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Orginal Article

The Effectiveness of Brain -Based Teaching Approach (BBTA) on Motivating Students' Learning with Different Learning Styles to Physics (Newton's law in motion)

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Abstract

The purpose of this study was to measure the effectiveness of the brain-centered teaching approach on the motivation to learn physics among second-year high school students. In this semi-experimental study, a pre-test-post-test design was used with a control group. The statistical population included female students of the twelfth grade of the second year of secondary school in the city of Takestan, with 50 people selected from among them as an available sample. The research tools included the brain-based educational package along with the learning motivation questionnaire for physics, daily writings and structured interviews of students. Initially, the subjects of both groups were pre-tested, after which the subjects of the experimental group were tested for eight weeks with the help of the brain-based method, whereby the subject of dynamics (Newton's laws) was taught. Meanwhile, the control group was subjected to common training at school. After the end of the intervention on the experimental group, the subjects of both groups were ascertained by the post-test. With the help of SPSS software, analysis of covariance was employed for data analysis. The findings indicated that the students of the experimental group had greater motivation to learn than the control group, and we observed their significant superiority in the subscales of internal motivation, goal and self-efficacy. Further, three motivational patterns were identified after the

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intervention: The first pattern of students' parallel motivation compared to pre-implementation of the experimental plan, the second pattern of students' motivation becoming positive after the experimental intervention, and the third pattern of students' motivation becoming negative following the experimental intervention. Overall, it can be concluded that brain-based education can be used by teachers and counselors as an effective intervention to boost motivation in second-secondary physics lessons.

Keywords: Brain- based teaching approach, Motivation, physics educatin

Extended Abstract

Introduction

Low motivation toward learning physics is a persistent challenge in secondary education. Many students perceive physics as an abstract, difficult, and calculation-heavy subject, which often results in disengagement and low academic achievement. Traditional teacher-centered instructional methods have been identified as a major contributor to this problem. In response, recent advances in neuroscience and educational psychology underscore the significance of aligning teaching practices with the brain's natural learning processes. One such approach is the Brain-Based Teaching Approach (BBTA), which is grounded in neuroscientific principles. It focuses on creating optimal learning environments through emotional safety, active engagement, and meaningful cognitive processing. The present study aimed to examine the effectiveness of BBTA on motivating female second-secondary school students to learn physics, with a specific focus on the topic of Newton's laws of motion.

Method

This study applied a quasi-experimental reaserch pre-test–post-test design with a control group. The statistical population consisted of all twelfth-grade female students enrolled in second-secondary schools in Takestan along the 2019–2020 academic year. Owing to the specific environmental and instructional requirements of brain-based learning, a convenience sample of 50 students was selected. Participants were randomly assigned to either an experimental group (n = 25) and a control group (n = 25). The experimental group received physics instruction based on the Brain-Based Teaching

Approach for eight weeks, whereas the control group was taught using conventional teaching methods (CTM), primarily lecture-based instruction.

Students' motivation toward learning physics was measured using the Science Motivation Questionnaire II (SMQ-II), adapted for physics. This instrument appraises five dimensions of motivation: self-efficacy, autonomy, intrinsic motivation, career motivation, and goal orientation. The validity of the questionnaire was confirmed through content and face validity, with reliability established using Cronbach's alpha coefficients, ranging from 0.85 to 0.89 for the subscales and 0.87 for the total scale. In addition to quantitative data, qualitative data were collected via students' daily reflective writings and structured interviews to gain a deeper insight into motivational changes. Data were analyzed using descriptive statistics and analysis of covariance (ANCOVA) in order to control for pre-test differences.

Results

The findings revealed a significant increase in overall motivation toward learning physics among students in the experimental group compared to the control group. ANCOVA results indicated that BBTA had a statistically significant positive effect on intrinsic motivation, self-efficacy, and goal orientation. Even though mean scores for autonomy and career motivation grew in the experimental group, these changes were not statistically significant. Descriptive analyses demonstrated that students exposed to BBTA presented higher post-test motivation scores across most dimensions compared to their pre-test scores.

Qualitative findings supported the quantitative results. Students in the experimental group reported greater enjoyment of physics lessons, improved understanding of concepts, and enhanced confidence in their ability to solve physics problems. Analysis of reflective writings and interview data identified three motivational patterns post-intervention: students whose motivation remained unchanged, those whose motivation increased, and a small number of students whose motivation diminished. The majority of students in the BBTA group exhibited a positive shift in motivation, while motivational patterns in the control group indicated minimal change.

Discussion

The results of this study suggest that the Brain-Based Teaching Approach is effective on enhancing students' motivation to learn physics. Through integrating principles such as relaxed alertness, orchestrated immersion, and active processing, BBTA establishes a learning environment that supports emotional engagement and meaningful learning. These conditions facilitate

deeper cognitive processing as well as help students internalize complex physics concepts more effectively. The findings are in accordance with previous research demonstrating that brain-based instructional strategies positively influence motivation, conceptual understanding, and academic performance.

One possible explanation for the effectiveness of BBTA is its emphasis on aligning instructional strategies with students' cognitive and emotional needs. Activities such as the usage of visual aids, concept maps, music, storytelling, and collaborative learning opportunities help mitigate anxiety and boost students' interest in learning. In contrast, conventional teaching methods often fail to address students' emotional states and learning preferences, which may restrict their motivational impact.

Conclusion

Overall, the Brain-Based Teaching Approach can be an effective instructional strategy for enhancing motivation to learn physics among female secondary school students. Students who were taught using BBTA presented higher levels of intrinsic motivation, self-efficacy, and goal orientation compared to those taught through conventional methods. These findings emphasize the importance of incorporating neuroscience-informed teaching practices into physics education. It is recommended that teachers and educational planners consider the usage of BBTA to enhance students' motivation and engagement. Future research should explore the long-term effects of this approach, its applicability across different subjects and grade levels, as well as its effectiveness among diverse student populations.

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