

# The effectiveness of using context-based and project-based methods in inclusive biology teaching

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**Abstract.** This study investigates the effectiveness of employing context-based and project-based methods in inclusive biology education, focusing on the outcomes of contextual learning tasks for eighth-grade students at M. Gandhi Specialized Lyceum No. 92. The research evaluates the performance of inclusive children on tasks related to the topic "Structure and hygiene of the organ of vision" taken from the biology textbook. Results indicate that the traditional textbook approach yielded low levels of task completion among inclusive children, suggesting that the content complexity posed challenges. Conversely, when presented with simplified, easily understandable texts, inclusive children demonstrated significantly higher proficiency levels in addressing the same topic. Additionally, the study extends its analysis to include the results of contextual teaching tasks for inclusive children from the eighth-grade class at School No. 15, where 20 students participated, including individuals with ADHD, mild autism, and isolation. Among these students, varying levels of performance were observed across tasks. Specifically, in the first task aligned with the textbook, five students scored low, eleven scored average, and four scored high. However, when presented with the second task featuring simplified text, performance improved, with one student scoring low, twelve scoring average, and seven scoring high. These findings underscore the potential benefits of utilizing context-based and project-based methodologies in inclusive biology education, particularly in enhancing comprehension and engagement among students with diverse learning needs..

## 1 Introduction

As part of its "Future without Barriers" initiative, the Republic of Kazakhstan joined the UN Convention on the Rights of Disabled People in January 2015 and has worked to make most of its schools inclusive [1]. As a signatory to several international documents, including the

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United Nations Convention on the Rights of Persons with Disabilities (2006), the Bologna Process [2], and the Salamanca Statement (UNESCO, 1994), Kazakhstan committed to moving towards the global trend of inclusivity and facilitating democratic education system. These pledges demonstrated to the international community Kazakhstan's goal of bringing inclusive education into line with those of developed, democratic nations. After signing international agreements, the next step is to integrate global knowledge into Kazakhstan's inclusive educational system. The State Program of Education Development for 2011-2020 was created by the Kazakhstani government in response to its announcement that inclusive education would be implemented more widely [3].

For 21st-century individuals, critical thinking is an essential ability since it enables them to solve societal problems that impact both local and global populations. Students in elementary school find it difficult to understand and get involved in these concerns. It appears that many kids lack the ability to come to their own conclusions about these matters or develop the habit of organizing and articulating their own opinions through discussion and introspection [4]. Although inclusive education faces many challenges, it can be gradually attained, particularly when we consider that some "measures of support" in this process are insufficient to meet the social and intellectual needs of these individuals. Selecting between an inclusive school and a special school can be difficult for certain disabled students, particularly when considering the nature of their condition. Although inclusive education is the perfect educational model, social and economic issues make it difficult in many places [5].

However, Contextual learning also fosters collaboration among students, encourages them to voice their perspectives confidently, and prepares them to defend the discussion's conclusions in front of their peers. Students can engage and collaborate to accomplish learning exercises, comprehend the studied content, and get ready to present responses during group discussions [6].

Research on the application of context-based learning is required to improve biology students' critical thinking abilities in learning biology, given the significance of critical thinking abilities and the requirement for active learning by connecting the course materials to real-world situations [7, 8]. In order to create inclusive classrooms, pedagogical training approaches involve interventions that explore learning barriers such as unconscious bias, microaggressions, stereotype threat, and fixed mentality as well as enhance awareness of the social identities of both students and instructors. The purpose of this article was to study the effectiveness of project-based and context-based methods of teaching biology within the framework of inclusive education [9].

## **2 Materials and Methods**

Given the aforementioned information, it is crucial to develop biology students' critical thinking abilities through a variety of creative learning experiences. Students that engage in innovative learning are more likely to collaborate and learn on their own. The educational paradigm may change from one of teaching to learning and from teacher-centered to student-centered because of innovative learning.

This research used a project-based approach method with pretest-posttest non-equivalent groups design consisting of two classes, Eighth graders from school No. 92 and secondary school No. 15 aiming at comparing the critical thinking skills of biology. Each class was given a pretest and a posttest using the same test items related to students' critical thinking skills in the framework of the "Coordination and Regulation" subject. The treatment class was taught by using the context-based learning, while the control class was taught by using inclusive biology education. Test questions served as the instrument for gathering data. The

e-say questions on critical thinking skills indicators were part of the test. The authors indicators were used to gauge the pupils' critical thinking abilities.

