruction and study its impact on their academic achievement. There is felt a need to orient teachers to differentiate instruction in their general inclusive classroom as they consider it too much of a hassle to implement. There needs to professional development workshops to get the idea across. There is also a need to conduct research and determines teacher's understanding of the concepts of Multiple Intelligence, learning profile, differentiation of content, process and product. This could deepen the understanding of the phenomenon of differentiated instruction.

With various policies and acts coming out, the classroom is turning heterogenous with students of various backgrounds coming together in a single setting. Thus, there is a need for educational modifications in our teaching-learning process. This study did not reveal what methods or strategies were effective but revealed student's perception. This study helped students vent their frustrations and discuss their views and perspectives regarding implementation of differentiated instruction.

One of the recurring view which came out during the research were the teachers were reluctant to change their instructional method from a "one size fits all" approach to a more inclusive one. It revealed their lack of understanding and empathy to the needs of the students. Change is only possible if teachers are assisted in implementing new improved instructional strategies.

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