

## EFFECTIVENESS OF DIFFERENTIATED INSTRUCTION IN LEARNING BIOLOGY AT SECONDARY LEVEL

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**ABSTRACT**— Differentiation is a way of planning the teaching methods and materials in which teachers proactively adapt instructional activities, teaching processes and curricular resources in order to address the various students' needs. There are three major principles which acts as a foundation behind differentiated instruction. They are ongoing assessments, flexible grouping and respectful tasks. A differentiated teacher plans and prepares the instructions and teaching based on individual students, not on a pre-planned fixed curriculum. Teaching Biology using the conventional methods about Animal kingdom, and Nutrition and Health is challenging because the scientific terms are difficult to understand as the contents are descriptive in nature. The anatomical and morphological terms are very hard for the students to comprehend. Students with varied abilities scored poorly in Biology due to monotony of conventional methods. Hence the present study was undertaken with the objective to find out the effectiveness of Differentiated Instruction (DI) in learning Biology. In this study the Differentiated Instruction (DI) modules were designed using a set of teaching aids, assignments and activities for the selected chapters from class 9 of NCERT book. An experimental research was conducted with sixty (N=60) students of a Government Higher Secondary School. The students were tested using a Pre-test of Twenty-five questions on Animal Kingdom, and Nutrition and health. An intervention based on Differentiated Instruction was given to the Experimental group for eight weeks of 40 instructional classes. The effectiveness of DI was measured by giving post-test. The data was analyzed and examined using SPSS trial version and the statistical analysis involved (a) descriptive statistics, (b) Paired sample t -test to find out the mean scores of the same topics (prior and after the intervention). The results indicate that there was significant improvement in learning Biology as a result of Differentiated Instruction. So it is recommended that Differentiated Instruction is highly beneficial to the students for teaching Biology at secondary level.

**Key Words:** *Differentiated Instruction, Digital Resources, Respectful Tasks, flexible grouping, ongoing assessments, and conventional method.*

## **INTRODUCTION**

Differentiated instruction refers to an orderly and scientific approach of preparing the curricular instructions according to the needs of various learners. It is assumed that students differ in their styles, aptitudes, needs, strengths and in their abilities. So it is necessary that all the classroom activities must be catered to meet these needs. Ongoing assessment and flexible grouping are the two major activities that help this approach a successful one. By differentiation the needs of the slow and advanced learners can be fulfilled. When the learning tasks are very difficult, learners become anxious, excited, frustrated and loose hope. On the other hand if the learning tasks are too easy, it results in boredom and fatigue. So to keep the motivation and achievement level of the students to a maximum, it is necessary to differentiate the instructions in such a way that it reduces the anxiety and boredom of the students at an optimal level.

## **II REVIEW OF RELATED LITERATURE**

Brian (2012) explored whether differentiated instruction by any means improved students' academic growth. Students with a higher academic ability were improved by the opportunity to be challenged at a higher level while students of average ability did not benefit by this approach. Atilla (2012) experimented on the biological topics that students have difficulties learning. The main reasons for learning difficulties were the nature of the topic, teachers' style of teaching. The other reasons included students' learning and studying habits. Students' negative feelings and attitudes towards the topic and a lack of resources are some of the other reasons for the difficulties. Suzanna (2011) experimented on Differentiating Instruction by using the concept of Multiple Intelligences in the Elementary School. Teaching students according to their strengths and needs by using MI (Multiple Intelligence) has so many benefits and advantages such as meeting students' learning needs and engaging students, which in turn can lead them to higher student achievement. Jane et al (2017) studied the effectiveness of Differentiated Instruction on learning outcomes or performance of high school science students. The researchers used a research methodology with a convergent, parallel, mixed method which included an interview and survey with six science teachers 65 biology students. Further the survey revealed that teachers and students have a high positive perceptions towards DI. Mohammad and Jaber (2014) experimented on the Effectiveness of Differentiated Instruction. They assessed how far Iranian students Reading Comprehension improved upon using DI. It was done on Separate Genders. The results of ANOVA from post-test results showed that the students of the experimental group outperformed the control one. The analysis of post test revealed that female learners of the experimental group had done better when compared to male ones in the post-test.

## **I. THEORETICAL BACKGROUND OF DIFFERENTIATED INSTRUCTION**

Identifying the learning process of students is essential while planning teaching strategies. Knowing and understanding learning styles helps us to group students in the classroom.

