Highly Optimised Structured Teaching

Case Study – Descriptive Statistics –

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Abstract: Growing awareness of the significant differences among teachers has led to ongoing dialogue among teachers, researchers, and education policymakers on how to improve teaching practices. This study provides a framework for effective and efficient teaching using evidence-based strategies and follows the structured approach of high-productivity teaching. It applies these strategies in teaching descriptive statistics to first-year students in the Faculty of Economics, by finding an easy and practical way to implement successful teaching strategies. The teaching method was evaluated using an experimental approach, and the effect size was calculated between the experimental group, which was taught using the methodology proposed in this paper, and the control group, which was taught in the traditional way. The effect size was also calculated between the two groups. It should be noted that the proposed teaching framework aims to maximize learning outcomes with minimal time and effort. This methodology also focuses on improving teaching techniques to enhance learning and improve performance.

Keywords: Education Strategy, Teaching Efficiency, Teaching Method, Impact Size

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التدريس المنظم عالي الإنتاجية. دراسة حالة – مادة الإحصاء الوصفي –

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الملخص: أدى الوعي المتزايد بالاختلافات الكبيرة بين المعلمين إلى حوار مستمر بين المعلمين والباحثين وصانعي السياسات التربوية حول كيفية تحسين ممارسات التدريس. تقدم هذه الدراسة إطارا للتدريس الفعال والكفء باستخدام الاستراتيجيات القائمة على الدليل واتباع هيكل التدريس المنظم عالي الإنتاجية، وتطبيقه في تدريس مادة الإحصاء الوصفي لطلبة كلية

الاقتصاد السنة الاولى، وذلك بإيجاد طريقة سهلة وعملية لوضع استراتيجيات التدريس الناجحة موضع التنفيذ. تم تقييم طريقة التدريس باتباع المنهج التجريبي وحساب حجم التأثير بين مجموعة التجربة التي تم تدريسها بالمنهجية المقترحة في هذه الورقة، ومجموعة التحكم التي تم تدريسها بالطريقة التقليدية، كما تم حساب حجم التأثير بين المجموعتين. وتجدر الإشارة الى ان إطار التدريس المقترح يهدف إلى تعظيم نتائج التعليم بأقل وقت وجهد. كما تركز هذه المنهجية على تحسين تقنيات التدريس لتحقيق أقصى قدر من التعلم وتحسين الأداء.

الكلمات المفتاحية: استراتيجية التعليم، كفاءة التعليم، طريقة التدريس، حجم التأثير

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Introduction

The Highly Optimized Structured Teaching (HOST) method focuses on improving teaching techniques to maximize learning and improve performance. A model of the education system based on systems theory (Tikrity, 2023) was used to ensure that the system works effectively and efficiently by proposing meaningful metrics for the education process. These metrics are divided into four categories: education objectives, education specifications, education time, and education cost. The first two measure effectiveness, and the latter two measure efficiency (see Figure 1).
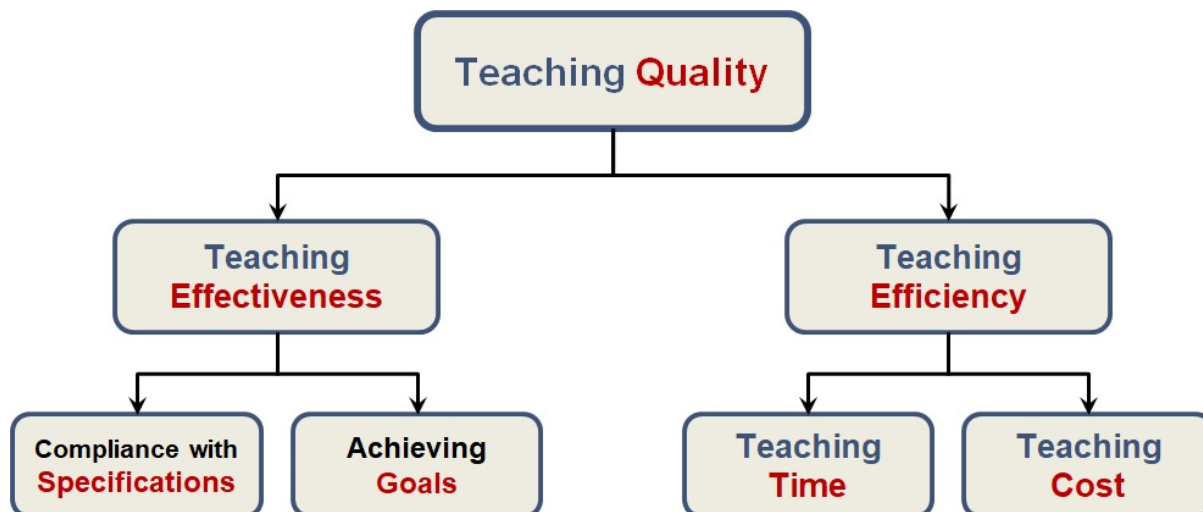

