Migration Letters

Volume: 21, No: S14 (2024), pp. 159-171

ISSN: 1741-8984 (Print) ISSN: 1741-8992 (Online)

www.migrationletters.com

An Investigation To The Results Of Differentiated Instructions In Science Subject

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Abstract

Finding out how different types of education affected students' performance in science classes was the primary motivation for this experimental study. There was a split of 102 people in the sample, with 51 people serving as experimental subjects and 51 as control subjects. We conducted a four-week intervention in which one group of students learnt using tactics tailored to their individual learning styles (the experimental group), while the other group got standard, whole-class instruction. To [1]investigate students' progress and engagement in science, we created a checklist for their participation, as well as a pre- and post-test. Significant difference was after post to the students who were given the treatment. The results show that students' engagement and performance in science classes are greatly impacted by differentiated Instructions.

Keywords: *Teaching of Science, Differentiated Instructions, Experimental Design.*

Introduction:

Differentiated instruction is the most talked-about subject in elementary school. Differentiated instruction is a relatively new concept in elementary education. This strategy can modify instruction based on what the students want. According to several studies (Mulder, Q.,2014). Most primary school teachers struggle to implement differentiated instruction. According to research by Houtveen and Van de Grift (2014) and the Inspectie van het Onderwijs (2013), the public at large simply uses the equal teaching for all pupils. For some teachers, this is the only way to ensure that every student receives individual attention. However, many children may not be adequately prepared when all students adopt the same approach, since this puts the learning topic outside of their zones of proximal development (Hogan, M. R.,2014). The degree to which students of the same age require guidance and support during studying varies among studies (Alomran, A. A., & Al-Shemali, N.,2023). Therefore, it is significantly more important for primary school teachers to identify students' individual needs and incorporate those needs into lesson plans (van het Onderwijs, 2013). According to Reezigt (2012), differentiated instruction is one of primary education's weak spots. According to Landrum and McDuffie (2010), this is a major issue; teachers should strive to improve their students' learning, and they will be most successful in doing so when they provide diversified instruction.

Therefore, there is still a long way to go in primary school when it comes to using differentiated instruction. According to the Inspection van het Onderwijs (2011), success-oriented teaching is the most important factor in the improvement of Dutch education and the achievement gap. (Inspectie van het Onderwijs, 2011) The success-oriented technique

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is a way that schools methodically and intentionally work on maximising scholar success.

The possible effects of differentiation on students' achievement are hard to pin down, according to Hayes and Deyle (2001), in part because the results of separation may also vary from school to school. Although it is still not confirmed, Roy et al. (2013) state that detached guidance is accepted to cultivate the accomplishment of understudies. Clean positive outcomes from divided arrangement eventually need to be monitored, but according to Smit and Humpert (2012), students who receive separate instruction do not have worse accomplishments. Due to the increasing importance of separated instruction, it is crucial to determine whether or not separate preparation leads to better student accomplishment.

This is mainly due to the fact that the educational trend is moving towards full inclusion, which states that all students, regardless of disability, should attend regular classrooms (Hayden, S., et.al., 2024). Preparation, convention, and science are all areas of focus for this pattern. The standard investigation to room becomes the hub for managing variations among understudies, and it implies substantial alterations and modifications to personnel procedures (Mulder, Q.,2014). This enables crucial educators to provide individualised instruction. Furthermore, it seems that only a small number of students exhibit an aberrant level of overall performance in prerequisite training (Willemsen, R. , et.al., 2023). Students' overall performance in fundamental tutoring is quite consistent. The reason behind this is because pupils that perform above average don't seem to be assessed very often (Hingstman, M., et.al.,2021)

Teachers must be able to adapt their teaching strategies to meet the diverse requirements of their pupils in order to implement differentiated education. Thus, differentiating instruction occurs whenever a teacher attempts to alter his typical method of teaching in order to concentrate on a specific student or group of students so that they can fully understand a concept while simultaneously creating an environment that is equally beneficial for the other students (Tomlinson, 2000).

