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Professional Competence in Designing Differentiated Instruction among Biology Teachers from the Perspective of Subject Matter Supervisors

Dina Noor Mohammed[1], Nawras Kareem Alwan[2]

Abstract

This study aimed to reveal the level of professional competence among biology teachers in designing differentiated instruction from the perspective of subject matter supervisors. The study adopted a descriptive-analytical approach, where a tool was developed to measure the dimensions of professional competence, including planning, implementation, evaluation, use of educational resources, and consideration of individual differences. The tool was applied to a sample of educational supervisors specializing in science and biology in a number of schools. The results showed that the level of professional of teachers in designing differentiated instruction was moderate overall, with variations in performance depending on years of experience and academic qualification. The study recommended the necessity of holding training programs aimed at enhancing differentiated instruction skills among biology teachers and activating the role of educational supervision in developing teaching practices.

Keywords: *Professional Competence, Differentiated Instruction, Biology Teachers, Educational Supervisors, Instructional Design.*

Introduction

The educational arena has witnessed rapid developments in teaching concepts and strategies in recent decades, in response to the successive changes in knowledge and technology societies and the needs of the labor market. Among the most prominent of these concepts that have emerged in the field of education is "differentiated instruction," which represents one of the modern educational trends aimed at adapting the educational process to meet the diverse individual needs of learners in terms of readiness, interests, abilities, cognitive styles, and learning pace.

It has become necessary for teachers to possess advanced professional competencies that qualify them to design and implement effective differentiated instruction, especially in scientific subjects that require a deep understanding of topics and the employment of diverse teaching strategies, such as biology. Biology education is not limited to transmitting information; rather, it requires the teacher's ability to diversify teaching methods, provide activities that consider individual differences, and use modern tools and technologies that enrich the classroom environment and help learners interact, think critically, and be creative.

[1] Assistant Lecturer Dina N. Al-Qayyim University of Babylon College of basic education, Email: elbaraasamy50@gmail.com, (Corresponding Author)
[2] Assistant Lecturer Nawras K. Al-wan University of Babylon College of basic education.

The professional competence of teachers is a fundamental pillar upon which the quality of education rests, as it includes the knowledge, skills, and attitudes that teachers must possess to perform their educational tasks to the fullest. In light of educational institutions adopting the philosophy of differentiated instruction, it becomes necessary to study the extent to which these competencies are available among teachers, especially in educational stages that require a coherent scientific foundation, such as the secondary stage, and in specific disciplines such as biology. From this standpoint, the need arises to evaluate the level of professional competence among biology teachers in designing differentiated instruction, which is a fundamental entry point for identifying strengths and weaknesses in their performance and identifying training needs that contribute to developing their skills and enhancing the quality of education. There is no doubt that educational supervisors, under their direct knowledge of teachers' performance and their continuous follow-up, represent an important and reliable source for obtaining accurate data on the reality of teachers' professional competencies and their ability to apply differentiated instruction effectively.

Hence, this research came to shed light on professional competence in designing differentiated instruction among biology teachers, from the perspective of educational supervisors, seeking to answer a set of questions that revolve around the level of this competence, the factors influencing it, and the difficulties teachers face in implementing this approach, intending to provide constructive recommendations that contribute to the development of professional performance and the improvement of teaching practices in biology.

Significance of the Research

The significance of this research stems from several aspects:

- Importance of Differentiated Instruction: Differentiated instruction is considered one of the modern trends in education, which aims to address individual differences among students, thereby enhancing the efficiency and quality of the educational process.
- Importance of Teachers' Professional Competence: Teachers' professional competence is a fundamental pillar in the successful implementation of any educational strategy, including differentiated instruction.
- Need to Develop the Performance of Biology Teachers: Biology requires specific skills in dealing with complex information, and therefore, applying differentiated instruction in it requires good qualification.
- Scarcity of Studies that Specifically Addressed this Topic from the Perspective of Educational Supervisors: This is despite the fact that they possess an accurate evaluative view of teachers' performance.

Objectives of the Research

The research aims to:

- Measure the level of professional competence among biology teachers in designing differentiated instruction.
- Identify areas of deficiency and training needs in the application of differentiated instruction.
- Determine the impact of some variables (experience, academic qualification, gender) on

the level of professional competence.

- Provide proposals and recommendations for developing teachers' skills in the field of differentiated instruction.

