Patient-Centered Approaches to Medical Intervention

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About MedForum

This book is the collection of selected articles that appeared at the First MedForum: International Conference on Patient-Centered Approaches to Medical Intervention held in Hyderabad in virtual mode on September 27 & 28, 2024.

In this forum following issues were discussed: exploring the collaborative process where healthcare providers and patients work together to select treatments that best align with clinical evidence, patient values, and individual preferences, delving into cutting-edge approaches to tailoring medical interventions based on genetic profiles, lifestyle choices, and environmental factors for improved efficacy and minimized risks, discovering methods to empower patients through education, communication, and the integration of patient-reported outcomes into healthcare practices, examining strategies for reducing disparities and ensuring equitable healthcare access for all, particularly underserved populations, learning about the transformative role of telemedicine, wearable devices, and digital health platforms in modern healthcare, and how they connect patients and professionals with the latest medical advancements, gaining an understanding of the ethical challenges in patient-centered care, including privacy, autonomy, and the ethical use of emerging technologies.


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Enhancing Biophysics Problem-Solving Skills in Medical Students Through a Targeted Three-Step Strategy

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Abstract

This study evaluates the impact of a three-step biophysics problem-solving strategy on students from disadvantaged backgrounds enrolled in the Basic Medicine Program at SMU. The research involved three cohorts (2010, 2012, 2013) and measured performance improvements through pre- and post-intervention tests. Significant enhancements were observed in the 2012 and 2013 cohorts, with 100% and 96% passing post-intervention tests, respectively, compared to marginal scores in the 2010 cohort, which did not receive the intervention. The study utilised lectures, group discussions, and practical sessions to build students' cognitive abilities and problem-solving skills. The three-step strategy led to better understanding and application of biophysics concepts, showing the effectiveness of targeted interventions in closing educational gaps. The study suggests extending this approach to other medical modules and recommends further research into additional cognitive parameters for optimising learning among disadvantaged students.

Key words: Medical University Biophysics, Methodology, Integration, Contextual Learning, Scored Criteria, Integrated Model Of Specialist Training And Activities

Introduction

Access to medical education for underprivileged students, particularly from rural areas, remains a significant challenge in South Africa, with universities requiring excellent grade 12 performance in mathematics and physics as prerequisites for medical degrees. This limited access creates barriers for students in disadvantaged communities (Resnick, 1987). Problem-solving, especially in biophysics, is a critical skill for mastering medical and scientific concepts, yet it requires strategic design and cognitive processes that many students struggle with (Meyer, 1992). The importance of effective problem-solving strategies in biophysics has been widely discussed in the literature, with Gordon (2004) highlighting the need for continuous practice, and Maloney (2009) emphasising the role of internal and external representations in solving complex problems. A well-structured approach to problem-solving, such as the three-stage strategy, can significantly enhance students' cognitive abilities and academic performance in biophysics (Maloney, 2009). This research proposes that implementing this strategy can not only improve students' performance but also contribute to addressing the broader problem of access to medical education, ultimately benefiting the medical field by fostering skilled professionals who can contribute to underserved communities.

Objective of the Study

The aim of this study is to evaluate the impact of a three-step biophysics problem-solving strategy on improving the cognitive abilities and academic performance of students from disadvantaged communities. By implementing this strategy, the study seeks to enhance students' understanding of biophysics concepts and promote success in their medical education journey.

Materials and methods

The study employed a retrospective analysis of biophysics and numeracy module performance data from three cohorts (2010, 2012, and 2013), consisting of 50 students each in 2010 and 2013, and 45 in 2012. Participants were selected based on their disadvantaged educational backgrounds, particularly in mathematics and physics, where most scored between 50-59%, with some achieving 60-69%. The intervention involved a three-step biophysics problem-solving strategy designed to enhance students' understanding of key concepts.

The study duration spanned over one academic year for each cohort, with weekly lectures, study sessions, and practical experiments. These sessions covered topics like force, energy, fluid dynamics, electromagnetism, and radioactivity, with students engaging in problem-solving exercises and group discussions. Tools included textbooks, laboratory manuals, study guides, and pre- and post-intervention tests to evaluate progress.