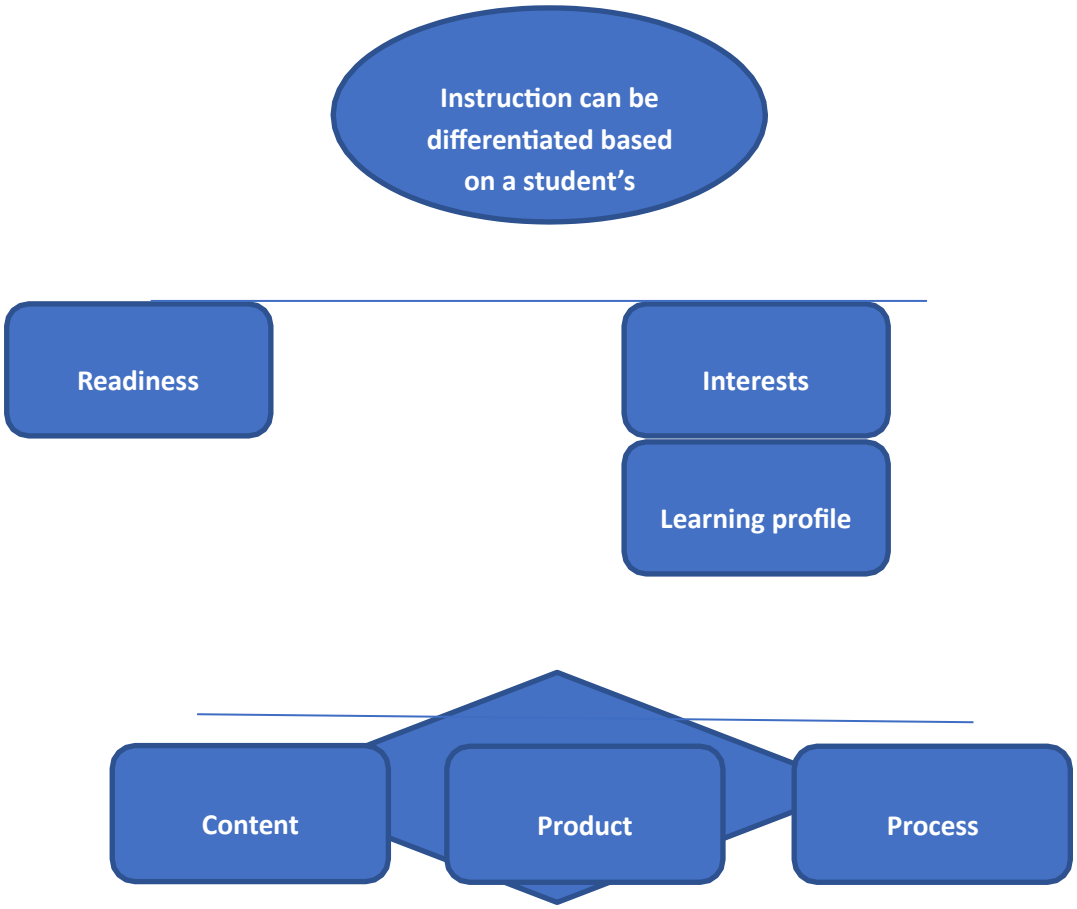

Figure 1 Differentiated Instruction is Implemented in the Following Way;

Content

Any subject matter that an educator chooses to teach can be differentiated. Concepts, goals, and guiding principles of the field, as well as other relevant information, make up the content. Included in the content as well are the intended pieces of information that a teacher hopes to instill in his pupils. Typically, pupils should be able to grasp the same fundamental ideas and skills from lesson to lesson. However, the true test of a teacher's differentiated instruction skills is in ensuring that each student has equal access to the course's central topic. Teachers must strike a balance between presenting the material in a way that is accessible to all students and accommodating their varying levels of comprehension so that all students fully grasp the lesson's central theme. A teacher can distinguish his content by implementing tactics such as: ϖ Using math manipulatives to assist students in grasping the concepts.

1. He has the option to utilize texts or stories at multiple reading levels to enhance comprehension.
2. You can convey information using whole-to-part and part-to-whole ways.
3. Using a variety of reading buddy programs to assist and assess students as they work with content.Providing the option for pupils who require additional explanations to be re-taught.
4. To ensure that students fully grasp the topics, we employ visual aids such as charts, computer simulations, tape recorders, and movies.

Process

What matters most to a student is their process, or their understanding of the material and the skills covered. It is also possible to differentiate processes. A more general definition of process would be an efficient activity that encourages several students to actively participate, draw on their core competencies, and concentrate solely on learning in order to grasp a concept. Depending on the students' interests and the work at hand, teachers might differentiate instruction by assigning varying degrees of difficulty. Teachers have the option to provide varying levels of assistance to their students as they work to complete the given assignment. In addition, the instructor can provide students with a variety of options for freely expressing themselves in relation to the material they have learnt in class, such as drawing, writing, or presenting the process they have been working on. One option to differentiate the process is for the teacher to employ tiered activities. This will allow learners to work at their own pace while still working in an atmosphere where their level of comprehension and skills is equal.