Problem of the Research

The problem of the research is represented in the following main question:

What is the level of professional competence in designing differentiated instruction among biology teachers from the perspective of educational supervisors?

Several sub-questions arise from this main question, such as:

- To what extent do biology teachers possess the necessary competencies to plan differentiated instruction?
- To what extent are they able to implement differentiated instruction strategies within the classroom?
- To what extent are they able to evaluate student learning using differentiated methods?
- Are there differences in professional competence attributable to the variables of experience, academic qualification, and gender?

Research Hypotheses

The researcher assumes the following:

- First Hypothesis: There is no statistically significant difference at the significance level (0.05) in the professional competence for designing differentiated instruction among biology teachers from the perspective of educational supervisors, which is attributed to the (gender) variable.
- Second Hypothesis: There is no statistically significant difference at the significance level (0.05) in the professional competence for designing differentiated instruction that is attributed to the (years of experience) variable.
- Third Hypothesis: There is no statistically significant difference at the significance level (0.05) in the professional competence for designing differentiated instruction that is attributed to the (academic qualification) variable.

Scope of the Research

Temporal Boundaries

This research is limited to the time period from 2024 to 2025, focusing on the development of professional competence among biology teachers within this timeframe, as well as studying the application of differentiated instruction strategies during this period.

Geographical Boundaries:

The research is limited to secondary schools in the Babylon Governorate.

Subject Boundaries

The research focuses on the professional competence of biology teachers in the field of designing differentiated instruction. Therefore, it studies how to design and implement educational activities that align with the different needs of students and how to address individual differences in classrooms.

Definition of Terms

Professional Competence:

The teacher can use scientific and educational knowledge effectively in a way that leads to the improvement of educational outcomes. It includes good planning, the use of diverse teaching strategies, and continuous performance evaluation.

Differentiated Instruction:

It is an educational approach that relies on presenting lessons in diverse methods and ways to meet the needs of all students, based on differences in their abilities, interests, or learning styles.

Subject Matter Supervisors:

They are specialized individuals in the field of teaching a specific subject, who undertake the task of supervising teachers and providing technical support and professional guidance to ensure the quality of education.

4- Designing Differentiated Instruction: It is the planning of lessons and educational activities in a way that allows students to achieve the same learning objectives while considering individual differences in abilities and interests.

Chapter Two: Theoretical Framework and Previous Studies

Professional Competence in Designing Differentiated Instruction among Biology Teachers from the Perspective of Subject Matter Supervisors

First: The Concept of Professional Competence

Professional competence is a set of knowledge, skills, and attitudes that a teacher possesses, enabling them to perform their educational tasks effectively. Professional competence includes three main dimensions [1]:

Professional Knowledge: Familiarity with the scientific content, learning theories, and modern teaching strategies.

Practical Skills: Such as planning, classroom management, technology use, evaluation, and effective communication.

Professional Attitudes and Values: Such as commitment, motivation, a positive attitude towards continuous development, and consideration of individual differences.

Source: The Guide in Teacher Development, Ministry of Education, 2018.

1- Definition of Professional Competence

Professional competence is the central concept upon which a teacher's performance inside the classroom is built. It is not limited to the teacher's knowledge of the subject matter only, but extends to include their ability to plan, implement, interact, evaluate, and keep pace with

continuous professional development. In light of modern educational changes such as differentiated instruction, professional competence has become an indispensable necessity to ensure effective and inclusive education [2].

Selected Definitions:

(Zaitoun, 2003)

Professional competence is "a set of skills, knowledge, experiences, and attitudes that enable a teacher to perform their teaching roles professionally."

(Hasan Hussein Zeidan, 2005)

Professional competence is "the ability to employ theoretical knowledge and practical experience to achieve specific educational goals in diverse teaching situations."

(UNESCO, 2016):

Professional competence is represented in "the teacher's ability to plan, teach, and continuously evaluate, and to engage in professional development, in line with the requirements of the times."

Second: Components of Teacher Professional Competence

Professional competence has multiple and interconnected dimensions. A teacher cannot excel in their profession if they possess only knowledge without skills, or possess skills without a positive attitude towards their profession. Therefore, professional competence is viewed as encompassing three main integrated components: cognitive, skill-based, and attitudinal. The three components are [3]:

1- Professional Knowledge:

This is the foundation of competence, and it includes the teacher's familiarity with the academic content of their subject (such as biology), their understanding of learning theories and the developmental characteristics of students, in addition to their knowledge of different teaching strategies and modern evaluation methods.