### 3 Results and discussion

However, the context-based learning phases make it possible to enhance critical thinking abilities. The context-based learning phases, which include the invitation and exploration stages, encourage students to voice their first thoughts in a group setting so they can practice presenting arguments based on the materials they have studied. Additionally, students must work in groups to undertake an inquiry for the explanation and solution stage. In order to address the provided problem, students are urged to cooperate while performing an inquiry in these steps.

Eighth grade students from Schools 15 and 92 participated in a study to determine the success of a context-based approach to learning. Twenty students from an inclusive class of school No. 15 took part in it, three of whom suffered from withdrawal syndrome, a mild form of autism, and attention deficit hyperactivity disorder. In addition, 18 students from 92 schools who did not need special educational assistance took part in the study. In order to participate in the experiment, students were given two assignments covering distinct subjects and levels of difficulty that had to do with the "Structure and hygiene of the organ of vision" and "Structure and hygiene of the organ of hearing." Context-oriented learning technology was used to create contextual assignments for these subjects.

The study's findings demonstrated the efficacy of the context-based method as a biological education strategy in inclusive classroom environments.

The details on the subject of "Structure and hygiene of the organ of vision" are laid forth in the biology textbook for eighth graders as follows: "Sight, hearing, taste, smell, touch, and other sense organs are how humans sense their surroundings. Sight is the most important sense among them, giving us the most knowledge about our environment. The sense of hearing is not far behind, and it plays a major role in how well we perceive our surroundings. Important roles are also played by other sense organs. Photoreceptor cells, which collect light reflected from objects, make up the anatomy of the eye. The lacrimal gland, eye muscles, eyelid, eyebrow, eyelash, and the eyeball—which consists of three membranes and an optical system for focussing and transferring light—are further parts of the eye."

**Table 1.** Results of contextual learning tasks for inclusive children of specialized Lyceum No. 92

No	Class	Number of pupils	Low (1-3 point)	Average (4-6 point)	High (7-8 point)
1-task	8A	18	4	13	1
2-task			0	10	8

The following is an outline of the topic "Structure and hygiene of the organ of hearing": "The human ear is an essential organ for taking in and processing different sounds from its surroundings. It helps with sound discrimination and makes spoken word communication easier. The organ of hearing also contributes to balance maintenance.

The outer, middle, and inner ear are the three primary components of the ear's structure.

1.The external auditory canal and the eardrum make up the outer ear. Sound waves from the surrounding environment are guided into the ear canal by the eardrum. There is a thin, dense, and taut membrane at the termination of the external auditory canal. After passing through the eardrum and the external auditory canal, sound waves enter the middle ear. The middle ear and outer ear are divided by the tympanic membrane.

2.The middle ear is located inside the temporal bone and starts beyond the eardrum. The middle ear cavity, which is air-filled, is connected to the pharynx through a tube. 1. This tube

opens into the pharynx during movements like yawning and swallowing, and then it briefly closes. Three tiny bones called ossicles—the stirrup, anvil, and hammer—are joined by joints inside the middle ear cavity."

The outcomes of contextual learning assignments for inclusive kids from M. Gandhi Specialized Lyceum No. 92's eighth-grade students are displayed in table 1. As the table illustrates, the task indicator for the first task, which was drawn from the biology textbook's "Structure and hygiene of the organ of vision" topic, had a low level. The fact that the inclusive child was able to complete the exercise on the topic of "Structure and hygiene of the organ of vision" with ease and produce high-level results suggests that the content in the book is complicated for them.

**Table 2.** The results of completing contextual learning tasks for inclusive children of school No. 15

No	Class	Number of pupils	Low (1-3 point)	Average (4-6 point)	High (7-8 point)
1-task	8G	20	5	11	4
2-task			1	12	7

Additionally, the outcomes of the contextual teaching assignments for inclusive kids from school No. 15's eighth-graders are displayed in the second table. Twenty students from fifteen schools participated in the inclusive class; three of them had minor autism, ADHD, and isolation. In the first task offered by the textbook, 5 out of 20 students received a poor score, 11 students received an average score, and 4 students received a high score. In the second test, which was based on a text that was simplified from a complicated one, 1 student received an average score, 12 students received a good score, and 7 students received a high score.

## 4 Conclusion

Context-oriented learning is, all things considered, a reasonably successful strategy for teaching biology in inclusive classrooms. Students can actively engage with the subject they are studying by using this strategy to strengthen their critical thinking abilities. In this context, we reiterate the significance of the aforementioned pedagogical approaches and the need for their widespread application in biologically inclusive education.

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