He needs to make sure that pupils have access to interest centers where they can delve into subjects that truly captivate them.

A teacher's personal agenda should include both class-wide and individual assignments for students who need additional time or clarification on concepts covered. All of these agendas need to be finished by the given time.

1. Students must be provided with practical assistance anytime they require it.
2. In order to provide additional assistance to a vulnerable student, it is necessary to modify the time it takes for a student to complete an assignment. or to encourage a good student to truly grasp the material by getting a firm grasp on the lessons.
3. Students' diverse learning capacities and levels of preparedness necessitate a range of materials to cater to their needs.
4. A variety of activities need to be created to cater to visual, auditory, and kinesthetic learners.
5. Create spaces where productive activities based on inquiry can take place.
6. Flexible grouping needs to be implemented to encourage accessibility and adaptability based on interests, abilities, and course material. (Ashfaq.M., et.al.,2022)

Product

The term "product" describes the tools that students have at their disposal to demonstrate the knowledge and abilities they have gained from an advanced curriculum. In this context, the "product" could be anything from a rigorous paper-and-pencil test to a portfolio of their academic work, a strategy to solving real-world problems utilising what they learnt in class, etc. Features of a high-quality product include: It helps students to understand the material they have learnt.

1. It enhances their knowledge and abilities.
2. They are able to put their class information and talents to use.
3. Engaging in creative thinking is facilitated for students. Differentiating the product can be done by letting students design it while keeping the fundamentals of learning in mind.
4. To inspire students to demonstrate their knowledge through various forms of self-expression.
   Instruct them to finish the project using a variety of working arrangements, either independently or as a group. (Ashfaq, 2015)

The idea of differentiated instruction (DI) has been around since the 1600s, when teachers would often accommodate children with a wide range of ages, cultural backgrounds, language abilities, and learning profiles in a single classroom. Even in the days of the one-room schoolhouse, ancient Greek and Egyptian authors showed concern for the requirement of varied lesson plans to accommodate students with varying learning styles. In 1899, Preston Search made an effort to facilitate independent learning. The

educational system has evolved into grading schools over the years. At first, it was believed that students of the same age learnt similarly. However, assessment tests, which were introduced in 1912, showed that there is a significant ability gap even among students in the same grade. Because of this disparity, educators began to rethink their approaches to the classroom and use new ideas, such as differentiated instruction, to help pupils of similar ages overcome their inherent learning differences. The "People with Disabilities instruction Act" is the most current piece of legislation addressing DI in the realm of school infrastructure. The United States Congress introduced it in 1975 to guarantee that all students, regardless of disability, have equal access to high-quality public education (Miller, 2012).

For pupils with a wide range of strengths and weaknesses in the classroom, educators in the 1980s received training in ad hoc, trial-and-error pedagogy. Dr. Howard Gardner's theory of multiple insights served as the conceptual foundation, with subsequent instructional ideas building on it (Corley, 2005)

utterly flawless research papers (Gardner, 2008). Beyond engaging PC-based educational initiatives, innovation is impacting guidelines from a variety of angles today. Compared to 1999, today's PC and Internet-based instruction has far greater potential to let teachers separate guidelines.
UNESCO's worldwide training commission (2017) advocated that, "Technological know-how & generation ought to end upimportant components in any instructional corporation; they must be integrated into all educational interest intended for youngsters, young human beings & adults."

Science is a required course of study in modern schools, yet its impact on people's daily lives and on society at large is far-reaching. The essence of teaching is the instructor's unique perspective on a subject, which is based on his or her personal observations and insights. All of the rules and regulations that we are required to follow in school are based on the pedagogical principles held by our professors. The need of educators reflecting on and developing their own pedagogical stances is emphasized by Fisher (2007). Students will have an easier time grasping scientific concepts if the lessons they learn include material that is relevant to their everyday lives. The material should be committed to memory so that pupils can test their understanding and confirm their connections. (The College Entrance Examination Board [CEEB] in 1990).

What kids learn and how teachers develop their professional behaviour are both aspects of primary science education that are directly impacted by teachers' efforts. According to Smith and Fitzgerald (2013), primary school teachers should be able to identify the when, where, and how of technology knowledge curriculum needs. Teachers at elementary school students should make these decisions as generalists: which students to teach, when to teach them, and where to teach them.