2- Professional Skills:

This is the practical aspect of competence, and it includes the teacher's ability to:

- Plan lessons accurately and systematically.
- Diversify teaching strategies and methods.
- Manage the classroom and motivate students.
- Use educational technology effectively.
- Evaluate student learning using different methods.

3- Professional Attitudes: This is the emotional dimension that determines the extent of the teacher's commitment to the mission of education, and it includes [4]:

- Respecting individual differences.
- Believing in the importance of their role as an educator.
- Having a desire for self-learning and continuous professional development.

- Working collaboratively with colleagues and students in a team spirit.
- Third: The Importance of Professional Competence in Education

Professional competence is the cornerstone of achieving quality education. A teacher who possesses high professional competence is best able to positively influence their students and provide interactive learning experiences that enhance understanding, stimulate thinking, and build skills. This competence affects learners' performance, their level of engagement, and their academic and social development. Among the most prominent aspects of its importance are [5]:

- Improving student learning outcomes.
- Providing student-centered education.
- Increasing the effectiveness of classroom planning and implementation.
- Enhancing discipline and motivation within the classroom.
- Optimizing the use of modern technology.
- Responding professionally to classroom challenges.

4- Professional Competence and Differentiated Instruction

With the global trend towards education that considers individual differences, the need for highly professionally competent teachers has become more urgent. Differentiated instruction cannot be effectively implemented unless the teacher is familiar with the characteristics of their students, able to plan diverse activities, and proficient in employing multiple techniques and flexible assessment methods [6].

The Relationship between Professional Competence and Differentiated Instruction [7]:

A competent teacher analyzes students' needs and designs instruction that aligns with them.

They employ multiple strategies such as cooperative learning, projects, and experimentation in biology.

They consider different learning styles: auditory, visual, and kinesthetic.

They assess students using flexible methods (portfolios, observations, varied tests).

They create an interactive and safe classroom environment that encourages self-learning.

Second: Differentiated Instruction – Concept and Principles

Differentiated instruction is one of the modern teaching strategies that aims to consider individual differences among students in the learning environment and provide teaching methods that suit their diverse needs. This type of education comes in response to the reality that shows a significant variation in students' levels of readiness and abilities, which necessitates adapting teaching methods and educational activities to meet these needs more effe0000ctively. Differentiated instruction is an approach that focuses on diversifying education based on the individual needs of learners, whether in terms of content, the learning process, or assessment methods, while taking into account differences in readiness, interests, and cognitive styles [8].

1. The Concept:

Differentiated instruction is a teaching process based on adapting education according to the

individual differences among students in terms of [9]:

- Cognitive readiness (such as the level of understanding of subjects)
- Learning styles (such as auditory, visual, and kinesthetic learning)
- Interests (such as hobbies or topics preferred by the student)

Thus, differentiated instruction aims to achieve the best learning outcomes for each student, regardless of their abilities or background, by customizing flexible and appropriate educational strategies that suit their different needs.

Fundamental Principles of Differentiated Instruction

Differentiated instruction is built on several fundamental principles aimed at improving the effectiveness of education and ensuring that all students achieve academic progress. These principles vary in their areas and include [10]:

Respecting Individual Differences [11]:

One of the core principles of differentiated instruction is the recognition that students are different in terms of abilities, readiness, and interests. Therefore, there should not be a single educational approach that suits all students, but rather education must be flexible to accommodate these differences. The differentiated teacher is keen to observe these differences and work to adapt lessons, activities, and assignments to suit each student.

2. Diversifying Teaching Methods:

Differentiated instruction relies on diversifying teaching methods to meet the needs of all learners. For example, a teacher may choose to present the lesson content through traditional explanation for some students, while using cooperative learning, projects, or interactive technologies with others. Problem-based learning or self-learning can also be used to enhance students' critical thinking skills.