Figure 1. Teaching Quality, Effectiveness and Efficiency

Research goals:

Improve teaching efficiency by finding easy and practical ways to put evidence−based learning strategies into practice.

The Significance of the Research:

Develop a common language of instruction that defines the student's teaching and learning process and classroom environment.

Provide a clear, structured, well-defined, and actionable intervention for highly effective teaching.

Help teachers improve their effectiveness and teaching efficiency significantly and quickly.

Methodology

The experimental approach was used on two equal groups of students: the control group, which was taught in the traditional way, and the experimental group, which was taught using a high teaching system. The study measured the Effect size.

Theoretical Framework and Previous Studies

Evidence-Based Teaching Strategies

The term "evidence-based" is commonly used in education to refer to any concept or strategy supported by factual evidence, often collected from educational studies or measurements of teacher, student, and school performance. This includes evidence-based decisions, evidence-based school improvement, and evidence-based instruction. For a practice to be considered evidence-based, it must have been developed based on some form of research, and its effectiveness must have been tested by someone other than the people or organizations that developed it. The practice should have yielded positive results in order to be considered an Evidence-Based Practice (EBP). EBP is not just based on learning theory or science, but rather must also be supported by proof successful outcomes for both teachers and learners (Aglen, 2016; Thomas et al., 2009; McSherry, Scott & 2011). These outcomes are reached and documented through meta-analysis and the effect size. The most important sources of these strategies are:

Work of John Hattie

Works by Robert Marzano

The British Educational Endowment Foundation (EEF)

Meta-analysis

Meta-analysis is a statistical method used to synthesise the results of previous quantitative research studies and draw a single, comparable result from a large body of research (Normand, 1999). It combines the findings of individual studies to arrive at a more comprehensive understanding of the topic being studied. In meta-analysis, researchers combine the results of multiple studies addressing the same research questions. This is usually accomplished by finding a common measure of the effect size and using a meta-regression model (Shelby & Vaske, 2008). This analysis assumes that each study provides a distinct measure of the underlying relationship within the population. By accumulating the results from different studies, a more precise representation of the population is achieved, as opposed to estimates from individual studies (Higgins et al., 2022).

Effect Size

Meta-analysis relies on effect size to provide an accurate and meaningful assessment of the size and importance of the differences between two or more groups. It allows a comparison of studies with different sample size, enabling a more objective and quantitative analysis of the data. This approach encourages a more scientific approach to understanding an intervention's effectiveness, and provides a better understanding of the importance of the intervention. The effect size is a valuable tool for meta-analysis, as it provides a way to compare and analyze multiple studies by quantifying the magnitude of differences between two groups. This standardized measure makes it easy to compute and interpret data, and allows for a more scientific approach to understanding the effectiveness of an intervention. Effect size can inform the importance of the intervention beyond whether it is statistically significant, and is essential for reporting and interpreting findings in terms of effect sizes.

Professor John Hattie is widely known in the education sector. He has combined the results of numerous meta-analyses of educational research and created a list of interventions and their corresponding average statistical effect size. An effect size of 0.4 is considered a "hinge point" as interventions above this are regarded as more successful. The effect size table developed by Professor John Hattie is a compilation of all these studies, showing which elements have the greatest effect on student performance, that is, the highest average effect size.

The work of Professor Robert Marzano and his team (Marzano, 2001) is essential to educators, as it provides evidence-based summaries of effective teaching strategies. These strategies include making analogies and metaphors, having students create study notes, and

giving feedback/formative assessment. These strategies have the highest effect size that Hattie has reviewed and synthesized from classroom-based research and are suitable for almost any subject or topic. Although more recent research has been conducted since its publication, the top nine teaching methods outlined by Marzano et al (2001) remain invaluable to educators.

