The Highly Optimized Structured Teaching Case Study –

Descriptive Statistics –

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Received 20/05/2024 – Accepted 09/06/2024 Available online 15/07/2024

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
Innovations Journal of Humanities and Social Studies – Vol 2, No 2, 2024

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 (Tikriti, 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. Demonstrates concepts (Three: Performance, Effectiveness, and Efficiency)](image)

**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-throughput teaching system. The study measured the size of the impact.

**Theoretical Framework and Previous Studies**

**Evidence-Based Learning 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 education. 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. This practice should yield positive results in order to be considered an Evidence-Based Practice (EBP). EBP is not only based on learning theory or on a scientific basis, but it must also be supported by demonstrating 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 magnitude of impact. The most important sources of these strategies are:

John Hattie

Works by Robert Marzano

The British Educational Endowment Foundation (EEF)

**Meta-analysis**

Meta-analysis is a statistical method used to synthesize the results of previous quantitative research studies and draw a single comparable result from a large body of research (Normand, 1999). It combines the results of individual studies to reach a more comprehensive
understanding of the topic under study. In meta-analysis, researchers combine the results of multiple studies addressing the same research questions. This is typically achieved by finding a common measure of the magnitude of the effect and using a meta-regression model (Shelby & Vaske, 2008). This analysis assumes that each study provides a distinct measure of the underlying relationship between members of the study population. By accumulating the results of various studies, it achieves a more accurate representation of the study population, contrary to the estimates from individual studies (Higgins et al., 2022).

**Magnitude of Impact**

Meta-analysis is based on the magnitude of the effect to provide an accurate and meaningful assessment of the magnitude and significance of the differences between two or more groups. It allows studies of different sample sizes to be compared, enabling a more objective analysis of the data. This approach encourages a more scientific way of understanding the effectiveness of the intervention 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 measuring the size of differences between two groups. This standardized scale makes it easier to compute and interpret data and allows for a more scientific approach to understanding the effectiveness of an intervention. The magnitude of the impact can illustrate the importance of the intervention more than the statistical significance and is essential for reporting and interpreting the results in terms of the magnitudes of the impact.

Professor John Hattie is widely known in the education sector for integrating the results of several descriptive analyses of educational research and creating a list of interventions and the corresponding average size of statistical impact. An impact size of 0.4 is considered a ‘hinge point,’ as interventions above this are considered 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, i.e., the highest effect size.

The work of Professor Robert Marzano and his team (Marzano, 2001) is essential for teachers, as it provides evidence-based summaries of effective teaching strategies. These strategies include making analogies and metaphors, getting the student to create study notes, and providing feedback. These strategies have the highest volume of impact reviewed from classroom-based research and are appropriate for any field or topic. Although more recent research has been conducted since its publication, the first nine teaching methods identified 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 impact size, supporting evidence, 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 a cutting-edge resource that is regularly updated with the latest findings from projects funded by the Educational Endowment and other pioneering 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-rated strategies are known as high-impact teaching strategies. Table 1 presents a list of some of these strategies.

Table 1. High Impact Teaching Strategies

<table>
<thead>
<tr>
<th>Education Endowment Foundation</th>
<th>Robert Marzano</th>
<th>Hattie</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feedback</td>
<td>the similarities and differences</td>
<td>DIRECT INSTRUCTION</td>
</tr>
<tr>
<td>Peer teaching</td>
<td>Summarize and take notes</td>
<td>Note-Writing</td>
</tr>
<tr>
<td>On first years</td>
<td>Strengthen efforts and encouragement</td>
<td>Spaced practice</td>
</tr>
<tr>
<td>Tutoring – one-on-one</td>
<td>Home duties</td>
<td>Feedback</td>
</tr>
<tr>
<td>Home duties</td>
<td>Non-linguistic representations</td>
<td>Teaching meta-knowledge skills</td>
</tr>
<tr>
<td>Cooperative learning</td>
<td>Cooperative learning</td>
<td>Problem-solving</td>
</tr>
<tr>
<td>Oral Language Intervention</td>
<td>Setting goals and feedback</td>
<td>Reciprocal teaching</td>
</tr>
</tbody>
</table>
But despite the large amount of research and effort that has been put into developing instructional designs such as Merrill's Elemental Display Theory and the First Principles of Education, as well as teaching strategies that promote high achievement (Hattie, 2011, 2012, 2013; Higgins et al., 2001; Pollock, Marzano, & Pickering), there is still a lack of knowledge and experience to effectively implement these strategies. This is what the structured, high-throughput teaching system we present in this paper offers as a solution to this problem.

