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An Investigation of Whether Exposure to Problems Involving Real-world Applications of the Pythagorean Theorem Facilitates Transfer of Learning

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ABSTRACT

Transfer of learning is a fascinating concept that has intrigued educators and researchers for several years. Transfer of learning refers to the transferability of skills and knowledge from one scenario to another unfamiliar scenario. The present study investigates whether giving students real world examples of the application of the Pythagorean Theorem to real world settings would lead to improved performance on such problems on a post-test compared to giving students problems that only apply the Pythagorean Theorem to triangles. Twenty-one middle school students ranging from 6th to 8th grade from Fairfax County and Loudoun County, Virginia were newly introduced to the concept of Pythagorean Theorem. The students were randomly assigned into two groups. One group received instruction in the Pythagorean Theorem that utilized problems that exclusively involved triangles. The second group received similar instruction that also included problems involving real world applications of the Pythagorean Theorem. At the end of their respective instructional periods, both groups were given a 15-question post-test that included Pythagorean Theorem-related problems using both triangles and real world applications. Results showed that both groups performed virtually identically on the post-test, including on the real-world problems. This suggests that transfer of learning did not occur.

Introduction:

Transfer of learning, a concept in educational cognition, regards the ability of individuals to apply knowledge gained in one context to a new context. This idea is vital in education because it shows that learning isn't limited to solely one situation, but extends to several. Transfer of learning encourages a more than satisfactory understanding of a concept. It allows a student to see different perspectives of a concept. As a result, students who understand transfer of learning can apply their knowledge across diverse situations.

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Perkins and Salomon's (1992) work on "Transfer of Learning" explores how knowledge and skills can be applied across different contexts. They distinguish between near transfer (applying knowledge to similar situations) and far transfer (applying knowledge to more different contexts), highlighting the challenges of the latter. Successful transfer depends on recognizing structures that underlie different situations, a concept rooted in schema theory. The authors identify key factors influencing transfer, such as the learning context, which should mirror real-world situations to encourage transfer. They emphasize the importance of metacognitive awareness and the learner's ability to recognize similarities across contexts. Additionally, explicit teaching of transfer, through reflection and connection to prior knowledge, is crucial for promoting effective transfer. Perkins and Salomon also address challenges such as inert knowledge (Whitehead, 1929), where learners struggle to apply what they've learned to new situations. They argue that practice and thorough instruction in transfer can help overcome this barrier. Their work provides practical strategies for educators, causing an understanding in varied learning contexts. These insights are essential for developing a curriculum that prepares students for real-world issues and adaptability.

In "Emerging Trends of Research on Transfer of Learning" (2004), Subedi explores key developments in transfer of learning research, emphasizing the shift toward adaptive expertise and contextual learning. Theories by scholars set the foundation, stressing the importance of prior knowledge and social interaction in learning transfer. Subedi (2004) highlights emerging trends, including the recognition of transfer as a dynamic process of adapting knowledge to new situations, rather than just applying it directly. It is critical for teaching to include the promotion of thorough learning, reflection, and much more to help students apply their knowledge in diverse contexts. Overall, Subedi's review highlights the evolving nature of transfer research and offers insights for enhancing teaching practices that support students' ability to adapt their learning across different situations.

The article "5 Ways to Help Students Transfer Their Learning to New Situations" (Edutopia, n.d.) highlights effective methods for implementing the transfer, supported by research. Key strategies include linking new material to prior knowledge (Ausubel, 1692), promoting conceptual understanding (Bransford et al., 2000), and offering diverse and realistic experiences. Encouraging self-reflection and other crucial skills (Flavell, 1979) alongside collaborative learning (Vygotsky's social constructivism) also enhances transferability. The issue of "inert knowledge" (Whitehead, 1929) emphasizes the importance of practice and self-awareness. Students can apply their learning across various contexts, fostering flexibility and lifelong learning skills.

Larry Ferlazzo's "Response: Ways to Promote Transfer of Learning" (2017) outlines strategies to help students apply knowledge across contexts, grounded in educational research. Key

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approaches include activating prior knowledge (Ausubel's Subsumption Theory) and using real-world tasks (Dewey's experiential learning theory).Timely feedback (Hattie & Timperley, 2007) also supports effective transfer. Ferlazzo (2017) acknowledges challenges such as unusable knowledge and strategies to combat them. Unusable knowledge is knowledge that is known but not applicable. These strategies connect classroom learning to the real-world, promoting critical thinking and learning.

Transfer of learning, the ability to apply knowledge in new situations, is essential in education. Sqborden's "6 Ways to Help Students Transfer Learning to New Contexts" (2021) provides strategies grounded in research and theory to support this goal. Key strategies include activating prior knowledge (Ausubel's Subsumption Theory) and teaching for understanding (Bransford et al., 2000). Providing opportunities for application and promoting problem-solving aligns with Dewey's experiential learning theory, further emphasizing its importance.These methods show ways to support students in transferring knowledge effectively.