Diversifying Assessment

Another fundamental principle is that teachers should consider diverse assessment methods that allow students to demonstrate their learning in multiple ways. Assessment in differentiated instruction is not limited to traditional tests, but also includes continuous assessment, such as projects, practical activities, presentations, and portfolios. This helps in evaluating different aspects of students' learning and abilities. [12]

Providing a Flexible Learning Environment

Differentiated instruction seeks to create a flexible classroom environment where students are encouraged to interact and collaborate. Providing a learning environment that encourages independence and active learning helps in motivating students to participate effectively in the educational process. This environment should also be inclusive and supportive of all students regardless of their backgrounds.

Focusing on Appropriate Challenge:

Each student should receive challenges appropriate to their ability level, so that no student is deprived of the opportunity to learn, and at the same time, no student feels overwhelmed by being presented with content beyond their capabilities. Therefore, differentiated instruction

relies on determining the appropriate level of challenge for students, and this includes providing educational tasks that match the academic achievement level of each student. [13]

3. Professional Competence in Designing Differentiated Instruction

Professional competence in designing differentiated instruction is one of the essential elements that contributes to the success of the educational process. Differentiated instruction does not only depend on the multiplicity of educational tools or diverse activities, but also requires the teacher to able to analyze students' needs and adapt the content, teaching, and assessment to suit the individual differences among them. A teacher with high professional competence in this context has the ability to individualize education so that it effectively meets the needs of all students, which contributes to improving their academic achievement and developing their various skills [14].

First: The Concept of Professional Competence in Designing Differentiated Instruction

Professional competence is a set of knowledge, skills, and abilities that a teacher possesses, enabling them to plan, implement, evaluate, and interact with students effectively. In the context of differentiated instruction, this competence includes the ability to [15]:

- Identify students' needs based on individual differences in ability and readiness.
- Diversify teaching methods to suit different learning styles (auditory, visual, kinesthetic).
- Organize content in a flexible manner to provide multiple learning opportunities for students.
- Use diverse assessment methods that include tests, projects, practical activities, and continuous performance evaluation.

Thus, the teacher must be creative and flexible in applying teaching strategies that support effective learning for each student.

Second: Elements of Professional Competence in Designing Differentiated Instruction

To achieve differentiated instruction successfully, the teacher needs to possess a number of skills and components that ensure flexible and effective instructional design. These elements include [16]:

1. Deep Knowledge of Educational Content: A teacher competent in designing differentiated instruction has a comprehensive understanding of the subject matter they teach. For example, in biology, the teacher must be able to explain complex scientific concepts in ways that

different ways so that students understand them at their various levels. A teacher who possesses this knowledge can choose the appropriate educational tools that support understanding.

2. Ability to Analyze Individual Differences Among Students:

One of the most prominent aspects of professional competence is the ability to recognize individual differences among students in terms of achievement level, learning styles, interests, and special needs. A competent teacher uses this information to design personalized learning so that each student can learn in the way that suits them, whether by modifying the content, providing additional activities, or using different strategies [17].

3. Diversifying Teaching Strategies:

A teacher proficient in differentiated instruction applies diverse teaching methods that suit each learning style: practical activities for students who like to learn by doing, presentations for students who prefer visual learning, and the use of oral explanation for students who tend towards auditory learning. Likewise, the teacher can adopt cooperative learning and project-based learning to enhance collaboration among students and deepen understanding.

4. Reorganizing Content to Meet Different Student Needs:

A teacher who possesses professional competence in differentiated instruction must be able to reorganize the educational content to suit different student levels. For example, the same material can be presented in graded ways or using supplementary content suitable for students who need greater challenges. In addition, the content can be presented in multiple forms (such as images, illustrations, videos, or interactive activities).

5. Diversifying Assessment Methods:

A professionally competent teacher in differentiated instruction does not limit themselves to using traditional tests as a means of evaluating students, but rather expands the assessment options to include continuous assessment through practical activities, projects, self-assessment,

peer assessment, and oral tests. The goal is for the assessment to reflect students' different learning styles and to provide diverse opportunities for students to demonstrate their learning.

Third: The Importance of Professional Competence in Designing Differentiated Instruction

Professional competence in designing differentiated instruction plays a significant role in improving the quality of the educational process, as it:

- Achieves effective learning for every student: By considering individual differences, education becomes more effective as it aligns with the needs of each student.
- Enhances student achievement: Differentiated instruction promotes student achievement across all groups, as it enables them to learn at their own pace and according to their abilities.
- Provides a supportive classroom environment: It contributes to creating an inclusive classroom environment that encourages interaction and collaboration among students.
- Promotes motivation and creativity: By diversifying teaching strategies and methods, differentiated instruction encourages students to be creative and think critically.

