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The Role of Differential Teaching Methods in the Development of Chemical Modification Skills

Bo‘riboyev Aziz Abdumannonovich

(orcid.org/0000-0003-2394-2845)
Jizzakh Polytechnic Institute, Jizzakh city, I.Karimov Street 4-house, Uzbekistan
boriboyev2020@gmail.com
Associate Jizzakh Polytechnic Institute

Abstract

Currently, teachers of higher educational institutions use various teaching methods and techniques to solve the problem of meeting the educational needs of their students. In organic chemistry, it is important to develop students’ skills in the chemical modification of substances. Due to the different learning levels of students, some problems arise in their learning. As a solution to this problem, training using differentiated approach methods was taken as a basis. Differentiated education ensured that all studnts, regardless of their learning style, ability and background, had the opportunity to master the skills included in the curriculum and contributed to positive change in outcomes.

Keywords: Education, method, methodology, differentiated education, advanced training, curriculum, adaptation, pedagogical process, polymer, chemical modification, skill, development.

INTRODUCTION

In the context of globalization, reforming the education and science systems is a factor determining the solution to many problems, and it is thanks to this that educational models characterized by high quality education are increasing. The issue of education is one of the important issues in many countries of the world. Most countries are implementing fundamental reforms aimed at creating a flexible education system that meets the new demands of global competition. Their main goal is to expand the adaptability of higher educational institutions and educational programs, which are implemented by reforming academic and organizational structures, updating infrastructure, teaching methods and technologies, improving the pedagogical process, and improving the composition and quality of teachers [Rozieva D., Usmonboeva M., Halikhova Z.,2013: 18-20]. Currently, higher education teachers face the challenge of meeting the various educational needs of their students. Students have different levels of learning and different abilities. To effectively address this diversity, it is advisable to use differentiated methods of teaching students[Clarin M.V.,1994:108]. Differentiated instruction is an approach that adapts instructional strategies and content to meet the needs of individual students, ensuring that all students are successful at their level [Polonsky V.M.., 2000:50]. Differentiated education is based on the principle that students learn science in different ways and at different paces[Kolishev N.S., 1993:16]. Rather than taking a one-size-fits-all approach to all students, they tailor learning to accommodate these differences, aiming to engage and challenge each student based on their individual learning capabilities[Kovyazina E.P.., 1989: 24].

From the perspective of educational differentiation, rather than quality professional development, effective differentiation requires teachers to be well trained and competent in adapting teaching methods. Quality training is needed to equip teachers with the necessary knowledge and tools. Workshops, courses, and ongoing training in technology differentiation and integration strategies are necessary for teachers to develop their personal learning abilities and develop them step by step [Slastenin V.A., 2000: 303].

In this article we will consider the development of chemical modification skills among students of chemical engineering education based on a differentiated approach using the example of the chemical properties of organic substances.

METHODS

For future chemist-technologists-engineers, chemical modification, that is, depending on the chemical composition of the raw material in the initial state, the nature of the processes occurring during modification may be different, and a positive effect from changing the operational or technological properties of materials can have various chemical, physical or physical and chemical effects. It is important to have skills that can be achieved with the help of secrets. Chemical modification is a cellular modification of the chemical composition of macromolecules with cellular synthesis of new high molecular weight compounds [Gorbunov G.I. Nauchnye., 2016: 51].

Higher education students will gain the following information through chemical modification.

These are: The main types of chemical modification when modifying polymers[Shishonok, M.V., 2012: 232]:

• reactive chain reaction (polymeric-analog change);
• reactions of the latter groups;
• macromolecular reactions;

Chemical modification of polymers is carried out both during their synthesis and by changing the chemical composition of finished high-molecular compounds, chemical modification of organic high-molecular compounds using reactions of polymer analogues, as well as specific reactions of macromolecules: decomposition. and cross-linking, heteropolymerization, processes of macromolecular reactions [Shishonok, M.V.,2017:18].

Types of modification[Shishonok, M.V.,2018:22]:

• changing the chemical composition of the polymer and its molecular weight without changing the structural and physicochemical properties;
• composition – inclusion of substances capable of interacting with the polymer, including high molecular weight ones: plasticization, stabilization, filling;
• chemical – the effect of the polymer on chemical or physical factors;

Why is chemical modification necessary [Shishonok, M.V.,2016:16];

• change the properties of polymers in order to give them valuable technical qualities (elasticity, strength, resistance to cold and heat, flammability);
• give products new properties of raw materials and improve processing conditions.