Transfer of learning, the ability to apply knowledge to new contexts, is a vital educational goal. The article "15 Ways to Promote Transfer of Learning in Your Class" (2022) outlines strategies grounded in constructivist and cognitive theories, including the works of Vygotsky (1978) and Dewey (1938). These strategies are supported by detailed research on effective practices. A major focus was activating prior knowledge (Ausubel's Subsumption Theory), and self-awareness, which Flavell (1979) identified as essential for adaptive thinking. Learning with peers, feedback, and scaffolding further enhance transfer by engaging and providing support. Success requires thoughtful design, reflection, and opportunities for practice. Overall, the strategies in the article are well-supported by theory and research, providing tools for thorough teaching.

Encouraging engagement through activities and discussions improves the transfer. Studies show active learning improves student engagement and application of knowledge (Freeman et al., 2014). Reflecting on learning helps students internalize and apply knowledge. Research suggests that reflection supports skills that are crucial for transfer (Suzuki & Dekeyser, 2015). Linking classroom learning to real-life situations helps students know its relevance. Studies show that contextual learning boosts transfer (Bransford et al., 2000). Working with peers promotes deeper understanding and which is key for transferring learning (Johnson & Johnson, 1999). These strategies align with research on effective teaching methods and enhance students' ability to apply learning in diverse situations. The present study examines whether including real world applications of the Pythagorean Theorem can facilitate transfer of learning of the Pythagorean Theorem to problems other than those explicitly involving triangles.

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Method

Participants

The participants were 21 middle schoolers from Fairfax and Loudon County in Virginia who were taking either Math 7 or Math 7 Honors in school. No student had knowledge about Pythagorean Theorem. Of these students, 11 were assigned the standard method of teaching group and the remaining 10 students were assigned to the transfer of learning method of teaching group. The students were unaware there were two groups and two different teaching methods.

Materials

Two sets of nearly identical instructional materials were created. For the control condition, a set of lecture notes was created that explained the Pythagorean Theorem, including how to find a hypotenuse of a right triangle given two legs and how to find a leg of a right triangle given a leg and a hypotenuse. This was followed by examples using right triangles and missing values for legs or hypotenuses. The experimental condition (the transfer of learning condition) had the same lecture notes and examples with the addition of real world applications of the Pythagorean Theorem that involved calculating distances traveled or a height of a ladder leaning against the wall. A 15-question post-test was also constructed that had three questions regarding triangles in general, six questions requiring the application of the Pythagorean Theorem to right triangles and six questions that involved the application of the Pythagorean Theorem to real world settings (the transfer of learning questions). The link to the post-test is https://docs.google.com/forms/d/e/1FAIpQLSextdSZrn4pXhS3rOKRFXqzXb74DE92HOdSl_2hUbaUEJdRvw/viewform.

The standard method of teaching lecture explained Pythagorean Theorem and then gave the participants a video (https://www.youtube.com/watch?v=WqhlG3Vakw8) and a worksheet to reinforce what they have learned. The transfer of learning method of teaching was the same. However, it gave participants additional real world problems to which the Pythagorean theorem could be applied.

Procedure

Participants were taught in a group based on their respective assignment to condition. Instruction in the Pythagorean Theorem was delivered via slideshow, followed by walkthrough problems led by the instructor. Each group received the walkthrough problems associated with their condition. This was followed by a video presentation (https://www.youtube.com/watch?v=WqhlG3Vakw8). When Participants completed the video, they did the post-test through an online Google Form. Total session time was about 90 minutes.

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Results:

The purpose of the present study was to test whether transfer of learning could be achieved. In order to test this, analysis of whether or not Participants gave the right answer to the transfer questions only was conducted. There were six of these questions in total. The mean number of correctly answered questions was virtually identical in both conditions at 3.3, suggesting transfer of learning did not occur. More broadly, overall performance on the 15-item test was unaffected by condition with mean total correct answers of 10.45 and 10.4 for the control and experimental conditions, respectively. Similarly, overall mean scores for Pythagorean Theorem questions (including both standard triangle and non-standard real world application questions) were 8.63 and 8.4 for the control and experimental conditions, respectively.

Discussion:

The results of the present study showed no transfer of learning as a result of providing students with examples of the application of the Pythagorean Theorem to real world settings. Student performance on both the real world problems and the overall Pythagorean Theorem problems was identical in both conditions. Given that the mean number of correct solutions to the real world problems was around 55% in both conditions and the mean number of overall correct solutions was just under 70%, the lack of transfer of learning could not be attributable to ceiling effects.