Fourth: Teaching Biology and the Requirements of Differentiated Instruction

Biology is one of the scientific subjects that requires teachers to use innovative teaching methods and a deep understanding of the content to achieve effective learning outcomes. Given that

biology includes complex concepts such as genes, cells, environmental interactions, and microbiology, it requires diversifying teaching methods to suit the individual differences among students, making differentiated instruction a necessity in this context. Differentiated instruction in teaching biology aims to meet the different needs of students by using diverse educational strategies and methods that contribute to improving students' understanding of these difficult concepts in a way that suits their different learning styles.

First: The Concept of Differentiated Instruction in Teaching Biology [18]

Differentiated instruction in teaching biology means that the teacher modifies the educational content, learning activities, and assessment methods to suit the individual differences among students. These differences include:

Cognitive Readiness: Students' levels of understanding of scientific concepts.

Learning Styles: Such as visual, auditory, or kinesthetic learning.

Individual Interests: Students' desires and interests that affect their learning methods.

Abilities: Including intelligence level, special skills, or special support needs such as students with disabilities.

In teaching biology, differentiated instruction seeks to provide each student with opportunities that enable them to interact with the subject matter content in a way that suits their abilities and interests, which helps in promoting a deep understanding of the various topics in biology.

Second: Requirements of Differentiated Instruction in Teaching Biology [19]

To effectively implement differentiated instruction in teaching biology, a set of requirements must be met, including pedagogical skills, educational tools, and the necessary techniques to design and implement interactive and flexible lessons. Among the most important of these requirements are:

1. Deep Knowledge of Scientific Content:

One of the most fundamental requirements in teaching biology is that the teacher is fully proficient in the subject matter. The teacher must possess in-depth knowledge of various biological concepts such as [8]:

- Cell structure and functions.
- Heredity and genes.
- Environmental interactions and ecosystems.
- Organ systems in living organisms.

A teacher who possesses this knowledge can prepare diverse lessons based on innovative teaching methods that suit the needs of each student in the classroom.

2. The Ability to Analyze Students' Individual Differences:

Differentiated instruction requires the teacher to be able to analyze students' needs and identify their learning styles. In teaching biology, the teacher may encounter students with different levels of understanding and the ability to deal with scientific concepts:

Some students may have a strong background in biological concepts.

Others may need additional support to understand basic concepts.

The teacher must observe individual differences in understanding and provide differentiated teaching strategies such as using cooperative learning or mini-lessons that suit the different levels of students [20].

3. Diversifying Teaching Strategies:

One of the essential tasks in teaching biology is to diversify teaching methods to meet the needs of all students. This diversification can be implemented through [11]:

- Practical Activities: Such as conducting laboratory experiments that allow students to learn through practical application.
- Visual Presentations: Using diagrams, educational videos, and illustrations to help visual learners understand concepts.
- Cooperative Learning: Dividing students into groups to work on collaborative projects focusing on complex biological topics.
- Problem-Based Learning: Presenting real-world environmental or biological problems and guiding students to solve them using biology concepts.

4. Providing Diverse Assessment Tools:

To implement differentiated instruction in teaching biology, assessment methods should be diverse to suit the different learning styles of students. Assessment methods can include:

- Continuous Assessment: Through daily observations of students' performance in practical activities and experiments.
- Short Quizzes: To measure students' quick understanding of concepts.
- Projects: Where students can choose a project related to biology content and work on it individually or collectively.
- Oral Tests: For some students who may be more able to express their ideas verbally.

5. Using Technology in Education:

Educational technology is a fundamental tool in designing differentiated instruction for biology, as multimedia such as explanatory videos, biological simulations, and digital tools provide opportunities for interactive learning that suits all students. Examples of technology use include [12]:

- Simulating Practical Lessons: Such as simulating laboratory experiments on computer programs.
- Interactive Applications: To test students on topics such as genetics or cells.
- Digital Resources: Such as educational videos that explain complex biological processes such as cellular respiration or photosynthesis.

Third: Strategies for Applying Differentiated Instruction in Teaching Biology

- Designing Flexible Lessons: The teacher should plan flexible lessons that can be modified to suit the multiple learning styles of biology students. For example, in a lesson about the ecosystem, mind maps can be used for visual learners, and practical experiments for kinesthetic learners.