Inclusions for the study were students enrolled in the Basic Medicine Program with grade 12 results in mathematics and physics, while exclusions included students who did not meet the prerequisites. No specific patient data was involved, as the focus was on academic performance. Additional parameters, such as cognitive ability assessments, could have been

considered for more detailed analysis of individual student progress.

The three-step strategy for solving biophysics problems improves students' understanding of biophysics concepts.

Table 1. Biophysics Problem-Solving Evaluation Criteria

Did the student make a qualitative description of physical phenomena using diagrams?	1
The student listed the data	0.5
Did the student list the unknown or what needs to be calculated or found?	0.5
Did the student provide a power diagram?	1
Are the forces defined correctly in both the Y and X directions?	2
Is the resultant force calculated correctly?	2
Did the student write the appropriate mathematical formula?	1
Has the corresponding mathematical formula been rewritten, as a result of which the unknown variable must be calculated?	1
Is the data entered correctly in the formula?	2
Are the units of measurement correct in the final answer?	1
Any indication that the answer has been checked to see if it is numerically sound.	1
Has dimensional consistency been assessed?	1
Is the appropriate number of significant digits used?	1

A three-step strategy for solving biophysics problems (intervention mechanism) was presented to the students during their lecture period after the pre-intervention test. Then the students were given the opportunity to consolidate the studied strategy for solving problems in biophysics during the training session. At the end of the training session, a post-intervention test was performed. This was scored based on the criteria in Table 1. However, this test was not included in the final score. It was used as a barometer to measure the impact of near-introduced intervention mechanisms (three-step biophysics solution strategy).

The students worked in small groups of three or four during the study sessions. These groups were kept for a year during training. Small groups gave students the opportunity to participate effectively in group activities and discussions, thus engaging in ideas while improving their communication skills. During the training sessions, at least two different groups were assigned to the same tasks. Other groups solved other problems, but the same level of complexity. All groups used a three-stage strategy for solving biophysical problems. The students presented their answers on the board, while the rest reviewed the answers and compared them with their own. This gave them the opportunity to change and internalize the strategy. A modification of the strategy has been made to tailor its application to specific problems. Tutor and lecturer intervened when students encountered difficulties [5].

Results

The results of the study show a clear difference in the performance of the three cohorts (2010, 2012, and 2013) across multiple assessments, including tests and the final exam. The 2012 and 2013 cohorts consistently outperformed the 2010 cohort, with noticeable improvements in their test scores, particularly after implementing the three-step biophysics problem-solving strategy. This indicates the effectiveness of the intervention in enhancing the academic performance of students from disadvantaged backgrounds.

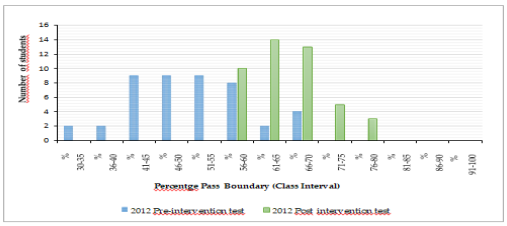

Fig 1. Distribution of concept strength scores before and after the intervention in the cohort 2012 y.

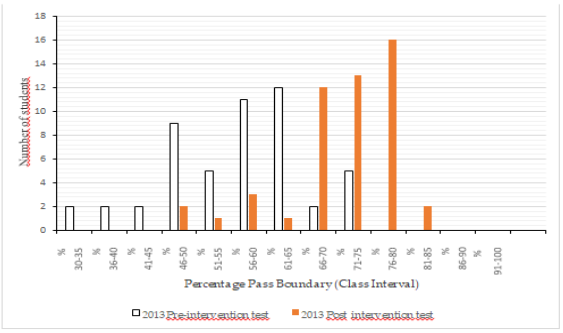

Fig 2. Distribution of concept strength scores before and after the intervention in the cohort 2013 y.