The fact that student performance on the real world problems was lower than those on the standard Pythagorean Theorem problems underscores how difficult transfer of learning is. Contrary to our original hypothesis, the standard method of teaching yielded higher results compared to the transfer of learning method of teaching when applying transfer of learning. This was surprising as we originally believed that a more in-depth course with testing the application of this concept to various scenarios would allow students to understand concepts better, and in turn, have higher results. The transfer of learning method of teaching required more effort and work, but the results were equal to the standard method, and sometimes less. These results showed that the standard method of teaching performed equally to an approach that implements practical applications. This challenges how we design education to balance understanding and practical learning for the best learning outcome.

Conclusion:

In conclusion, transfer of learning plays a crucial role in education by enabling individuals to apply knowledge across different contexts, fostering a deeper understanding and multiple perspectives of concepts. This study aimed to explore the effectiveness of different teaching methodologies, specifically related to the transfer of learning concept applied to the Pythagorean

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Theorem among middle school students. Contrary to our initial expectations, the results demonstrated that there was no transfer of learning as a result of giving students instruction and practice with real world applications of the subject matter being taught.

References

5 Ways to Help Students Transfer Their Learning to New Situations. (n.d.). Edutopia. https://www.edutopia.org/article/5-ways-help-students-transfer-their-learning-new-situations

15 Ways to Promote Transfer of Learning in Your Class - Classroom Management Expert. (2022, May 6). Classroommanagementexpert.com. https://classroommanagementexpert.com/blog/15-ways-to-promote-transfer-of-learning-in-your-class/

Ausubel, D. P. (1962). A Subsumption Theory of Meaningful Verbal Learning and Retention. *The Journal of General Psychology*, *66*(2), 213–224. https://doi.org/10.1080/00221309.1962.9711837

Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). How People Learn Brain, Mind, Experience, and School. Washington DC National Academy Press. - References - Scientific Research Publishing. (n.d.). Www.scirp.org. https://www.scirp.org/reference/ReferencesPapers?ReferenceID=1750614

Ferlazzo, L. (2017, May 9). *Response: Ways to Promote Transfer of Learning (Opinion)*. Education Week. https://www.edweek.org/teaching-learning/opinion-response-ways-to-promote-transfer-of-learning/2017/05

Five Ways to Help Students Transfer Their Learning to New Situations. (2020). Where Y'at New Orleans. https://www.whereyat.com/five-ways-to-help-students-transfer-their-learning-to-new-situations

Flavell, J. (1979). *Metacognition and Cognitive monitoring: a New Area of Cognitive–developmental inquiry*. Psycnet.apa.org. https://psycnet.apa.org/record/1980-09388-001

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences*, *111*(23), 8410–8415. https://doi.org/10.1073/pnas.1319030111

Hattie, J., & Timperley, H. (2007). The Power of Feedback. *Review of Educational Research*, *77*(1), 81–112. https://doi.org/10.3102/003465430298487

ISSN: 2455-8834

Volume:09, Issue: 12 "December 2024"

Johnson, D. W., & Johnson, R. T. (1999, March). *Making cooperative learning work*. ResearchGate; Taylor & Francis (Routledge). https://www.researchgate.net/publication/243775553_Making_cooperative_learning_work

Dewey, J. (1938). Experience and education. New York, NY: Macmillan.

Perkins, D. N., & Salomon, G. (1992). Transfer of Learning. In T. Husén, & T. N. Postlethwaite (Eds.), The International Encyclopedia of Education (2nd ed., pp. 425-441). Oxford: Pergamon.

Sqborden. (2021, May 4). *6 Ways to Help Students Transfer Learning to New Contexts - The K. Patricia Cross Academy*. The K. Patricia Cross Academy. https://kpcrossacademy.ua.edu/6-ways-to-help-students-transfer-learning-to-new-contexts/

Subedi, B. (2004). Emerging Trends of Research on Transfer of Learning. *International Education Journal*, *5*. https://files.eric.ed.gov/fulltext/EJ903882.pdf

Suzuki, Y., & Dekeyser, R. (2015, February 21). *Suzuki, Y. & DeKeyser, R. (2015). Comparing elicited imitation and word monitoring as measures of implicit knowledge. Language Learning. 65(4), 860-895.* Language Learning. https://www.academia.edu/10973236/Suzuki_Y_and_DeKeyser_R_2015_Comparing_elicited_imitation_and_word_monitoring_as_measures_of_implicit_knowledge_Language_Learning_65_4_860_895

Vygotsky, L. (1978). *Vygotsky -Mind in Society*. https://autismusberatung.info/wp-content/uploads/2023/09/Vygotsky-Mind-in-society.pdf

Whitehead, A. (1929). The Aims of Education. New York McMillan. - References - Scientific Research Publishing. (2015). Scirp.org. https://www.scirp.org/reference/referencespapers?referenceid=1416425