Addressing the demands of the technology curriculum while also striving to achieve a balance in the demands of instruction across all areas of the curriculum (Fitzgerald, 2021). Their professional and personal knowledge of pedagogy and subject matter, as well as their own curiosity, beliefs, and views about the significance of science, as well as their ideas about how science impacts their students' lives, inform these decisions (Fitzgerald, 2013). At the most fundamental level, there are differing perspectives on scientific concepts because of the diversity of teacher expertise and the complexity of professional practice (Tytler, R., 2009)

Statement of Problem

The purpose of this thesis is to study is the effect of differentiated instruction on the achievement of class IV in science subjects.

Significance of the Study

This study helps for development of new concept teaching specially for the subject of science. It helps to stop cramming in science. It also helps for research in future and also developed interest in field of science. It also opens the new ocean in scienceand motivate the students motivated to adapt the profession as a science teacher or a scientist**.**

Objectives of the Study
Followings were the major objectives

1. To explore the effect of differentiated instruction on the academic achievementof students in science subject.
2. To explore the effect of this instruction method on the involvement of studentsin classroom activities.

Research Questions

- ✓ What are the effects of differentiated instruction on the academic achievement of students of class IV in the subject of science?

- ✓ What are the effects of differentiated instruction on the involvement in classroom activities of students of class IV in the subject of science?

Research Methodology

The research was conducted using a positivist mindset and quantitative technique. Data for this study was collected using the control group pretest-posttest experimental research methodology.

Research Design
The research design utilized in this study was a pre- and post-test control group. This design included both a control and an experimental group. The experimental group received instruction using differentiated methods, while the control group received instruction using more conventional methods. Both the experimental and control groups were tested twice following instruction; the former was given the treatment and the latter did not.

Population and Sample
The participants in this study were fourth graders. The kids of Government Girls Elementary School Farooq colony Lahore were divided into two groups for this study. One group served as a control, while the other group served as an experimental group.

Population
In this study the population was students of primary level in the government sector.

Selection of research subjects

The research was conducted in the Government Girls Elementary School in Farooq Colony, Lahore, Pakistan, during the 2017–2018 academic year. A convenience sample was used to select the primary class. The headmistress of the school denied the researcher's request to skip class. The researcher's various responsibilities may have been aggravated by this conduct. Since the researcher needed to save a lot of time getting permissions from multiple schools to fit their opportunity plans, convenient sampling was another time-sensitive justification they had to use. Class IV students from Government Girls Elementary School Farooq Colony in Lahore (n=102) were the subjects of this research. Two groups were formed from the participants. The experimental group consisted of 51 pupils, while the control group consisted of 51 students.

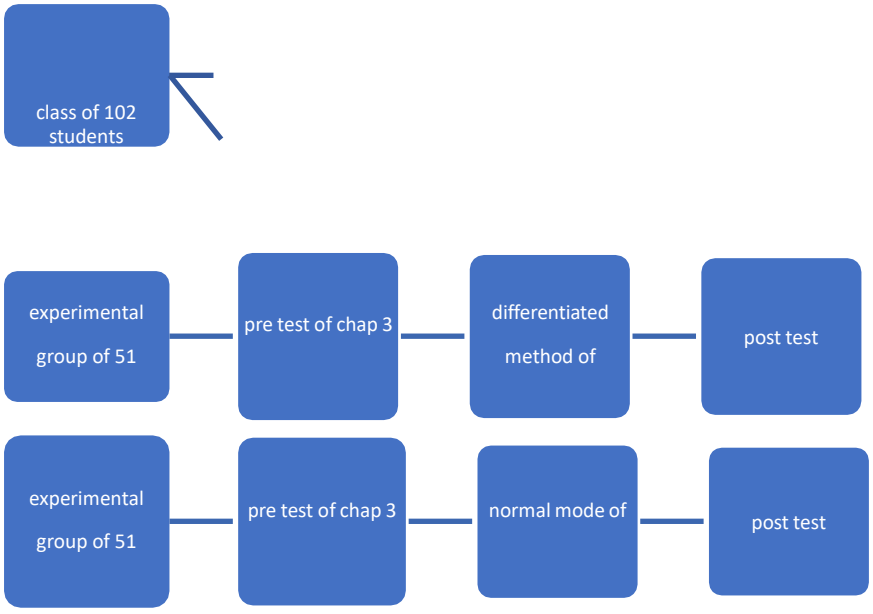

Figure.2. Procedure of the Study

Data Collection

In this study instrument was pre-test and post-test. This showed the difference between the achievement levels of students in a science subject.