Advantages of chemical modification [Plate, N. A.,2008:33];

• a unique combination of properties not characteristic of other materials (strength, deformation, impact resistance, elasticity, temperature, rheological, adhesive, electrical conductivity, thermal conductivity, etc.);
• the ability to control the properties of polymer composite materials by simply changing the composition and production conditions;

maintaining the main advantages of polymers: relative ease of processing, low density.

The ability to control the structure of individual macromolecules and morphoses, that is, to master modification methods, is a necessary knowledge for modern highly qualified chemical engineers. Modification makes it possible to obtain high-molecular compounds with a given set of properties necessary for the creation of new materials.

We consider the formation of chemical modification skills among students of the Faculty of Chemistry (building materials) on the basis of a differentiated approach. Differentiation can be carried out at different levels. We will need to choose one of the levels of differentiation. In our definition we will use Ronald De Groot's three levels of differentiation. This:

1st micro level - we call it group, and a different approach is taken to individual groups of students within the group. This level of differentiation is sometimes called intr or intragroup differentiation.

2nd meso - we call it the level of the educational institution, at which differentiation is made between individual groups, profiles, directions within one educational institution.

3rd macro level – differentiation of educational institutions, creation of different types of schools. Levels 2 and 3 – external differentiation [R. de Groot,1995:56].

At this point, the levels of differentiation are defined by Yu.M. Dick and V.A. Orlov divided only into intragroup - level and external - profile differentiation [Dick Yu.I., Orlov V.A.,1998:101]. Using these distinctions, we have attempted to incorporate a meso-level differentiation approach into the educational practice of teaching chemical modification. Starting from the new academic year, students of the chemical-technological (structural materials) Faculty of Organic Chemistry were divided into traditional interactive and differential experimental groups. In the experimental group, intragroup differentiation was carried out.

Distinctive features of intragroup differentiation are its flexibility, softness and amorphousness of homogeneous groups created in a heterogeneous group [Prokopishina N.A.,2005:32].

In practice, differentiation within a group is represented by tasks of different difficulty levels, increased teacher support for students, and differentiation of levels. With differentiation within a group, the following elements of the learning process, the content of educational material and, to some extent, the results change. The goals, methods and forms of the educational process do not differ [Kovaleva T.M.,1198:123]. In foreign experiments, correctional classes are organized in educational institutions to teach “at-risk” children who have difficulties mastering the basic content of education. Students' difficulties may be due to low learning ability. Low learning ability is explained by various objective and subjective reasons [Osmolovskaya I. M. 2002:32].

Taking into account the above information, the experimental group was differentiated within the group. After three lectures on organic chemistry, control was carried out in all groups of the educational direction and the results were analyzed. Among the groups, the group that showed a low learning result was selected as an experimental one. The group was divided into subgroups with low, good and excellent digestibility.

Effective group differentiation strategies were used:

Phased missions; There are different levels of assignments to suit different skill levels. This allows students to progress at their own pace.

Flexible grouping; Students in subgroups are transferred to other groups based on their needs after achieving certain results.

Taking into account the above information, the experimental group was differentiated within the group. After three lectures on organic chemistry, control was carried out in all groups of the educational direction and the results were analyzed. Among the groups, the group that showed low academic results was selected as an experimental one. The group was divided into subgroups with low, good and excellent digestibility.

Regular assessment: Students are assessed on an ongoing basis to assess their progress and adjust their learning as necessary. This differentiation ensures that they meet changing needs [Shneiderman M.V.,2000:25].

Several main components of differentiated teaching methods were taken into account:

1. Assessment: The first step in differentiation is to assess students' readiness, interests, and orientation to learning. This helps teachers understand what each student's learning goals are and how they can best learn the material.

2. Content: Differentiated learning includes adapting content to the level of students. Some students may need more basic material, while others may want to go deeper into the topic.

3. Process: Teachers adapt the methods and techniques used for teaching. Some students may benefit from group work, while others may thrive on independent work, projects, or hands-on experiences.

4. Result: Differentiated instruction allows for the use of various forms of assessment and demonstration of learning. It was believed that students could choose how to express their understanding, which encouraged creativity and individual expression [Stepanova M.V.,200:18].

