

**CHEMISTRY DIRECTION STUDENTS FOR SUPREME MATHEMATICS TO THE FIELD
DIRECTED ADAPTIVE AND INTEGRATIVE APPROACH BASED ON TEACHING
METHODOLOGY**

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Abstract

In the article chemistry student in the specialty students for mathematics science adaptive (to the field) redirect in the sense of and integrative approach based on of teaching effective methodology scientific based without brought. Taken visited in research mathematics science student's professional to the network suitable in case teaching and current the most from modern pedagogical technologies used without chemistry in science issues with integration to do in mind caught. Developed countries and national education in the system personnel in preparation the most current from problems one as interdisciplinary dependency and professional competencies formation learned is coming. Exactly this because of the article uses an adaptive approach to the field orientation in terms of looking at chemistry in science to topics suitable coming mathematical modular function This is a methodical adaptive and integrative approach in the system based on cited theoretical information, practical training for tasks, integrated examples and independent work and control works for questions package given. Scientific search results mastery level noticeable increase, topics specialized practical issues with tie students to class relatively interest increase with one in line their scientific - creative development of thinking showing gave.

Keywords: Adaptive approach, integrative approach, superior mathematics, chemistry education, interdisciplinary integration, methodological system.

Introduction

Last in years world education in the system interdisciplinary integration and in education professional competence increase concepts place further increasing is going on World with the help of STEM (Science, technology, engineering, mathematics). from integrated science programs used, they using students to class interest increasing and theoretical knowledge with one in line taken knowledge in practice application skills are also being developed [1]. approach natural sciences in the directions especially effective is, it is the students' complicated issues solution to solve the problem mathematician modeling and analysis to do DEVELOPS SKILLS. Chemistry science in mastering mathematics place very big importance profession will be. The present the most last chemical research and working in the output various processes kind of mathematician models, statistical analyses and modern calculation to the methods is based on. Example as a rule thermodynamic processes modeling, reaction speed determination and substances concentration determination like practical issues students mathematician knowledge enough to be and them hand to take skill to be requirement [2]. This because of mathematics science chemistry adaptive and integrative approach to the direction based on teaching not only the lesson good quality organization to, maybe future of personnel professional competence

increase It is also important for. Last in years Uzbekistan In the Republic education process fundamentally reform to do, interdisciplinary connection strengthen and adaptive modules create and current to reach circle one how much measures done is being increased. High training in their homeland mathematics science as the most "unnecessary" theoretical science from teaching away from it specialty sciences with tied to teach The demand is increasing is going on. But unfortunately this regarding currently Uzbekistan education in the system usable textbook and training in the manuals mathematics-chemistry to integration circle enough systematic approaches there is it's not. Adaptive approach student training individual mastery in the process level, needs or training to the field customized teaching methodology as This is described. In case of topics selection, use of issues content and complexity level students face arrival possible was clear professional to problems customized [3]. Integrative The approach is the same. How many various become same in research it is different kind of sciences content to unite in terms of looking at the student scientific world view and complicated thinking ability to develop basis [4]. Scientific search both adaptive and integrative approaches within combined without, mathematics and chemistry sciences between dependency training process the most main main principle as is considered. World on a scale take visited experiments this shows that Germany, USA, England, Japan and South Korea like developed countries supreme training in their homeland mathematics adaptive approach to science based on that is to the field directed in a way teaching wide [5] For example, chemistry specialization to their students mathematics in their classes mainly laboratory results based on structured issues given, statistical analysis methods is taught and independent education tasks for chemical processes mathematician modeling is given. And of course this taken theoretical of knowledge practice with dependence in providing help gives. This of the research theoretical importance from that consists of mathematics science education directions to the field directed adaptive and integrative approach based on to teach circle scientific and methodological the basics working exit and this of the process didactic model in creation sample is having a baby . Practical the importance is also broad extensive was created methodology to natural science fields adaptation and him/her supreme training in their homeland application opportunity in giving is considered. Therefore, the research main purpose — chemistry studying in the field of students for supreme mathematics to the field directed adaptive and integrative approach based on teaching methodology working exit, experiment works through his/her efficiency proof and education to the process current from reaching This is approach through students not only theoretical knowledge, but also in real life chemical problems solution to grow The ability is also noticeable at the level increase is expected.