## A. FLEXIBLE GROUPING

It is a way of grouping students according to the student's needs, the instructional aims or objectives, and the capability level of the students. Teacher led groups and student led groups are the two main categories of grouping. Collaborating with and learning from their peers help students organize themselves depending on their skills and abilities. Groups which are flexible, fluid or dynamic, changing helps meet the different needs of the students. Teachers can make group assignments, tasks and projects based on the reports of ongoing assessments. Students also can choose a particular group based on their aptitude, interests or learning needs and they get the opportunity to work with classmates who are either similar or quite different in strengths, skill levels, learning profile or interests.

## B DIGITAL RESOURCES

By using interactive digital tools the mixed ability students get the opportunity to approach a topic from different perspectives. It gives better learning outcome and digital skills.

## C. CONTINUAL ASSESSMENT

Regular assessment and feedback helps teachers to cater the teaching methods as per the learning style and space of the students. By assessing students' knowledge and skills often, teachers can develop and refine their teaching methods and instruction to meet the students' dynamic needs. By assessing students' interests and learning profile, teachers can create learning tasks that are easy, interesting, engaging, motivating, and accessible.

## D. RESPECTFUL TASKS

Teachers give different worksheets or assignments to students according to their strength and weakness. It allows students to work and learn at their own place and space. Creating meaningful tasks means that students know clearly what they are learning and why they are learning it. They should be able to connect and apply it to their daily experiences. At the end of the learning activities or the tasks, students should be able to self-assess and find out whether they have mastered the content.

## E. SUPPORTIVE LEARNING ENVIRONMENT BY TEACHERS AND PEERS

It is about how the students are valued, included, and empowered. It is all about giving constructive comments and suggestion for students and make ourselves available to the students. It is encouraging the students and applause them for their performance and involving them in the learning activity whole heartedly. It is making an environment in which all the children feel socially, physically and emotionally safe.

## F. FITTING TEACHING STRATEGIES

It is necessary to understand that each student has wide range of intelligence aptitude. But they excel in two or three of the intelligence categories. This understanding helps a teacher create a classroom that is supportive, congenial, nurturing. This makes academic progress in all the students.

## II. NEED FOR THE STUDY

A classroom with diverse students, each one of them with different strengths and needs, it is hard to decide where to begin and how to begin. To solve this problem, Carol Ann Tomlinson found a solution by introducing a concept or method called Differentiated instruction in the year 2005. But it is in our hands to apply, explore and experiment it to get the best out of it. Thus this paper tries to implement the principles and strategies of differentiated instruction to

teach biology for secondary students to find out its impact. The chapter Animal kingdom was selected because the scientific terms are difficult to be understood as the contents are descriptive in nature. The anatomical and morphological terms are very hard for the students to comprehend. To eliminate the students' difficulties regarding the learning material about the Animal Kingdom, and Nutrition and Health the researcher made a Differentiated instructional strategy in such a way that all the students in the classroom would be able to learn Animal kingdom with ease. Learners of standard IX face the problems in learning scientific terminologies in biology by adopting conventional or traditional methods of learning. Using Chalk and talk method imparts knowledge to students orally and students are evaluated by keeping assessments. Students score less marks in achievement tests because of monotony of conventional methods of teaching biology. To find an innovative method for eliminating the problems of the learners the researcher proposes to find out the effectiveness of Differentiated Instruction (DI) in learning Biology. Students have problems in scoring less marks in biology at standard IX because of conventional method of teaching biology. This experiment was done to apply differentiated instruction to teach the concepts of biology so that students can improve their achievement scores of biology.

#### **V STATEMENT OF THE PROBLEM**

Students have problems in scoring more marks in biology at standard IX because of conventional method of teaching biology. This study tries to use differentiated instruction to teach the concepts of biology so that the students improve their achievement scores of biology.

#### **VI OPERATIONAL DEFINITION**

##### **A. EFFECTIVENESS**

The term "effectiveness" refers here to the extent to which learning through Differentiated instruction (DI) produced better results in terms of the scores of students in achievement tests.

##### **B. DIFFERENTIATED INSTRUCTION**

It means tailoring or catering or individualizing instruction to address the needs of each learner in the classroom by ongoing assessment, flexible grouping, giving meaningful tasks and creating supportive and inclusive learning environment.

#### **VII OBJECTIVE OF THE STUDY**

The objective of the study was to find out whether there is difference in achievement mean scores in Biology of the students that are exposed to Differentiated instruction and those exposed to conventional methods in teaching biology at Secondary level.

#### **VIII MAJOR ASSUMPTIONS OF THE STUDY:**

The instructor who uses differentiated instruction assumes and take into consideration the multiple aspects of the learner to best meet his learning needs. The researcher assumed that using a teacher made instructional module for teaching the concept of biology would enhance their mean score in biology.