Instrumentation

Prior to administering the medication, the pre-test scores were used to compare the two groups' initial potential. The impact of differentiated instruction on the experimental group was determined by the scores of the post-tests. Information gathered included scores from the following sources:

This study evaluated the gold standard for data collection tools. The purpose of using it was to determine how differentiated instruction affected students' performance. This research was structured in this way:

Pre-test

A pre-test was administered to both courses to gauge the degree to which the two pedagogical approaches differed. One class followed the conventional wisdom of the past, while the other made use of differentiated education. Prior to therapy, both classes were given the pre-test.

Post-test

Researchers administered a post-test to both the experimental group and the control group after they had been taught using either the standard approach or the differentiated teaching strategy. Students' scores in the two groups demonstrated significant differences in their academic performance.

Procedure

For this experimental investigation, a class of 102 pupils was chosen. A test was used to divide the pupils into two equal groups. The two groups were to be categorized as an experimental group and a control group, respectively. Each group has to take a pretest. After that, for four weeks, the experimental group received differentiated training while the control group received the standard approach. The experimental group's students' individual learning styles informed the development of their individualized lesson plans, homework, and assignments. Eight instructors (two per week) monitored the classrooms of

the two groups and recorded their observations using a checklist given by the experimenter. Both groups were given a post-test after four weeks of continuous instruction. A notable disparity in performance between the two groups was shown by the post-test results. The experimental group outperformed the control group by a significant margin. All three subgroups of experimental group students improved significantly.

Data Analysis

This study used quantitative methods. A statistically significant difference in performance between the control and experimental groups was analyzed using quantitative research methodologies. Researchers plotted the academic outcomes of the study's control and experimental groups on a graph. Next, she examined the kids' results to see if there was a statistically significant change in their academic performance. To compare the pre- and post-test scores of the fourth-grade science students, a t-test was employed. Researchers utilized a students' involvement checklist to assess the level of student engagement with scientific topics.

Independent Sample T-Test for the Comparison of Post-Test Scores between Control Group and Experimental Group

To determine the effect of the differentiated instruction on the students' achievement toward science and the students' involvement levels towards science were examined and then the significance of the differences between the achievement levels were tested.To determine the students 'achievement, the mean and Standard deviation values of thepre and post tests were calculated. In order to check whether the differences between the pre and post tests were significant or not, t test was employed, and the obtained findings were presented in following tables.

Table 1 Descriptive statistics of Pre-test score in Control group and Experimental group

	GROUP	N	Mean	Std. Deviation
Pretest	control group	51	14.9608	6.57559
	experimental group	51	16.2745	7.15843

Table 2 Independent sample T-test for the comparison of pre-test in control group and experimentalgroup

		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Pretest	Equal variances assumed	.230	.633	-.965	100	.337	-1.31373
	Equal variances not assumed			-.965	99.287	.337	-1.31373

Since mean score of pre-test in control group (M=14.9) and experimental group(M=16.2) have no more difference it means students have almost same caliber in both groups. There was no significant difference in the scores of pre-test of control group and experimental group as the p value is 0.337 which is greater than 0.05. This result shows that there is not any significant difference in scores of control group and experimental group.

Group Statistics

Table 3 Descriptive statistics of post-test in Experimental group and Control group

	GROUP	N	Mean	Std. Deviation
Posttest	Control group	51	15.3333	6.67732
	Experimental	51	36.1569	8.57991

Independent Samples Test

Table 4 Independent sample T-test for the comparison of Post-test score in Control group andExperimental group

		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	Sig.	t	Df	Sig.(2-tailed)	Mean Difference
Posttest	Equal variances assumed	3.534	.063	-13.678	100	.000	-20.82353
	Equal variances not assumed			-13.678	94.312	.000	-20.82353

The mean score of post-test in control group is 15.33 and in experimental group are 36.15 and p value i.e. level of significance is 0.000 which is less than 0.05. It shows that there is a significant difference between the scores of post-test in control group and experimental group hence the null hypothesis i.e. differentiated instruction havean not effect on academic achievement in science, is rejected.