Although differentiated instruction methods offer many benefits, they are not without challenges. Below are some problems and solutions that a teacher may encounter:

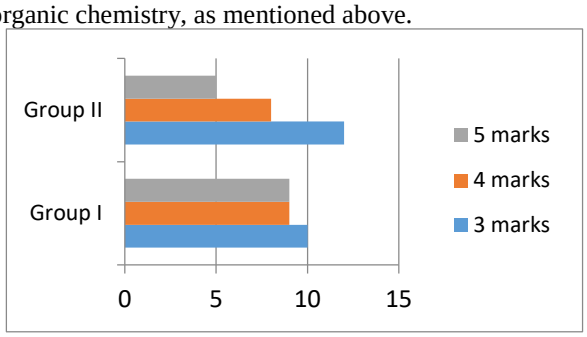
Table 1.1

Problems in the teacher's teaching process and their solutions

The teacher may have difficulties	Measures to alleviate difficulties that a teacher may encounter
It takes a lot of time	Takes a lot of time. Planning and implementing differentiated instruction can be time consuming. Teachers used computer and mobile applications to assess students and create individualized materials.
Managing group dynamics	Managing a group with different students can be difficult. Supervision is structured so that teachers can maintain a balance between meeting individual needs and maintaining a holistic learning environment.
Assessment tools	Traditional assessment tools cannot effectively measure learning outcomes in differentiated instruction. Therefore, teacher assessment was carried out using a multiple choice test, and alternative options for oral and written control were developed and put into practice.

RESULTS

As an experiment, two groups of chemical-technological education were selected, to identify which a general control was carried out after three lectures of organic chemistry, as mentioned above.



Picture-1. Preliminary results of groups I and II

The first group was chosen as an experiment, as a result of which satisfactory grades were obtained; interactive methods were used to teach all groups. The sample experiment was carried out using a group differential approach. Two groups of organic chemistry students were then assessed using the same test items (multiple choice test).

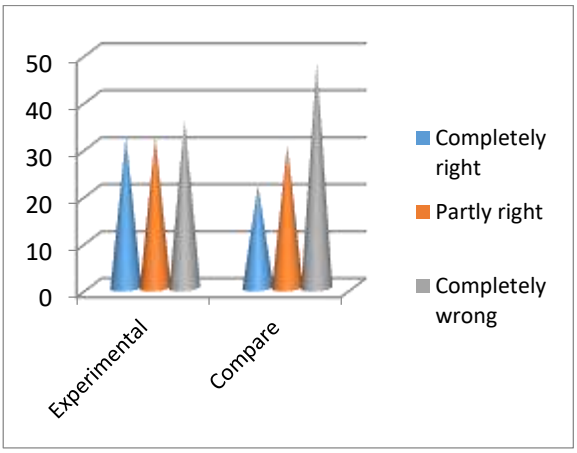
The change in the level of students' knowledge in the first module of the organic chemistry course was determined.

Table 1.2.

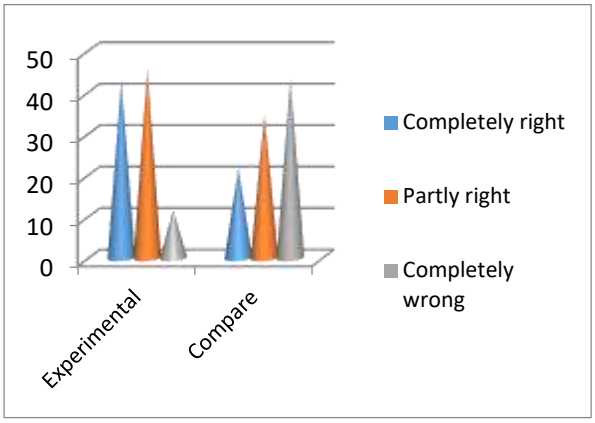
Changes in students' knowledge of organic chemistry

Groups	Number of students	Answers					
		Initial			The last one		
		Completely right	Partly right	Completely wrong	Completely right	Partly right	Completely wrong
Experimental	28	9/32,2%	9/32,2%	10/35,6%	12/42,8%	13/45,7%	3/11,5%
Compare	25	5/21,8%	8/30,4%	12/47,8%	5/21,8%	9/34,8%	11/43,4%

Comparison diagrams of the initial (picture-2) and final (picture-3) results of the Experimental and Compare groups (%)