#### **IX HYPOTHESES:**

*H1. There will be significant improvement in learning Animal Kingdom Lesson as a result of Differentiated Instruction.*

H2. There will be significant improvement in learning Nutrition and health lesson as a result of Differentiated Instruction.

### X SAMPLE

There are 113 government higher secondary schools and 290 private matriculation schools in Coimbatore districts. Out of which one Government higher secondary school and one private school were selected for the study. Eighty students studying in Standard IX from a Government School and a private school were selected as sample for the study. Sampling was done by simple random selection technique.

### XI METHODOLOGY

Experimental method (control group and experimental group) with pre-test and post-test was adopted for the study.

Before the commencement of the research the researcher obtained the permission from the Head of the schools. Before administering the treatment (Differentiated Instruction method of teaching) the researcher conducted a pre-test on both the experimental and control groups using BAT (Biology Achievement Test). Then the treatment i.e. Differentiated Instruction method of teaching on the two topics (Animal Kingdom and Nutrition and Health) was done for the experimental group alone. For each unit 15 instructional hours were used over the period of 60 days. The control group was taught only using conventional method of teaching. At the end of the intervention, post-test was administered to both experimental and control group using the same tool. The same procedure was followed to get data from the private school also.

### CONSTRUCTION OF RESEARCH QUESTION PAPER

Researcher constructed two self-made Biology Achievement Test question papers with 25 questions each. The Objective type questions were framed from the two topics (i) Animal Kingdom and (ii) Nutrition and Health Unit in Biology from the standard IX NCERT Science book which was used as a tool for the study. The tool was validated by two subject experts. The tool was also standardized using test retest method.

### MODULE TO ENSURE DIFFERENTIATED INSTRUCTION

The instructor designed a differentiated instruction module specially made to teach the concepts of Chapters of Animal kingdom and Nutrition and health. Which includes peer collaboration, flexible grouping, team work, meaningful tasks, continuous assessments, projects, tiered assignments, using ICT, activity method, self-directed learning, supportive environment, independent work etc.

**TABLE 1**

**Strategies used for Differentiated Instruction in this Study.**

S.NO	TOPIC	DIFFERENTIATED INSTRUCTION (MODES/ACTIVITIES/TOOLS)	TRADITIONAL TEACHING
1	Coelom types Acoelom Pseudocoelom	Card game. Pictures and labelling the layers. Matching the derm layers and state the type of coelom.	Book pictures

	True Coelom		
2	Binomials	Cards- Pairing of students with Names of animals and the respective pictures	Text only
3	Phylum	YouTube lessons Phylum Annelida in Tamil   Animal Kingdom in Tamil (20) Raju's Biology. + PPT.	Book pictures and notes alone.
4	Symmetry	You Tube lessons + Dhiksha lessons. Assignment on symmetry. (examples for radial and bilateral symmetry)	Pictures alone
5	Phylum identification	Role Play with students- Who am I card game and debate about the specialized features of the animals. PPT presentation	Book notes with book pictures
6	Carbohydrates and proteins	Samples of cereals and pulses in small bottles for the students to play and learn. Segregation of cereals and pulses. PPT presentation and YouTube lessons	Notes from text book
7	Vitamins and their deficiency disorders and symptoms.	PPT presentation and group discussion. YouTube lessons. Picture identification.	Table 21.2 from the text book
8	Minerals- Dietary sources, functions and deficiency disorders.	PPT presentation and YouTube lessons. Explanation by students. Group Activity on naming the sources of minerals.	Table 21.3 from the text book.
9	Methods of food preservation.	In detailed picture explanation for every method and discussion. Group activity on food preservation methods	Passages from the text book.
10	Food control agencies	Picture card matching game with their expansion (e g) ISI- Indian Standards Institution.	No game. Only book pictures and notes.

### XIII STATISTICAL TECHNIQUES AND DATA ANALYSIS

The data was analyzed and examined using SPSS trial version and the statistical analysis chosen for the study involved (a) descriptive statistics, (b) Paired sample t -test to find out the mean scores of the same subjects (prior and after the intervention period). The following results were obtained for lessons on Animal Kingdom.

