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"Effectiveness of a STEAM-Oriented Remedial Program in Reducing Mathematics Anxiety and Improving Conceptual Understanding of Geometry: An Action Research Study at the Upper Primary Level"

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Introduction:

Mathematics is often perceived as a difficult and anxiety-provoking subject by learners, especially at the upper primary level, where abstract concepts and symbolic representations become more prominent. Geometry, a core component of the mathematics curriculum, requires visualization, logical reasoning, and spatial thinking. Many students struggle to grasp geometric concepts when instruction is limited to rote procedures and textbook-based explanations. This struggle frequently results in mathematics anxiety, which negatively affects learners' confidence, motivation, and academic performance.

Mathematics anxiety is defined as feelings of tension, apprehension, or fear that interfere with mathematical problem-solving and learning. Research has consistently shown that high levels of mathematics anxiety are associated with low achievement and avoidance of mathematical tasks. At the upper primary stage, unresolved anxiety can persist into secondary education, further widening learning gaps.

In recent years, STEAM education has emerged as an innovative instructional approach that integrates Science, Technology, Engineering, Arts, and Mathematics to promote meaningful learning. STEAM emphasizes experiential learning, creativity, real-world problem solving, and interdisciplinary connections. Such an approach has the potential to make abstract mathematical concepts more concrete, engaging, and less intimidating for learners.

Remedial programs play a crucial role in addressing learning difficulties by providing targeted support to students who lag behind. When combined with STEAM principles, remedial instruction can move beyond repetitive drill practices and instead focus on

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conceptual clarity, engagement, and emotional well-being. This study explores whether a STEAM-oriented remedial program can effectively reduce mathematics anxiety and improve conceptual understanding of geometry among upper primary students.

Review of Related Literature: Previous studies have highlighted mathematics anxiety as a major barrier to effective learning. Researchers have found that anxiety often originates from negative classroom experiences, fear of failure, and teacher-centered instructional methods. Geometry, due to its abstract nature, has been identified as a topic where anxiety is particularly pronounced among young learners.

Conceptual understanding in mathematics refers to a learner's ability to comprehend mathematical ideas, relationships, and principles rather than merely memorizing procedures. Studies suggest that students with strong conceptual understanding are better problem solvers and exhibit lower anxiety levels.

STEAM-based instruction has gained attention for its learner-centered and interdisciplinary nature. Research indicates that integrating art, design, and real-life contexts into mathematics teaching enhances engagement and deepens understanding. Hands-on activities, model construction, use of digital tools, and collaborative projects help learners visualize geometric concepts such as shapes, angles, symmetry, and area.

Action research studies in school settings have demonstrated that remedial programs grounded in constructivist and experiential learning theories can significantly improve learning outcomes. However, limited research exists on the use of STEAM-oriented remedial programs specifically to address mathematics anxiety and geometry learning at the upper primary level. This study attempts to bridge this gap.

Objectives of the Study: To study the level of mathematics anxiety among upper primary students before and after the STEAM-oriented remedial program.

To assess the conceptual understanding of geometry among upper primary students before and after the intervention of the STEAM program

To examine the effectiveness of a STEAM-oriented remedial program in reducing mathematics anxiety.

To determine the effectiveness of the program in improving conceptual understanding of geometry.

Hypotheses: There is no significant difference in mathematics anxiety scores of students before and after the STEAM-oriented remedial program.There is no significant difference in the conceptual understanding of geometry scores of students before and after the STEAM-oriented remedial program.

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Methodology

Research Design:

The study adopted an action research design using a single–group pre–test–post–test approach. This design was suitable for a classroom-based intervention aimed at improving teaching-learning practices.

Sample

The sample consisted of 42 upper primary students from 6th Standard studying geometry in a regular school setting. Students were selected purposively based on medium to high mathematics anxiety levels and low performance in geometry. The sample size was limited due to the study being conducted as an action research project.

Tools Used

Mathematics Anxiety Scale: A standardized, Math Anxiety Test, at http://www.mathpower.com/anxtest.htm, is a standardized tool that is used to measure levels of mathematics anxiety, particularly in upper primary students.

Achievement in Mathematics Test in Geometry: A teacher-made, validated test focusing on core geometric concepts, including shapes, angles, perimeter, area, properties, and symmetry, was used.

Description of the STEAM-Oriented Remedial Program

The remedial program was implemented over several sessions and was designed using STEAM principles.

Key features included:

Hands-on activities using models, paper folding, and manipulatives to explore geometric concepts.

Integration of art through drawing, pattern making, and design tasks related to geometry.

Use of simple technology, such as videos and digital visuals, to enhance visualization

Engineering-based tasks like constructing shapes and structures.

Collaborative group work and discussion to reduce fear and promote peer learning.

Real-life applications of geometry to make learning meaningful

The learning environment emphasized encouragement, error-friendly discussion, and active participation to reduce anxiety.

Procedure

Pre-tests on mathematics anxiety and conceptual understanding were administered before the intervention. The STEAM-oriented remedial program was then conducted. After completion,

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post-tests were administered using the same tools. Data were analyzed using descriptive statistics and comparison of pre-test and post-test scores.

Results and Discussion

Analysis of pre-test and post-test scores revealed a clear reduction in mathematics anxiety among students after participating in the STEAM-oriented remedial program. Students appeared more confident, willing to attempt problems, and engaged actively during geometry lessons.

Post-test scores on the conceptual understanding test showed noticeable improvement compared to pre-test scores and showed a positive correlation. Students demonstrated better visualization skills, clearer understanding of geometric properties, and improved ability to explain concepts in their own words.

The findings suggest that integrating STEAM elements into remedial instruction creates a supportive and engaging learning environment. Hands-on activities and creative tasks helped students overcome fear and develop positive attitude toward mathematics. These results align with earlier research emphasizing experiential and interdisciplinary approaches in mathematics education.

Conclusion: The present action research study concludes that a STEAM-oriented remedial program is effective in reducing mathematics anxiety and improving conceptual understanding of geometry among upper primary students. By shifting the focus from rote learning to experiential, creative, and collaborative learning, the program addressed both cognitive and affective aspects of mathematics learning.

Although the study was limited in scope and sample size, it provides valuable insights for teachers and curriculum planners. Incorporating STEAM-based strategies in regular and remedial classrooms can enhance learning outcomes and foster positive attitudes toward mathematics.

Educational Implications:

Teachers can adopt STEAM-based remedial strategies to support learners struggling with geometry.

Mathematics instruction should focus on conceptual clarity and emotional well-being alongside academic achievement.

Schools may integrate STEAM activities into upper primary curricula to reduce learning anxiety.

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Limitations and Suggestions for Further Research

The study was limited to a small sample and a short duration. Future research may involve larger samples, control groups, and long-term interventions. Further studies can also explore the effectiveness of STEAM-oriented programs in other areas of mathematics.

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