Table 5 Descriptive statistics of pre-test and post-test scores of control group

Group Statistics

		Mean	N	Std. Deviation
Pair 1	**Pretest**	14.9608	51	6.57559

	Posttest	15.3333	51	6.67732

Table 6 Paired Samples Correlations of control group

		N	Correlation	Sig.
Pair 1	**Pretest & Posttest**	51	.966	.000

Table 7 Paired sample t-test for the comparison of pre-test and post-test scores of control group

Paired Samples Test of control group

		Mean	Std. Deviation	Std. Error Mean	T	df	Sig. (2-tailed)
Pair1	**Pretest - Posttest**	-.37255	1.73160	.24247	-1.536	50	.131

A paired-samples t-test was conducted to compare pre-test score and post-test score of control group. There was no significant difference in the scores of pre-test (M=14.96SD=6.57) and post-test (M=15.33, SD=6.67) because p value is 0.131which is not less than 0.05 therefore there is not any significant difference between the results of pre-test and post-test of control group.

Table 8 Descriptive statistics of pre-test and post-test scores of control group

		Mean	N	Std. Deviation
Pair 1	Pretest	16.2745	51	7.15843
	Posttest	36.1569	51	8.57991

Table 9.Paired Samples Correlations of experimental group

		N	Correlation	Sig.
Pair 1	**Pretest & Posttest**	51	.628	.000

Table 10. Paired sample t test of pre-test and post-test of Experimental group

Paired Differences						
	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)

Pair1	**Pretest - Posttest**	-19.88235	6.90405	.96676	-20.566	50	.000

A paired-samples t-test was conducted to compare pre-test score and post-test score inex SD=7.15) and post-test (M=36.15, SD=8.57) because p value is 0.000 which is lessthan 0.05 therefore there is significant difference between the results of pre-test and post-test of control group. These results show that differentiated instruction really doeshave an effect on the academic achievement of students in the subject of science.

Findings

1. The results demonstrate that there is no longer a difference between the control group and the experimental group in terms of mean pre-test scores (M=14.9) and M=16.2. So, the two groups of pupils are nearly identical in terms of quality. With a p-value of 0.337, which is higher than 0.05, there was no statistically significant difference between the experimental and control groups on the pre-test. The results demonstrate that the experimental group and control group did not differ significantly in their scores.
2. A p value (i.e., degree of significance) of 0.000, which is less than 0.05, indicates that the experimental group had a significantly higher mean post-test score (36.15 vs. 15.33 in the control group). The results demonstrate a notable disparity in post-test scores between the control and experimental groups, leading to the rejection of the null hypothesis, which states that science academic progress is unaffected by differentiated instruction.
3. To compare the control group's pre- and post-test scores, a paired-samples t-test was used. Preliminary test results were not significantly different. There is no significant difference between the pre-test and post-test results of the control group (M=14.96SD=6.57) and post-test findings (M=15.33SD=6.67) since the p value is 0.131, which is not less than 0.05.
4. The pre- and post-test scores of the control group were compared using a paired-samples t-test. The results showed a significant difference between the two sets of data (ex, SD=7.15) and (post, M=36.15, SD=8.57), respectively, with a p-value of 0.000, which is less than 0.05. The findings demonstrate that students' academic performance in science is positively impacted by individualized instruction.
5. The results demonstrate that both the control and experimental groups are observed by the professors. Following the observation, instructors provide feedback regarding the level of student engagement and enthusiasm for classroom activities. The researcher assigned a score of "2" to "Always," a score of "1" to "Seldom," and a score of "0" to "Never" to analyze the responses given by the teachers. After adding these statistics, the control group's average teacher response score is 5.75 while the experimental group's average score is 16. According to the teacher's observations, class IV science classroom activities benefit greatly from diversified instruction, as students' engagement and interest levels.

Conclusion

1. According to the findings, Differentiated Instructions improves pupils' performance in science at the elementary school level. Though this approach to education isn't without its flaws, it has the potential to yield excellent results when implemented properly.
2. Formal approaches. Finally, the data that support the guidelines highlight the benefits of Differentiated Instructions.

Recommendations

Following these Recommendations might help move the research forward, according to the researcher.

1. The researcher suggests that pupils will be more motivated and able to answer more impressively if they are allowed to step up to the plate as much as other groups. Students' learning competencies should be examined in more challenging groups under similar settings if they are showing progress in one group. The class will get an opportunity to take on some challenging tasks.
2. The researcher suggests that more teachers who are familiar with the needs of differentiated instruction should be provided to support the classroom teacher.
3. The researcher suggests making sure that both visual and kinesthetic learners have access to the resources they need to succeed in school. Making use of a combination of intelligences, such as interpersonal, intrapersonal, and so on. According to her, pupils will do more reading.
4. To add important diversity to the research, it is recommended to expand the studies to include students from both public and private schools.

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