XIV RESULTS

TABLE 2

Mean, Standard Deviation and Paired Sample t-test of the Sample (N=60) in the Animal Kingdom lesson using Differentiated Instruction Method

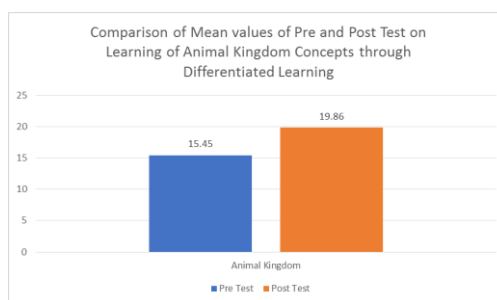
	N	Mean	Std. Deviation	Paired Differences		t	df	Sig.2-tailed
				Mean	S.D			
Animal Kingdom Pre test	60	15.45	4.24	-4.417	3.49	-9.789	59	.00**
Animal Kingdom Post test	60	19.86	4.34					

\*\* - Significant at 0.01 level

The above Table depicts that students scored higher in the Post test after the Intervention (Mean= Pre (15.45) and Post (19.86). This shows that there was significant improvement in the mean scores in Post-test. The results of the paired t-test which was run on a sample of sixty students (N=60) to find out whether there was statistically significant difference in the understanding of Animal Kingdom lesson in both the time period 1(Pre) (15.45 ± 4.24) as opposed to the time period 2 (19.86 ± 4.3) a significant increase of 4.417 (t (59) = 9.789, p < .001) was recorded.

GRAPH 1

Comparison of mean values of pre and post-test on learning Animal kingdom by Differentiated instruction



This clearly indicates that Differentiated Instruction improved the understanding on the lesson Animal Kingdom and students scored better in their achievement tests. Hence, the hypothesis which states that “There will be a significant improvement in learning Animal Kingdom Lesson as a result of Differentiated Instruction” has been **accepted**.

**TABLE 3**

Mean, and Standard Deviation and Paired Sample t-test of the Sample (N=60) in the Nutrition and health lesson using

	N	Mean	Std. Deviation	Paired Differences		t	df	Sig 2-tailed
				Mean	S. D			
Nutrition Pre test	60	15.26	3.16	-	4.02	-10.15	59	.00**
Nutrition Post test	60	20.55	3.82	5.28	2			

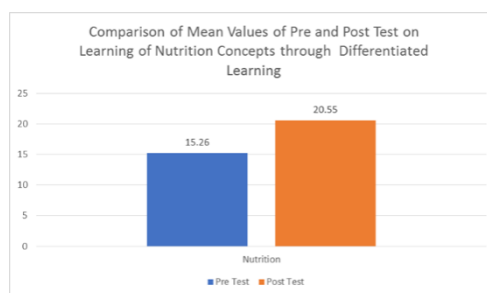
\*\* - Significant at 0.01 level

The above Table shows that the students scored higher in the Post test after the Intervention (Mean= Pre (15.26) and Post (20.55)).

This result shows that there was a significant improvement in the mean scores in Post-test. The results of paired t-test which was run on a sample of sixty students (N=60) to find out whether there was any statistically significant mean difference in the understanding of Nutrition and health lesson in both the time period 1(Pre) (15.26 ± 3.16) as opposed to the time period 2 (20.55 ± 3.82) a significant increase of 5.28 (t (59) = 10.15, p < .001) was recorded.

**GRAPH 2**

Comparison of mean values of pre and post-test on learning Nutrition and health lesson by Differentiated instruction.



This result clearly indicates that the Differentiated Instruction improved the understanding on the lesson Nutrition and health. Students scored better in achievement test. Hence, the hypothesis which states that “There will be significant improvement in learning Nutrition and health Lesson as a result of Differentiated Instruction” has been **accepted**.

**DISCUSSION**

Teachers would expose biology students to strategies and techniques of Differentiated Instruction to promote effective, complete and active learning. Motivation, attitude, learning by doing, and learning by experience among students could be enhanced using DI. Also, teacher education programs would be improved upon to prepare teachers who could apply innovative approaches and practices i.e. differentiated instructional strategies



which would enhance enormously the teaching and learning processes. The future of education lies in the hands of Instructional designers and instructional material developers. They would be able to develop relevant need based instructional packages for different subjects.

## CONCLUSION

In an institution, school or classroom where differentiated instruction is followed, all the students with varied knowledge levels, aptitudes, skills and abilities would feel at a comfort zone and welcomed. Sharing of knowledge, the feel of growing along, mutual respect and sense of belonging, creativity and collaboration is achieved. Students would feel physical, mental, social and emotional safety. As students are assessed often i.e. before, during and after their learning which in turn helps the teacher to get feedbacks about the strengths and weakness of the students. Though students have choices in demonstrating their learning, teachers can use a common assessment tool or achievement test so that all students' learning are evaluated or judged against the same assessment criteria. Thus differentiated instruction helps educators in creating and altering instructional strategies and teaching methodologies and materials in response to learners need.

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