Picture-2. Initial results % indicators

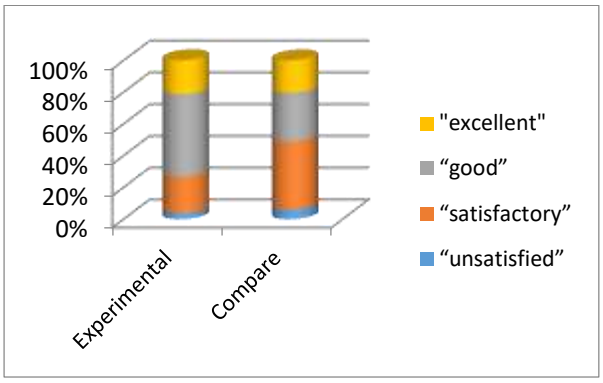


Picture-3. Last results % pointers

Table 1.3

Academic in Organic Chemistry Chemical Modification Module
final results of group summation (stream).

Groups	Number of students	Grades			
		"excellent"	"good"	"satisfactory"	"unsatisfied"
Experimental	52	11/21,2%	27/51,9%	12/23,1%	2/3,8%
Comparison	49	10/20,4%	15/30,6%	21/42,8%	3/6,2%



Picture-4. Final results chart

The obtained results were processed using the statistical criterion χ^2 (chi-square). To demonstrate the effectiveness of the proposed method, the χ^2 (chi-square) criterion was used. The value of the statistical criterion specified in it calculated using the formula.

$$T = \frac{1}{n_1 n_2} \sum_{i=1}^{c} \frac{(n1Q2i - n2Q1i)^2}{Q1i + Q2i}$$

Picture-5. Statistical criterion formula

Here is the C-category (category), that is, the number of ratings. In our study, C = 3, since we assessed student responses in 3 categories, i.e. CCA (correct, complete answer), CIA (correct, incomplete answer), IA (incorrect answer). i=1,2,3 – category number, α=0.05 – predetermined significance level; Q_1i is the number of objects in the first sample corresponding to the third category based on learning (we have the number of students who responded to the CCA in the experimental groups), Q_2i is the number of objects in the second sample corresponding to the third category in accordance with the learning characteristic (we have the number of CCA respondents in comparison groups [Tashpolatov B.T., Normatov A.A., Mavlonov O.M.,2000:75-78].

DISCUSSION

In the experimental groups, the number of correct complete answers increased by 11%, correct incomplete answers increased by almost 3%, and incorrect answers decreased by 12%. In the comparison groups, such positive results did not go beyond the experimental error.

The final results of the module (Table 1.3) show that the number of "satisfactory" and "unsatisfactory" ratings in the experimental groups decreased by almost 2 times compared to the comparison groups.

Differentiated teaching methods provided the following advantages:

Inclusion: Differentiated education ensures that all students, regardless of learning style, ability or background, have access to the curriculum.

High Engagement: Students learn in ways that suit their learning preferences, making them more engaged and motivated. This led to increased academic performance and a love of learning.

Personalized learning: A differentiated approach allowed students to master their own learning. They worked at their own pace, set learning goals and developed skills.

Flexibility: Teachers have the flexibility to meet the changing needs of their students. This flexibility came in handy in case of unexpected problems.

Conclusion

In conclusion, it can be noted that in our country and foreign pedagogy, many studies have been carried out to solve the problem of a differentiated approach to education. Differentiated instruction is an important approach to meeting the diverse educational needs of today's students. A differentiated approach allows you to identify and develop students' abilities and interest in chemistry among the natural sciences. Students will have the opportunity to select assignments based on opportunities to develop their abilities. The differential approach greatly facilitates the pedagogical process of acquiring skills such as chemical modification, which is relatively difficult. In a large audience, it is not always possible to determine the content and forms of interaction with each student. Using a differentiated approach makes it possible to create an educational system that meets the needs of each student, taking into account the individual characteristics of each student. Formation of skills in chemical modification methods among students of chemical engineering education, that is, the ability of students to control the structure of individual high-molecular compounds, that is, master modification methods, is necessary for modern highly qualified chemical engineers.

Therefore, teaching students knowledge, skills and abilities based on a differentiated approach gives them the opportunity to imagine and analyze complex processes that are difficult for them to understand. Of course, this requires solving a number of problems, such as determining the pedagogical conditions of the process, developing mechanisms for the development of student professional training based on a differentiated approach. Therefore, as students' educational opportunities expand, the number of creative tasks should also increase. To

summarize the above, we can conclude that, given the diversity of student ability levels, it is important to properly develop their development.

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