The Results of the Development of a Science Instructional Kit to Improve Teachers' Students' Memory and Understanding in Biology Courses

Phatcharida Inthama, Srinakharinwirot University, Thailand
Suwicha Wansudon, Srinakharinwirot University, Thailand
Sompong Jaideechoey, Srinakharinwirot University, Thailand
Trai Unyapoti, Srinakharinwirot University, Thailand

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Abstract
The objective of this research was to create a scientific learning kit that concentrates on improving the retention and comprehension of biological concepts, with a particular emphasis on the structure and function of cells, for students in the field of science education. Nineteen scientific education students from the Faculty of Education participated in the study, which utilized a one-group pre-test post-test design. The research instruments consisted of student satisfaction questionnaires, achievement assessments, and the scientific learning kit. The scientific learning bundle resulted in a statistically significant improvement in the academic performance of students. The pre-test score (26.74 points) was substantially lower than the average post-test score (43.89 points). The students expressed a high level of satisfaction with the learning kit, with an average satisfaction rating of 4 to 5, which indicates their adoption and approval of the developed package. The scientific learning program significantly enhanced learning achievement, particularly for students with lower pre-test scores, as evidenced by the average normalized gain of 0.73. Consequently, the scientific learning bundle that was developed effectively facilitated the comprehension and retention of biological concepts, as well as the development of students' analytical thinking abilities and the capacity to apply their knowledge. In order to evaluate learning outcomes in broader contexts, future research should consider expanding the sample size and adapting the learning package to more complex biology topics.

Keywords: Scientific Learning Kit, Memory Retention, Understanding, Biology, Learning Achievement

Introduction

Higher education, particularly in the field of science, presents significant challenges due to its complex content and the need for deep understanding. Science teachers' students must acquire both theoretical knowledge and practical skills to prepare themselves for their future roles as educators. Science education emphasizes not only memorization but also fostering understanding that can be applied in real-world contexts. This is especially crucial in biology courses, which cover intricate topics such as cell structure, biological systems, and various processes within living organisms. These are essential areas of knowledge for science teachers' students to master in order to effectively transfer knowledge to younger generations.

The National Education Act B.E. 2542 (1999) emphasizes learner-centered education, recognizing individual differences and the belief that everyone can learn. Teachers play a vital role in enhancing learners' potential through learner-centered approaches (Ministry of Education, 2008). This principle encourages the development of flexible learning materials tailored to the needs of students. In biology courses, using diverse learning materials such as diagrams, models, and animations to illustrate cell structures and processes helps science teachers' students gain deeper understanding and apply their knowledge in real-life situations.

Learning through observation and hands-on practice enables students to better retain and comprehend content. For example, using microscopes to observe cell structures provides learners with a clear visual understanding that connects theory to practice (Institute for the Promotion of Teaching Science and Technology, 2003). Combining theoretical and practical teaching methods is thus an effective approach to fostering in-depth knowledge among science teachers' students, which is critical for enhancing the quality of future teaching.

This integration of media and hands-on activities aligns with research findings that visual aids and colors impact memory and understanding. Warm colors, such as red and yellow, stimulate the brain and increase alertness, which enhances content retention and deeper understanding (Wolters et al., 2005). Therefore, developing learning materials that incorporate visual aids, and hands-on activities can significantly improve learning outcomes.

Science learning kits that are specifically designed not only enhance science teachers' students' understanding of biological content but also help them develop teaching skills applicable to their future classrooms. Creating diverse and innovative teaching materials enables them to design engaging and effective lessons. This is particularly important in today's rapidly evolving knowledge-based society.

This research is significant in developing science learning kits that enhance memory retention and understanding in biology courses for science teachers' students. These kits aim to prepare them to become high-quality educators capable of effectively passing on knowledge to future generations.

Methodology

Phase 1: Preliminary Study

This phase involves gathering foundational information to guide the development of the instructional kit. The activities include:

1. Studying Relevant Theories and Research

Reviewing literature and research on biology education to understand effective teaching strategies.

2. Analyzing Curricula and Standards
   Examining biology course content, learning objectives, and assessing standards to ensure alignment.
3. Exploring Instructional Kit Design
   Investigating principles of instructional design to create effective and engaging learning materials.

Phase 2: Development of the Instructional Kit and Evaluation of Its Use

This phase focuses on creating and refining the instructional kit while assessing its effectiveness. Key steps include:

1. Sample Group
   The study targets undergraduate students majoring in science education, specifically those enrolled in science teacher preparation programs.
2. Development of Research Tools
   - Achievement Tests in Biology: Design tests to evaluate memory and understanding, focused on biological concepts.
   - Multiple-Choice Test Design: Develop multiple-choice questions covering key content areas to assess both recall and comprehension.
3. Testing
   Trial the tests with a small sample group to identify and address potential issues.
4. Implementation in the Main Sample Group
   Administer the finalized tests to the larger target group of students to evaluate the instructional kit's effectiveness.

Phase 3: Data Collection and Research Design

The research adopts an experimental approach using a One-Group Pre-test and Post-test Design, which includes the following steps:

1. Pre-test Administration
   Conduct a pre-test with the sample group to measure baseline knowledge and understanding.
2. Treatment (Use of the Instructional Kit)
   Implement the instructional kit with the sample group to teach key biology concepts.
3. Post-test Administration
   Conduct a post-test with the same group to evaluate improvements in memory and understanding.