Method and materials.

1. Research approach and theoretical basis

This of the research methodological basis two didactic approach — adaptive and integrative approaches harmony organization will reach.

- Adaptive approach this on the ground student's training process professional in the direction of adaptation, that is topics chemistry real situations in science and practical problems based on choice and to teach means.
- Integrative approach and mathematics and chemistry sciences content mutual connected, complex knowledge and skills to form focused.

Theoretical basis as:

1. STEM education concept — interdisciplinary integration through problematic tasks solution ability development [1];
2. Competency approach — learning process the result student's practical in their competencies expression [6];
3. Constructivism — the student active participant as training to the process attraction [7].

2. Training modules create algorithm

High mathematics chemistry in the direction of adaptation for 6 -stage module create algorithm working was released (Figure 1).

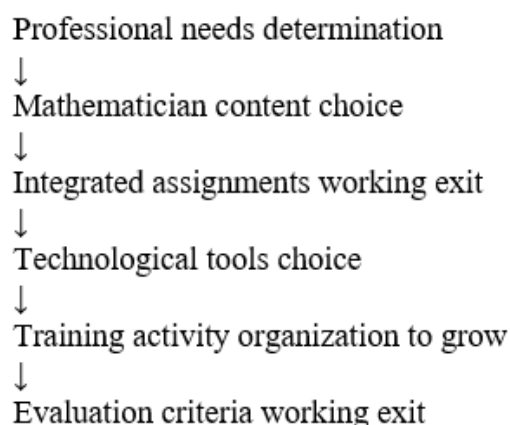


Figure 1. High mathematics chemistry in the direction of adaptation algorithm

Stages description:

1. Professional needs determination – chemistry science main departments and in them applicable mathematician methods detection (e.g., reaction) kinetics, stoichiometry, thermodynamics).
2. Mathematician content select – relevant mathematician concepts selection (differential equations, integral calculus, logarithmic equations, statistics analysis).
3. Integrated assignments working output – chemical processes mathematician modeling based on issues to compile.
4. Technological tools choose – calculate programs (Matlab, Maple, Excel), simulation programs (ChemDraw, Avogadro) and virtual laboratories.
5. Training activity organization laboratory training, group project works, practical seminars.
6. Evaluation criteria working output – theoretical knowledge, practical application, creativity level and problem solution ability assessment.

3. Experience design

Experiment-test works Namangan state university Chemistry faculty and Tashkent state pedagogy university 2023–2024 academic year based on in the year was conducted. In the study total 124 people bachelor student participated (Table 1).

Table 1. Research participants

Group	Students number	Teaching method
Control group (NG)	62	Traditional supreme mathematics course
Experience group (TG)	62	Adaptive-integrative approach based on modules

Experience stages:

1. Diagnostics –students knowledge and skill level determination (initial tests and conversation).
2. Intervention – 16 weeks module course based on education to give
3. Results assessment – final test, practical assignments, students his/her opinion to ask (questionnaire).

4. Integration degrees

In the study mathematics and chemistry between integration three at the level done increased: Level	Content	Example
Content integration	one topic the content of two subjects harmonization	Integral calculus → reaction speed determination
Methodical integration	Teaching methods harmonization	Laboratory + computing tasks
Practical integration	real processes based project works	Thermodynamic the process modeling

5. Evaluation criteria

Table 2. Evaluation criteria and share

Evaluation criterion	Share (%)
Theoretical knowledge	25
Practical application	30
Problem solution ability	25
Innovative approach / creativity	20

Evaluation methods: tests, laboratory works, project works, oral question and answer, writing reflection.