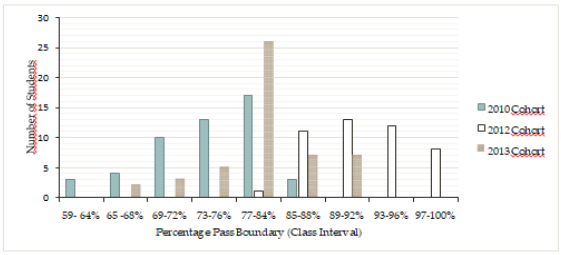

Fig 3. Distribution of results of the training test in biophysics for three cohorts.

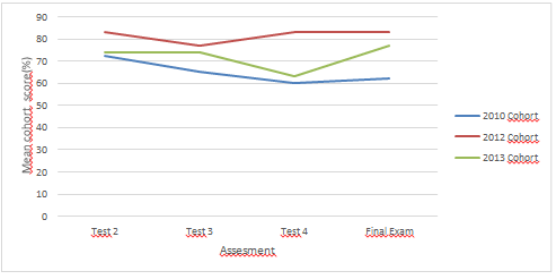

Fig 4. Comparison of estimates obtained by the 2010, 2012 and 2013 cohorts in the biophysics estimates

In conclusion, the results demonstrate the positive impact of the three-step biophysics problem-solving strategy, particularly in the 2012 and 2013 cohorts, which achieved higher test scores and final exam results compared to the 2010 cohort. The improved

performance highlights the effectiveness of the intervention in addressing academic challenges faced by students from disadvantaged backgrounds. This approach shows promise in bridging educational gaps and enhancing problem-solving abilities in biophysics, contributing to overall academic success.

Discussion

The 2010 MBCS-EKP cohort showed that students from disadvantaged schools struggled with traditional biophysics teaching methods and problem-solving. Although the group achieved a 100% pass rate, their scores were marginal. To address these challenges, an intervention mechanism was introduced across three cohorts. The 2012 cohort saw 69% of students failing the pre-intervention test, but 100% passed the post-intervention test. Similarly, 30% of the 2013 cohort failed the pre-test, but only 4% failed after the intervention, with 96% passing overall.

Before the intervention, most students failed to follow the steps outlined for solving biophysics problems, skipping vital steps such as identifying unknown quantities or manipulating units of measurement. Although some students arrived at the correct answers, many lost marks due to missing essential steps or incorrectly handling units.

Post-intervention results for the 2012 and 2013 cohorts demonstrated a significant improvement. Students were better able to identify data, perform proper analyses, and write appropriate formulas, although some minor steps were occasionally skipped. The three-step strategy improved their analytical skills and understanding of biophysics, as reflected in improved test results.

The 2010 cohort, which did not receive the intervention, had lower-quality results compared to the other groups. The 2012 and 2013 cohorts, taught using the three-step strategy, performed significantly better, underscoring the potential of disadvantaged students when given proper support and resources. This strategy allowed students to better grasp biophysics concepts, overcoming the limitations of their prior schooling.

Conclusion

This study aimed to assess the effectiveness of a three-step biophysics problem-solving strategy in improving academic performance among disadvantaged students enrolled in the Basic Medicine Program at SMU. Three cohorts (2010, 2012, 2013) were analysed. Pre- and post-intervention tests revealed significant improvements in the 2012 and 2013 cohorts, with 100% and 96% of students passing the post-tests, respectively, compared to marginal results in the 2010 cohort that did not receive the intervention. The study involved weekly lectures, practical sessions, and group activities to enhance problem-solving skills. The three-step strategy helped students understand key biophysics concepts, identify data, and apply correct formulas, ultimately improving their cognitive skills. The study highlights the potential of targeted interventions to bridge educational gaps. Recommendations include implementing similar strategies across other medical modules. Future research could explore additional cognitive parameters to further optimise teaching methods for disadvantaged learners.

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Note: All the figures and tables in this chapter were made by the author.