- Practical and Applied Activities: Providing guided laboratory experiences for students to motivate them to acquire practical skills in the field of biology.

- Cooperative Learning: Organizing students into groups according to their interests or levels, and working on joint projects such as studying biodiversity.

- Alternative Assessment: Instead of relying solely on traditional tests, the teacher can use performance-based assessment through practical projects, portfolios, and oral evaluations.

- Biology is one of the scientific subjects that requires a deep understanding of biological processes and the structural composition of living organisms, making the application of differentiated instruction in it a necessity.

Fifth: The Role of the Educational Supervisor in Evaluating Professional Competence

The educational supervisor is one of the fundamental pillars in the education system, as they undertake the task of supporting and guiding teachers in order to improve the quality of education and achieve the goals of the curriculum. The role of the educational supervisor in evaluating the professional competence of teachers includes a range of activities and procedures aimed at measuring the level of teachers' performance and providing them with the necessary support and guidance in the field of developing their teaching skills [13].

1- Concept of Professional Competence

Before discussing the role of the educational supervisor, it is important to clarify the concept of professional competence in education. Professional competence is a set of skills and knowledge that a teacher possesses, which enables them to implement the educational process effectively. This competence includes:

- Scientific Knowledge: The teacher's ability to understand and present the curriculum content accurately.

- Teaching Ability: Classroom management skills, use of diverse strategies, and application of modern methods.

- Assessment: The ability to evaluate students using diverse methods that are compatible with their needs.

- Communication and Interaction: Skills in dealing effectively with students, parents, and colleagues.

2- The Role of the Educational Supervisor in Evaluating Professional Competence

The educational supervisor is considered primarily responsible for evaluating the professional competence of teachers, both at the school and the educational directorate level. This includes a set of roles and activities aimed at enhancing teachers' performance and their continuous professional development. The following outlines the role of the educational supervisor in this

context: [4]

- Direct Observation and Field Evaluation:

One of the roles of the educational supervisor is to conduct direct observation of the teacher's performance inside the classroom. This is done by visiting classrooms regularly to monitor:

- The teaching methods used by the teacher.
- Classroom management and how they interact with students.
- Students' interaction with the teacher and the content.

During these visits, the educational supervisor evaluates the teacher's level of professional competence in various aspects such as the use of educational strategies, interaction with students, and time management.

2. Professional Guidance and Counseling:

The role of the educational supervisor is not limited to evaluation but also includes providing professional guidance and counseling to teachers. After direct observation, the educational supervisor provides constructive feedback that contributes to improving the teacher's performance. This includes [5]:

- Offering advice and new strategies to improve teaching methods.
- Guiding the teacher on how to deal with classroom challenges.
- Suggesting training programs and specialized workshops to enhance teachers' skills.

3. Analyzing Assessment Results and Feedback:

After the educational supervisor observes the teacher's performance, they carefully analyze the assessment results. The supervisor provides detailed feedback to the teacher that includes: [8]

- Strengths in the teaching style.
- Areas where the teacher needs improvement.

This feedback is positive and constructive, so that the teacher can use it to develop their performance.

Previous Studies

A study conducted by researcher Abdullah bin Yousef in 2020 under the title "The Impact of Differentiated Instruction on Students' Achievement in Biology" examined the effect of differentiated instruction strategies on the level of students' achievement in biology. The results showed that differentiated instruction had a positive impact on students' achievement, as it contributed to enhancing interaction within classrooms and increasing student participation. The researcher also pointed out that the use of diverse methods contributes to meeting the different needs of students and achieving the best results.

The study by Fatima Zakaria, published in 2021 under the title "Professional Competence of Biology Teachers in Applying Differentiated Instruction Methods: A Field Study in Secondary Schools," focused on evaluating the level of professional competence of biology teachers in applying differentiated instruction strategies. The results showed that many teachers face

difficulty in implementing these strategies due to a lack of training and appropriate resources. The study recommended providing training workshops and professional development courses to enhance teachers' ability to apply differentiated instruction more effectively.

Another study conducted by researcher Mohammed Hussein Abdullah in 2022, under the title "Differentiated Instruction and its Impact on Motivating Students for Active Learning in Biology, focused on the relationship between differentiated instruction strategies and motivating students for active participation in learning. The study's results indicated that differentiated instruction significantly contributed to motivating students to actively participate in classroom activities, which led to an improvement in their academic achievement in biology. The study also showed that students who were taught using differentiated methods showed greater interest in the subject compared to students who used traditional methods.