Results and Discussion

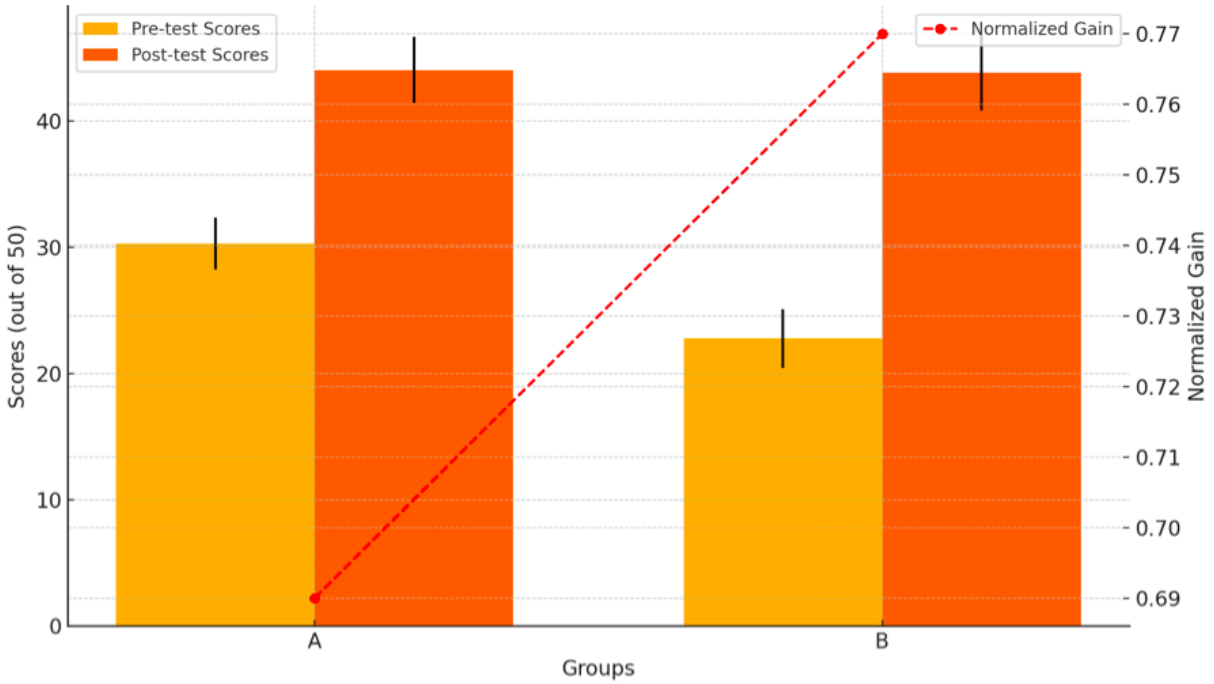

Figure 1: Comparison of Pre-test and Post-test Scores With Normalized Gain

The study analyzed the learning achievement in the biology topic "Cell Structure and Function" by categorizing students into two groups based on their Pre-test scores. The sample consisted of 19 science teacher students.

Group A (Higher Pre-test Scores) Students in this group demonstrated less score variation in the Post-test, indicating a more consistent level of performance after learning. And Group B (Lower Pre-test Scores) Students in this group showed greater improvement in learning outcomes after using the instructional kit.

Higher Normalized Gain for Group B

Group B (students with lower Pre-test scores) achieved a higher Normalized Gain (0.77) compared to Group A (0.69). This suggests that students starting with lower scores experienced greater improvement in learning ability after using the instructional kit.

Comparable Post-test Averages

The Post-test average score for both groups were very close44.00 for Group A. ,43.78 for Group B. This indicates that the instructional kit effectively supported both groups, leading to similar learning outcomes despite initial differences in Pre-test performance.

Conclusions

Improved Learning Achievement

The instructional kit focusing on cell structure and function significantly enhanced the academic performance of science teacher students, as evidenced by the marked improvement in post-test scores compared to pre-test results. This finding aligns with prior research by Tsai

and Chang (2005), which demonstrated the effectiveness of inquiry-based learning kits in improving scientific literacy and understanding. The integration of visual aids and interactive components in the kit contributed to better comprehension and retention of biological concepts, consistent with Mayer's (2005) multimedia learning principles.

High Satisfaction Levels

Students reported high levels of satisfaction with the instructional kit, citing the use of real-life tools and visual media as key factors in making the content more engaging and easier to understand. This is supported by Rieber's (1996) findings on the positive impact of interactive visualizations in enhancing learner engagement. The kit's engaging activities also align with Hofstein and Lunetta's (2004) research, which highlights the role of hands-on learning in fostering critical thinking and active participation.

Bridging Knowledge Gaps

The instructional kit effectively addressed disparities in prior knowledge among students. Those with lower pre-test scores showed significant progress, as reflected in their higher normalized gain compared to peers with stronger initial performance. This outcome resonates with Vygotsky's (1978) Zone of Proximal Development, emphasizing the importance of instructional support tailored to individual learning needs. Additionally, the results mirror the findings of Sundberg and Moncada (1994), who demonstrated that targeted teaching materials can bridge gaps in understanding complex biological processes.

The findings of this study corroborate existing research on the efficacy of well-designed instructional kits in science education. By combining visual aids, hands-on activities, and learner-centered strategies, the developed kit not only enhanced students' academic performance but also addressed diverse learning needs effectively. This reinforces the importance of innovative teaching materials in preparing science-teacher students to become competent educators capable of transferring knowledge to future generations.

Recommendations

1. Larger Sample Size Conduct studies with a larger sample to improve accuracy and broader applicability.
2. Complex Topics Adapt the instructional kit for advanced biology topics to test knowledge application.
3. Long-term Impact Perform follow-up studies to assess lasting effects on learning and future knowledge use.

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Contact email: phatcharida@g.swu.ac.th