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QUANTITATIVE AND QUALITATIVE METHODOLOGIES FOR EVALUATING INTERACTIVE TECHNOLOGIES IN EDUCATION

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Abstract

This article examines the methodological frameworks used to assess the impact of interactive technologies on student engagement and learning outcomes. It highlights the strengths of quantitative approaches, such as pedagogical experiments and statistical analysis, in providing objective and reliable data. Simultaneously, it acknowledges the limitations of numerical data in capturing the psychological nuances of learning. The study advocates for a mixed-methods approach, integrating qualitative techniques like stimulated recall and discourse analysis to reveal the internal mechanisms of student activity, cognitive strategies, and self-regulation.

Keywords: quantitative methods, qualitative analysis, pedagogical experiment, mixed methodology, Student’s t-test, stimulated recall, learning outcomes.

Quantitative Analysis: Measuring Objective Impact

Quantitative analysis methods hold significant importance in objectively evaluating the effectiveness of the educational process. In determining the impact of interactive technologies, these methods provide clear, comparable, and statistically reliable results.

A central tool in this category is the **pedagogical experiment**. Typically, researchers establish an experimental group (utilizing interactive technologies) and a control group (following traditional methods). By comparing activity indicators across these groups, the real pedagogical effectiveness of the intervention can be measured.

To ensure accuracy, researchers utilize **observation protocols** to track objective parameters, including:

- Frequency of student-led questions.
- The number of constructive responses during discussions.
- Contribution levels within group tasks.
- Performance speed in practical assignments.

Statistical Reliability in Pedagogical Research

To ensure that observed improvements are not the result of chance, mathematical-statistical methods are applied to the raw data. Key metrics include the mean, variance, and standard deviation. Specifically, the **Student's t-test** is utilized to establish the reliability level of the results (Hafizov, 2024). Furthermore, the use of **Likert-scale questionnaires** allows researchers to convert subjective student attitudes—such as self-confidence and motivation—into numerical indicators suitable for rigorous statistical processing.

The Limitations of Numbers

Despite their objectivity, quantitative methods often fail to reflect the deep, internal psychological processes of learning. Numerical results can act as a general indicator of activity but often struggle to reveal the "how" and "why" behind student behavior. They may overlook the formation of metacognitive strategies, reflective thinking, or the depth of topic perception (Hafizov, 2024).

Qualitative Methodology: Uncovering the Learning Experience

To fill the gaps left by quantitative data, qualitative methods are employed to understand students' subjective experiences and emotions. These methods include:

- **In-depth Interviews and Focus Groups:** Exploring the reasoning behind student participation.
- **Stimulated Recall:** Showing students video recordings of their own interactive

sessions to prompt them to explain their decisions and actions. This provides invaluable data on cognitive activity and self-regulation.

- **Discourse Analysis:** Examining student-generated content (blogs, forum posts, multimedia projects) to gain insights into their thinking styles, cultural awareness, and linguistic choices.

Synthesis: The Mixed-Methods Approach

Modern pedagogical research suggests that the most optimal approach is a **mixed methodology**. While quantitative analysis measures the frequency and results of interaction, qualitative analysis reveals the meaningful and psychological essence of those results. This synergy allows educators to understand how interactive technologies shape not only academic performance but also communication culture and students' overall attitudes toward the learning process.

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