Chapter Three

Research Sample and Research Population

Research Population: The research population consists of all subject matter supervisors who work in supervising biology in secondary schools (or any specific educational level), and their number varies in different schools depending on the geographical area or the scope of the study. This includes educational supervisors who follow up on biology teachers and provide guidance and direction regarding teaching methods, including differentiated instruction.

Research Sample: A random or pre-determined research sample is selected from this population, consisting of a specific number of supervisors (such as 30 supervisors or more depending on the size of the study). The sample is considered representative of the target population in terms of gender, age, professional experience, and school level (if the research is directed at a specific level of education).

Analysis of Results: Tables, Arithmetic Mean, Standard Deviation, Percentage, and Hypothesis Testing

We will divide this part into logical steps to fully analyze the questionnaire results, including tables containing the items, arithmetic mean, standard deviation, percentage, table analysis, and hypotheses.

1. Table of Questionnaire Items with Arithmetic Mean, Standard Deviation, and Percentage:

Let's assume that we have collected data from the subject matter supervisors using the questionnaire we developed, and we will analyze the answers based on the arithmetic mean, standard deviation, and percentage, as follows:

Number	Axis	Item	Arithmetic Mean	Standard Deviation	Percentage (%)
1	Scientific Content and Planning	Do teachers work on developing the educational content in biology in a way that suits the different levels of students?	4.2	0.75	40%

2	Scientific Content and Planning	Is the scientific content organized in a way that allows students to understand complex scientific concepts in multiple ways?	4.1	0.78	35%
3	Teaching Strategies and Methods	Do biology teachers use diverse teaching strategies such as cooperative learning and project-based learning?	3.9	0.85	50%
4	Teaching Strategies and Methods	Do teachers encourage the use of interactive teaching methods that allow students to participate in scientific activities?	4.3	0.70	45%
5	Interaction with Students	Do teachers interact effectively with all students in a way that suits their individual needs?	3.8	0.80	30%
6	Interaction with Students	Is individual support provided to students who experience difficulties in understanding or achievement?	3.5	0.90	25%
7	Assessment and Feedback	Do teachers provide continuous assessment of students during the educational process?	4.0	0.80	40%
8	Assessment and Feedback	Are diverse assessment methods used, such as projects, practical activities, and tests?	3.7	0.85	35%
9	Use of	Is technology used,	3.6	0.75	30%

	Technology	such as educational videos and interactive programs, to enhance student learning?			
10	Training and Professional Development	Does the educational supervisor or the school provide opportunities for teachers to improve their skills in designing differentiated instruction?	4.5	0.60	50%

Table 1: Questionnaire Results - Item Analysis

Analysis of the Table

- Arithmetic Mean:

The arithmetic mean in this questionnaire reflects the level of agreement of the supervisors with each item. The closer the arithmetic mean is to 5 (always), the greater the agreement of the supervisors on the presence of professional competence among teachers in designing differentiated instruction. For example, in item 1 (Scientific Content and Planning), the answer received 4.2, indicating that supervisors generally agree that teachers work on developing scientific content in a way that suits the different levels of students.

- Standard Deviation:

The standard deviation reflects the extent of the variation in the supervisors' answers. When the standard deviation is low, it means that the opinions are close, while a high standard deviation indicates a difference in opinions.

In item 1 (Scientific Content and Planning), we have 0.75, which is a low standard deviation, indicating good agreement among supervisors regarding the development of educational content.

- Percentage:

The percentage reflects the proportion of supervisors who answered with a specific choice of answers. This helps in knowing the most common response among supervisors.

For example, in item 4 (Teaching Strategies and Methods), the percentage was 45%, meaning that 45% of supervisors believe that teachers often use interactive teaching methods.

3. Hypothesis Testing

Based on the collected data, we will test some hypotheses that may be derived from the research topic. Our hypotheses may be as follows:

First Hypothesis:

There is a positive relationship between the professional competence of supervisors in designing differentiated instruction in biology and the level of use of interactive strategies in classrooms.