John Hattie and Robert Marzano conducted extensive research on the most successful teaching methods. Despite their differing techniques and terminology, they agreed that some strategies are the strongest. While Marzano's approach focuses on teacher-designed tests, Hattie's focuses more on standardized tests, and both experts agree that these strategies are the most effective.

The Education Endowment Foundation (EEF) in the UK has published the Teaching and Learning Toolkit, a comprehensive source of educational research that helps teachers and schools use their resources to maximize student academic achievement. The educational endowment toolkit includes 33 topics, each with an average impact on attainment, evidence to support it, and cost information. Evidence from multiple studies has been combined to provide intermediate results for each area. This guide helps schools make informed decisions about what they think might be helpful or warn them when trying something that hasn't worked in the past. The Toolkit is an evolving resource that is regularly updated with the latest findings from EEF-funded projects and other top-notch research (Higgins et al., 2013).

International experts, including John Hattie and Robert Marzano, have identified hundreds of teaching strategies after synthesizing the results of tens of thousands of studies conducted around the world. These strategies have been categorized according to their contribution to student learning. Higher-ranked strategies are known as high-impact teaching Strategies. Table 1 presents a list of some of these strategies.

Table 1. High Impact Teaching Strategies

Education Endowment Foundation.	Robert Marzano	John Hattie
Feedback	The similarities and differences	Direct Instruction
Peer tutoring	Summarizing and note taking	Note Taking & Other study skills
Early years intervention	Reinforcing effort & providing recognition	Spaced practice
One to one tuition	Homework and Practice	Feedback
Homework (secondary)	Non-linguistic representations	Teaching Metacognition skills
Collaborative learning	Cooperative learning	Teaching Problem solving skills
Oral Language Intervention	Setting objectives and providing feedback	Reciprocal teaching
Mastery learning	Generating and Testing Hypothesis	Proficient learning
Phonics	Questions, cues, and advanced organizers	Concept Mapping
Small group tuition		Worked Examples

Despite a large amount of research and effort which has gone into developing instructional designs such as Merrill's Component Display Theory and the First Principles of Instruction, and teaching strategies that foster high achievement (Hattie, 2011, 2012, 2013; Higgins et al., 2001; Pollock, Marzano, & Pickering) the teaching staff still lack the knowledge and expertise needed to effectively implement these strategies. Teachers must be knowledgeable not only of the high impact teaching strategies, but also how to effectively put them into practice. we present in this paper offers as a solution to this problem.

Highly Optimised Structured Teaching

The Highly Optimised Structured Teaching (HOST) method, which comprises a 3-levels teaching structure framework, designed to facilitate faster, better and Stronger learning.

The 3 levels teaching structures classifies the teaching activities into three levels

- Foundation Level

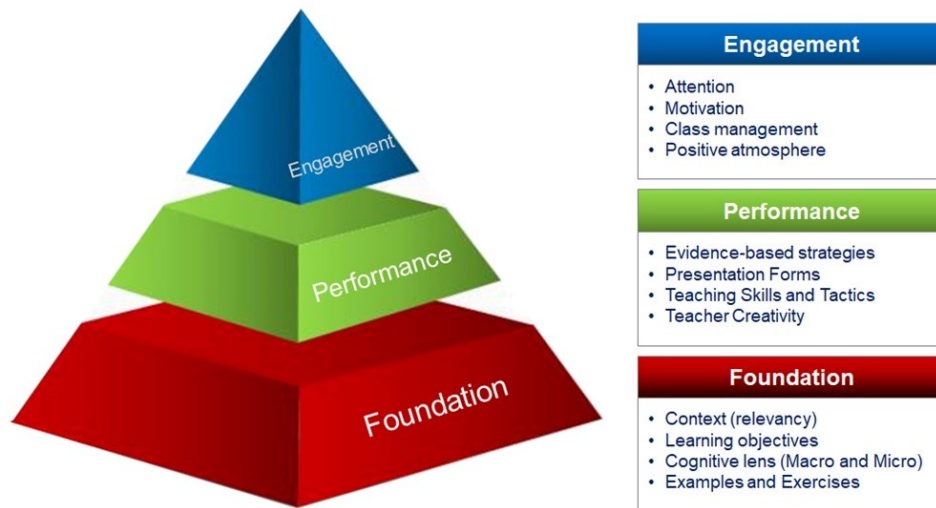- Strengthening Level

- Engagement Level

Figure 2. The 3-Levels Teaching Structure.