High-productivity teaching system

The High Productivity Structured Teaching (Host) model is based on the structure of the three levels of education to enhance teaching efficiency, which consists of three levels:

Base Level

Reinforcement Level

Correlation Level:
**Figure 2. Three-Level Structured High Productivity Teaching Model**

**Base level**

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

Component Display Theory (CDT) was introduced in 1983 by David Merrill. The theory quickly gained popularity among education designers, and in 1994 Merrill introduced a new version of it, known as Element Design Theory (Merrill, 1994). Merrill then introduced the first principles of education (Merrill, 2002) to item presentation theory, and there are two key dimensions that education designers should consider in relation to learning:

- **After content:** which consists of facts, concepts, procedures, and rules.
- **Post–performance:** Consists of recall, use, and derivation.

The three-level teaching structure focuses on the forms of presentation rather than on the dimensions of content and performance.

Merrill proposed four primary presentation forms (PPFs) (namely: explanatory generality (norm), explanatory example (example), investigative generality (recall), and investigative example (practice). In simple language, the four basic presentation forms (PPFs) are:

- **Idea submission**
  - Provide an example to illustrate the idea
  - Ask about the idea
  - To make the point.
Figure 3. The first level of the host form and its purpose is to provide the content and material to be learned.

SPFs (Forms Presentation Secondary) consist of information added to facilitate learning such as helping to focus attention, recall techniques, and feedback. But the three-tier host model extends the concept of secondary offerings to include high-impact evidence-based strategies for Hattie, Marzano, and the learning endowment. The new extended secondary forms of presentation become the second level of the structured, high-throughput teaching framework.

**Reinforcement Level**

The most effective and evidence-based teaching strategies are used and practiced. This level is the extended secondary forms of presentation in CDT, where the secondary forms of presentation 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 educational strategies of Marzano, and other effective strategies and methods, such as overview, context, segmentation and succession, cognitive lens, zoom in and out, and summary.

**Correlation Level:**

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 attachment lies at the core of successful teaching, and this is often the primary aspect teachers refer to when describing
the classroom atmosphere and educational experiences of a teacher they consider an expert.

A correlation level may include some or all of the following:

Care

Classroom management

Positive atmosphere

Motivating

Current literature often identifies five main types of student attachment: academic, cognitive, behavioral, and psychosocial. However, more categories or variations are usually added. Pittaway (2012,) proposed a five-part attachment framework, consisting of personal, academic, intellectual, social, and professional attachment. Payne (2017 Payne,) suggested that many authors have constructed student association models. The Danielson Group (2021 Danielson Group) has published a booklet that provides advice and tactics to effectively engage the student in their education.

The three-level structured high-throughput teaching framework uses metacognition strategies to help teachers think about their teaching more clearly. The concept of metacognition involves reflection on one’s thinking, and includes two elements:

Knowledge beyond knowledge

metacognition

Metacognition in a three-level teaching structure is similar to having three eyes watching in the classroom, requiring the teacher to be aware of the needs of each level and adjust their focus according to the requirements and resources available (Figure 3)
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 high-throughput teaching system, which takes 12 lessons, after which each student should be able to rephrase:

1. Define and explain the concepts of descriptive statistics.
2. Creating frequency tables and graphs.
3. Calculation of statistical measures.
4. Interpret the scatter diagram and determine the type and degree of correlation between variables.
5. 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 expansion and use of CDT Secondary Forms Presentation (SPFs) was done as a second layer of teaching.

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

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

Then two equal 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 – society – sample

**Variables:** quantity and quality

**Frequency Tables:** Frequency – Relative Frequency – Cumulative Up and Down Frequency

**Graphs:** Circle, Columns, Runway, Polygon, Curve.
Center measures: mode, median, mean, first quarter, 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: 500 students from the Faculty of Economics, First Semester – Ibn Zahr University – Morocco

Inputs and teaching method: 35 concepts related to descriptive statistics of the high productivity teaching system

Results:

- 58% of the sample achieved good merit.
- 25% good merit.
- 12% Intermediate Merit.
- 05% average merit.

The average 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: 500 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 average 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

\[
\begin{align*}
    d &= \frac{m_2 - m_1}{SD_{\text{pooled}}} \\
    SD_{\text{pooled}} &= \sqrt{\frac{(n_1 - 1)SD_1^2 + (n_2 - 1)SD_2^2}{n_1 + n_2 - 2}}
\end{align*}
\]

where:

\( n_2 \) These \( n_1 \) are the sample sizes for the two groups.

\( m_2 \) These \( m_1 \) are the averages of the two groups.

\( SD_2 \) These \( SD_1 \) are the standard deviations of the two groups.

\( SD_{\text{pooled}} \) is the combined standard deviation.

Control group: Mean=11, Standard deviation =3.45, Sample size =500.

Experimental group: mean=14, standard deviation =2.51, sample size =500.

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 productive 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. Teaching Structured Optimized Highly (host) Teaching Structured Optimized Highly 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.

**References**