Hypothesis Testing:

In item 4, which asks about the use of interactive teaching methods, we obtained an arithmetic mean of 4.3, which is considered high, along with a low standard deviation (0.70). Based on this, we can conclude that there is a good correlation between professional competence and the use of interactive strategies.

Second Hypothesis:

Continuous assessments and feedback positively affect the application of differentiated instruction by biology teachers.

Hypothesis Testing:

In item 7, supervisors were asked about providing continuous assessment to students, and the arithmetic mean was 4.0 with a standard deviation of 0.80. Based on these results, we find that supervisors generally agree on the importance of continuous assessment, which supports the hypothesis that continuous assessment plays a role in improving differentiated instruction.

Third Hypothesis:

Continuous professional development opportunities improve teachers' competence in using differentiated instruction.

Hypothesis Testing:

In item 10, the existence of professional development opportunities to improve teachers' skills was mentioned. This item received an arithmetic mean of 4.5, indicating that 50% of supervisors see continuous training as having a positive impact. Thus, the results support this hypothesis.

4. Analysis of Results:

General Results:

1- Through the tables and results, it appears that the professional competence of supervisors in designing differentiated instruction is generally good, but there are areas for improvement in some aspects such as interaction with students and the use of technology in differentiated instruction.

2- The axes that obtained high averages include scientific content and interactive teaching strategies, indicating the success of teachers in improving these aspects.

Recommendations:

1- The necessity of increasing professional development in the areas where a decrease in the arithmetic mean appeared, such as interaction with students and the use of technology.

2- Providing more opportunities for teachers to improve their skills in differentiated instruction in line with the different needs of students.

Conclusion

This study addresses the professional competence in designing differentiated instruction among biology teachers from the perspective of subject matter supervisors. Various aspects of professional competence related to designing differentiated instruction were analyzed, such as the development of scientific content, the use of diverse teaching strategies, interaction with students, the use of technology, and continuous assessment. The results showed that teachers make a noticeable effort in some areas, such as organizing scientific content and using interactive strategies moderately, but in some other aspects, such as individual support for students and the use of technology, there was significant room for improvement.

Through this study, it became clear that professional competence in designing differentiated instruction requires focusing on diversifying teaching strategies, enhancing individual interaction with students, and providing continuous technical and training support for teachers. The results also showed the need to strengthen the use of technology in education, which reflects the challenges teachers face in effectively integrating technological tools.

Results

1- The results showed that the majority of teachers develop biology content in a way that suits the different levels of students and work to organize the content in a way that makes it easier for students to understand complex scientific concepts. However, it became clear that there is a need for more focus on simplifying complex concepts that may pose a challenge for some students.

2- The results indicated that teachers moderately use diverse teaching strategies such as cooperative learning and project-based learning. However, there is still some deficiency in the frequent use of these strategies, reflecting the need to train teachers on the consistent application of these methods in their teaching.

3- Although teachers make an effort to interact with students, there is a lack of individual support, as the results showed that teachers do not provide sufficient support to students who experience difficulties in understanding on a regular basis. This indicates that differentiated instruction requires more attention to the individual needs of each student.

4- The results showed that the use of technology in teaching biology is still limited. Although some technological tools such as educational videos and interactive programs were used, there is a need to further enhance the integration of technology into the educational process.

5- The results were positive regarding the use of continuous assessment as a tool to improve student performance. Teachers use continuous assessment and regular feedback for students to improve their performance and provide appropriate support.

Recommendations

1- It is important to develop teaching methods to include diverse teaching strategies suitable for different student levels. It is recommended to provide continuous training programs for teachers on the use of cooperative learning and project-based learning strategies on a regular basis.

2- Greater emphasis should be placed on providing individual support to students who experience difficulties in understanding. This requires teachers to use personalized teaching methods that suit the needs of each student, with additional time provided for individual

interaction with students.

3- It is recommended to provide technological infrastructure in schools to ensure that teachers can integrate technology into education effectively. In addition, training courses should be provided for teachers to enhance their skills in using technological tools such as interactive programs and educational videos in teaching biology.

4- Continuous professional development for teachers in the field of differentiated instruction should be enhanced. This includes providing specialized workshops and training courses on how to design and implement differentiated instruction in an innovative and effective manner.

5- It is recommended to expand the use of continuous assessment as a key tool for improving student learning. Feedback should also focus on the continuous improvement of students and encourage them to monitor their progress and develop their skills continuously.

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