Foundation level

The first level is the foundation of effective teaching, the foundation level is the building blocks of teaching process. It is based on the Primary Presentation Forms (PPFs) model of Merrill's Component Display Theory (Merrill, 1983).

The Component Display Theory (CDT) was introduced in 1983 by David Merrill. The theory soon gained popularity among instructional designers, and in 1994 Merrill introduced a new version of it, known as the Component Design Theory (Merrill, 1994). Then Merrill introduced the First Principles of Instruction (Merrill, 2002). According to the Component Display Theory (CDT), there are two basic dimensions instructional designers should consider with respect to learning:

- The content dimension is comprised of facts, concepts, procedures, and principles.

- The performance dimension is comprised of remembering, using and finding.

The three-level teaching structure focuses on the Presentation Forms rather than the content and performance dimensions.

Merrill proposed four primary presentation forms (PPFs) which are: expository generality (rule), expository instance (example), inquisitory generality (recall), and inquisitory instance (practice). In simple language, the four primary presentation forms (PPFs) are:

- Tell (rules),

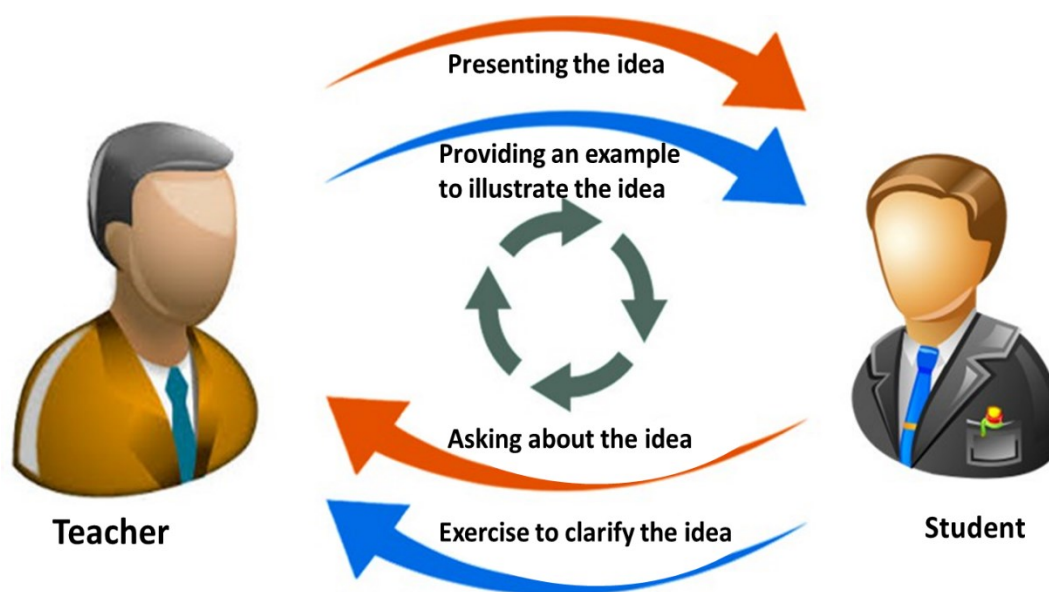- Show (examples),

- Ask (recall) and

- Ask to do (practice).

Figure 3. The four primary presentation forms (PPFs)

Secondary Presentation Forms (SPFs) consist of information added to facilitate learning such as attention focusing help, mnemonics, and feedback. The original CDT's secondary presentation forms include specific considerations (prerequisites, objectives, helps, mnemonics, and feedback). The 3-levels teaching framework expands the concept of the secondary presentation forms so that they include all evidence-based strategies such as the high-impact evidence-based teaching strategies of Hattie, Marzano and EEF. The new expanded second presentation forms becomes the second level of the Highly Optimized Structured Teaching framework.

Strengthener Level

The second level, where most effective and evidence-based teaching strategies are used and practiced. This level is the extended secondary presentation forms of Merrill's CDT,

where the secondary presentation forms have been expanded to include any evidence−based strategy, which enables the student to acquire concepts faster, better and stronger, for example, the first ten strategies of Hattie, the nine effective instructional strategies of Marzano, and other effective strategies and methods.