Results and discussion

1. Initial diagnostics results

Experience at the beginning control group (NG) and experience of group (TG) students knowledge level almost one kind was (Table 3).

Table 3. Initial test results

Group	Average score (out of 100)	Standard deviation	The most high score	The most low score
Control group (NG)	52.4	7.8	67	39
Experience group (TG)	53.1	7.5	69	40

The t-test result ($p = 0.67$) is two group between statistic difference whether there is showed

2. Final assessment results

16 weeks old from education then TG students average result to NG students relatively much high was (table 4).

Table 4. Final test results

Group	Average score	Standard deviation	Score growth (%)
Control group (NG)	66.3	6.9	+26.4
Experience group (TG)	81.7	5.4	+54.0

T-test result ($p < 0.001$) in favor of TG statistic in terms of significant the difference showed Figure 2.

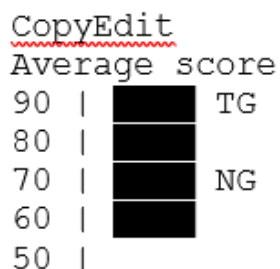


Figure 2 Control and experience groups average points

From the graph visible It is clear that TG students results to NG students relatively much high.

3. Practical assignments to perform quality

TG students reaction integral calculation of speed through detection, thermochemical processes differential equations with modeling such as assignments to perform quality NG students than high was (table 5).

Table 5. Practical assignments results

Assignment type	NG (correct) execution (%)	TG (correct) execution (%)
Reaction speed integral calculation	58	87
Thermodynamic processes modeling	52	82
Chemical concentration change analysis to do	55	84

4. Students idea request results

Through a questionnaire ($n = 124$) students the following They emphasized:

- 91% of TG students are "learning" process interesting and "motivational"; NG rated it The indicator is 64%.

- TG students — “mathematics my knowledge chemistry in practice hand" I will get it"; in NG — 59%.
- TG students — “modules” to me complicated issues in solution help gave” he said; in NG - 55%.

Received results this shows that adaptive -integrative approach based on teaching students

1. Theoretical knowledge deepens;
2. Practical skills noticeable increases;
3. Motivation strengthens;
4. Chemical processes mathematician modeling ability develops.

These results Frykholm and Glasson (2020) [8] and Research by Li and Chen (2019) [9] with suitable comes, but our our research different aspect — adaptive approach to the field orientation as wide application and local education to the system suitable modules working is an exit.

Conclusion

Research to the results based on the following recommendations working output:

1. **Training plans and programs improvement**

- High education in institutions chemistry in the direction of mathematics courses for interdisciplinary to integration based special module programs working exit necessary.
- Module content theoretical data, real chemical to processes related issues, laboratory works and independent search tasks to be need.

2. **Methodical manuals create**

- Adaptive-integrative approach based on structured methodical manuals and lesson developments working teachers in practice wide current to be necessary.
- In the manuals chemical processes mathematician modeling according to step by step instructions, sample issues and algorithms to be need.

3. **Teachers qualification increase**

- Mathematics and chemistry teachers for integrated teaching methods according to special seminar and trainings transfer necessary.
- Foreign experience based on working STEM and interdisciplinary teaching methodologies study and adaptation recommendation is being done.

4. **Modern technologies current to grow**

- Calculation and modeling a wide range of programs (Matlab, Maple, ChemDraw, Avogadro) use.
- Virtual labs and simulation from platforms using remote and mixture teaching opportunities expansion.

5. **Experiment-test their work expansion**

- Methodology efficiency other supreme education in institutions and various in natural sciences from the test transfer
- Statistical analysis based on methodology regular improving to go

6. International cooperation develop.

- the Scopus and Web of Science databases indexed in magazines scientific print results.
- Foreign education and scientific centers with joint research transfer and experience exchange.

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