Engagement Level:

Student engagement is a critical factor in education, and is essential for effective learning. The implications of student engagement are far−reaching, including improved learning, teaching, and quality processes. The importance of a student's intellectual engagement lies at the core of successful teaching; it is often the primary aspect that educators point to when describing the classroom atmosphere and educational experiences of a teacher they consider to be an expert. An engagement level may include some or all of the following:

- Attention

- Class management

- Positive atmosphere

- Motivation

Current literature often identifies five main types of student engagement: Academic, Cognitive, Behavioral, and Psychological, and Social. However, more categories or variations are usually commonly being added. Pittaway (2012,) proposed a five−part engagement framework, that was not hierarchical, consisting of personal, academic, intellectual, social, and professional engagement. Payne (2017) suggested that many authors have constructed student association models of student engagement. Danielson Group (2021) published a handbook offering advice and tactics to effectively involving students in their education.

The 3−levels of Highly Optimised Structured Teaching framework utilizes meta−cognitive strategies to help teachers think about their own teaching more explicitly. The concept of metacognition involves reflection on one's thinking, and includes two components: metacognitive knowledge and Metacognitive regulation.

Metacognition in a three−level teaching structure is similar to having three eyes keeping watch in the classroom, as it requires one to be aware of the needs of each level and adjust one's focus according with the available resources (Figure 3).
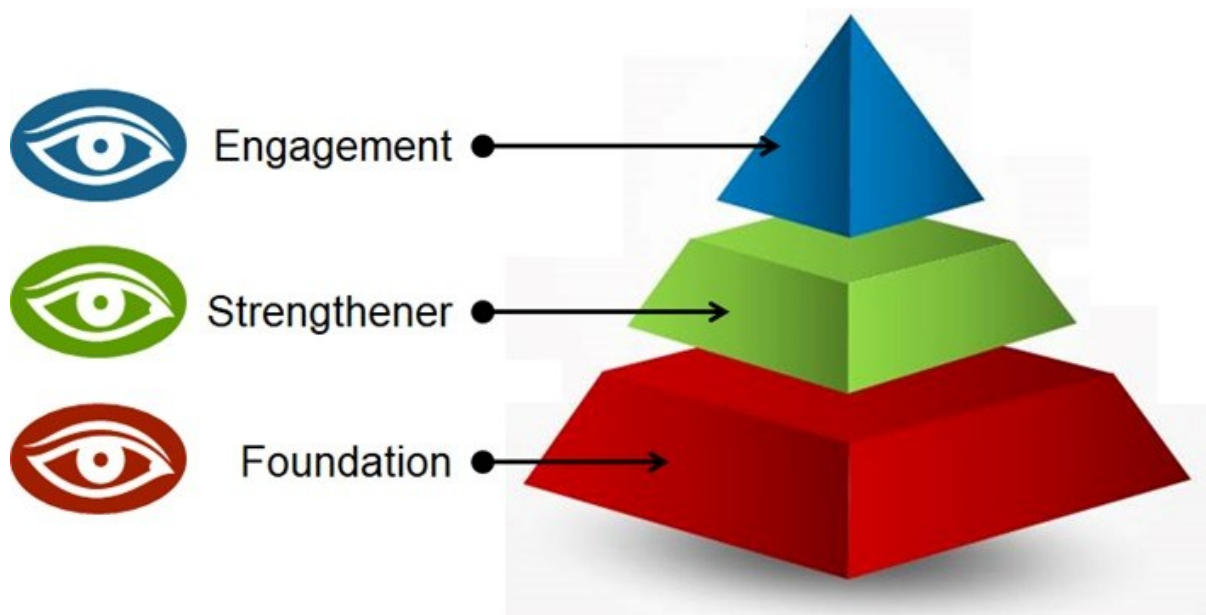
Figure 4. The 3-level teaching structure and three eyes

Case Study in Teaching Descriptive Statistics

Case Study

It is a research method used to collect and analyze data about a particular phenomenon or group to understand it in depth.

Importance of the case study

Provides a comprehensive and detailed overview of the topic considered.

It helps to understand the context in which the phenomenon occurs and the factors surrounding it.

Used to develop or modify theories based on factual observations.

Helps find practical solutions to problems by analyzing actual cases.

How to use the case study

Determine the case to be studied, and the choice is based on the objectives of the research and access to the necessary information.

Data collection

Data analysis

Presenting findings

Document all information and data used in the study.

Case Study: Teaching Descriptive Statistics

Descriptive statistics has been prepared using a Highly Optimised Structured Teaching system, which takes 12 lessons, after which each student should be able to rephrase:

Define and explain the concepts of descriptive statistics.

Creating frequency tables and graphs.

Calculation of statistical measures.

Interpret the scatter diagram and determine the type and degree of correlation between variables.

Using a scatterplot in many real applications.

The lessons were delivered using PowerPoint slides. The methods and strategies of the three-level high-productivity teaching system were applied Forms Presentation Primary (PPFs) were followed and applied in element presentation theory.

The extension and use of CDT Secondary Forms Presentation (SPFs) was done as a second layer of teaching.

The concept of Cognitive Lens, Segmentation & Chunking Sequencing of Charles Reigeluth's Theory Elaboration (Reigeluth et al. 1980) was used.

Care was taken to interact with students to keep them connected.

Then two qual-sized groups of students were selected, and they were taught the same curriculum, under the same conditions and surrounding environment, with only differences in teaching strategy and implementation of teaching methods.

The concepts taught are:

Statistics: Statistics – descriptive statistics – population – sample.

Variables: quantitative and qualitative.

Frequency Tables: Frequency – Relative Frequency – Increasing (Decreasing) Cumulative Frequency.

Graphs: Pie Chart – Bar Chart – Histogram – Polygon – Curve.

Measures of center: mode – median – mean – the first quarter – the third quarter.

Measures of dispersion: range, interquartile range, variance, standard deviation, coefficient of variation.

The relationship between two variables: covariance, Pearson correlation coefficient and explanations, direct correlation and inverse correlation, linear regression equation.

At the end of the semester, the same test was applied in the same period.

Results

Test group

Sample: 497 students from the Faculty of Economics, First Semester – Ibn Zahr University – Morocco

Inputs and teaching method: 35 concepts related to descriptive statistics using the Highly Optimised Structured Teaching method.

Results:

- 58% of the sample achieved good merit.

- 25% good merit.

- 12% Intermediate Merit.

- 05% average merit.

- The mean markup of the sample is: 14

- The standard deviation is: 2.51

One-third of the time allocated for teaching the subject was provided from 12 to 8 classes with better comprehension.

Control group:

Sample: 497 students from the Faculty of Economics, First Semester – Ibn Zahr University – Morocco.

Inputs and teaching method: Teaching 35 concepts related to descriptive statistics in the traditional method.

- 25% of the sample achieved good merit.

- 10% good merit.

- 45% average merit.

- 20% average merit.

- The mean markup of the sample is: 11

- The standard deviation is: 3.45

The duration is the time originally allocated for teaching the subject, that is, 12 classes.

The study of Cohn's effect size, denoted by d, is used to measure the difference between the mean of the experimental group and the control group

$$d = \frac{m_2 - m_1}{SD_{pooled}}$$

$$SD_{pooled} = \sqrt{\frac{(n_1 - 1)SD_1^2 + (n_2 - 1)SD_2^2}{n_1 + n_2 - 2}}$$

where:

n_2 and n_1 are the sample sizes for the two groups.

m_2 and m_1 are the means of the two groups.

SD_2 and SD_1 are the standard deviations of the two groups.

SD_{pooled} is the combined standard deviation.

Control group: Mean =11, Standard deviation = 3.45, Sample size = 497.

Experimental group: mean =14, standard deviation = 2.51, sample size = 497.

We use these values to calculate Cohen's d, so we get the following value: **d=0.76**

This value means that there is a clear and important difference between the two groups, which indicates that there is a statistical significance in the impact of the Highly Optimised Structured Teaching method.

Conclusion

This study proved the importance of teaching quality and its elements of effectiveness and efficiency in relation to student achievements and increasing the effectiveness of their teaching while reducing time and effort. Highly Optimised Structured Teaching based on a three-level teaching structure has two main benefits:

First, it provides teachers with a practical and clear teaching method.

Second, it ensures highly efficient and effective teaching. As a result of these features, teachers will be able to save classroom teaching time without compromising student achievement.

Recommendations

Understanding what constitutes effective and efficient teaching is an essential aspect of teacher CPD.

It is essential in any teacher development program to emphasize the two dimensions of teaching efficiency and effectiveness.

Teachers' professional knowledge and skills can be developed through professional development and in-service programs to achieve successful student outcomes.

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