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Research Article

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Analyzing Growth Mindset Based on Opportunity to Learn in Project-Based Manipulative and Virtual Learning Media Courses

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Abstract: This study investigates how opportunity to learn (OTL) in project-based mathematics education courses—Manipulative Learning Media (MLM) and Virtual Learning Media (VLM)—supports the development of a growth mindset among pre-service teachers. MLM is a compulsory course focusing on concrete instructional media, while VLM is elective and centers on digital tools. Both apply structured learning cycles involving media design, classroom implementation, revision, and reflection. Using a quantitative comparative approach, data were collected from 85 mathematics education students grouped by course enrollment. Growth mindset and OTL were measured using Likert-scale questionnaires and analyzed with descriptive statistics, t-tests, and Pearson correlation. Results showed that the MLM+VLM group reported slightly higher growth mindset scores (M = 3.54) than the MLM-only group (M = 3.47), though the difference was not significant (p = 0.483). However, OTL scores approached significance (p = 0.054), and a positive correlation was found between OTL and growth mindset (r = 0.642). These findings highlight the value of structured, project-based learning environments in enhancing students' learning beliefs and instructional readiness.

Keywords: Growth Mindset, Opportunity to Learn, Project-Based Learning, Manipulative Learning Media, Virtual Learning Media.

Introduction

In the era of 21st-century learning, cultivating a growth mindset has become a critical objective in modern education, particularly within mathematics education. Dweck defined a growth mindset as the belief that intelligence and abilities can be developed through sustained effort and learning (Dweck, 2006). This perspective has been associated with higher levels of academic resilience, motivation, and performance (Yeager et al., 2019). As future educators, pre-service mathematics teachers are expected not only to master content but also to adopt a mindset that fosters lifelong learning and adaptability.

In addition to learners' internal beliefs, academic achievement is influenced by the instructional opportunities provided by the educational environment. The concept of opportunity to learn (OTL), as outlined by Kurz et al. (Elliott et al., 2017; Kurz, 2011), encompasses students' access to quality content, effective instruction, and aligned learning experiences. Schmidt and McKnight emphasized that OTL is not only about curriculum exposure, but also about engaging students in meaningful and challenging academic tasks that promote deep understanding (Cogan & Schmidt, 2015; She et al., 2018; Zhang et al., 2019).

Project-based learning (PBL) is an instructional strategy that has gained prominence for its ability to support both OTL and mindset development. Blumenfeld et al. proposed that PBL engages students through real-world problems, collaborative inquiry, and product-oriented outcomes (C et al., 1991). In mathematics teacher education, project-based learning (PBL) enables pre-service teachers to develop both pedagogical competence and reflective thinking skills through active engagement in meaningful instructional tasks.

PBL promotes deeper conceptual understanding, collaboration, and critical reflection, which are essential for teacher preparation (Kaldi & Zafeiri, 2023). Studies have shown that when PBL is integrated into teacher education, it fosters students' ability to connect theory with practice and encourages metacognitive awareness through self-evaluation and classroom implementation experiences (Alrajeh, 2021; Denuga & Nkengbeza, 2022). In particular, PBL approaches that incorporate the use of manipulative and digital media—such as GeoGebra—further enhance pre-service teachers' technological and pedagogical skills (Ortiz et al., 2019; Song et al., 2012). These findings affirm the potential of PBL to shape future educators who are not only competent in instructional design but also reflective and responsive to dynamic classroom needs.

Despite the widespread application of project-based learning (PBL) in mathematics education, research remains limited on how structured opportunities to learn (OTL) through different instructional modalities contribute to students' growth mindset, particularly in the context of teacher education. The integration of manipulative learning media has been shown to support conceptual understanding and creativity by engaging learners in tangible, exploratory activities (Ummah et al., 2019; Wulandari & Qamar, 2018). In contrast, digital instructional tools, such as virtual manipulatives and platforms like GeoGebra, offer dynamic environments that foster logical reasoning and visual thinking (Ortiz et al., 2019; Song et al., 2012). However, few studies have examined how combining both modalities—manipulative and virtual—within a project-based framework affects pre-service teachers' mindset beliefs. Moreover, most existing research focuses on outcomes like content mastery or technological proficiency, rather than the deeper cognitive and motivational dimensions such as mindset development (Saubern et al., 2020; Wouters et al., 2013). By investigating how OTL is embedded in the MLM and VLM courses, this study contributes new insights into the pedagogical mechanisms through which PBL shapes not only knowledge and skills, but also beliefs about learning potential. This fills a notable gap in the literature, especially in the Indonesian context, where systematic evidence linking OTL, media-based instruction, and growth mindset is still scarce.

This study aims to examine how OTL provided through the MLM course supports the development of growth mindset among pre-service mathematics teachers, and whether continuation into the VLM course further enhances this effect. By analyzing differences in mindset and OTL between students who enrolled only in MLM and those who also took VLM, this study contributes to the growing body of evidence on how reflective, project-based instruction can shape not only skills, but also the learning beliefs of future educators. In this light, a growth mindset is not merely a desirable personal trait, but a foundational professional competence that mathematics teachers must develop to thrive in dynamic classroom environments and support diverse learners effectively.

Method

This study employed a quantitative comparative design to investigate the differences in growth mindset and opportunity to learn (OTL) among Mathematics Education students based on their enrollment in the Manipulative Learning Media (MLM) course and the elective Virtual Learning Media (VLM) course. The design is non-experimental as it does not involve manipulation of variables, but rather compares naturally occurring groups. For project-based learning activities in MLM courses and VLM courses, it is shown with the following scheme.

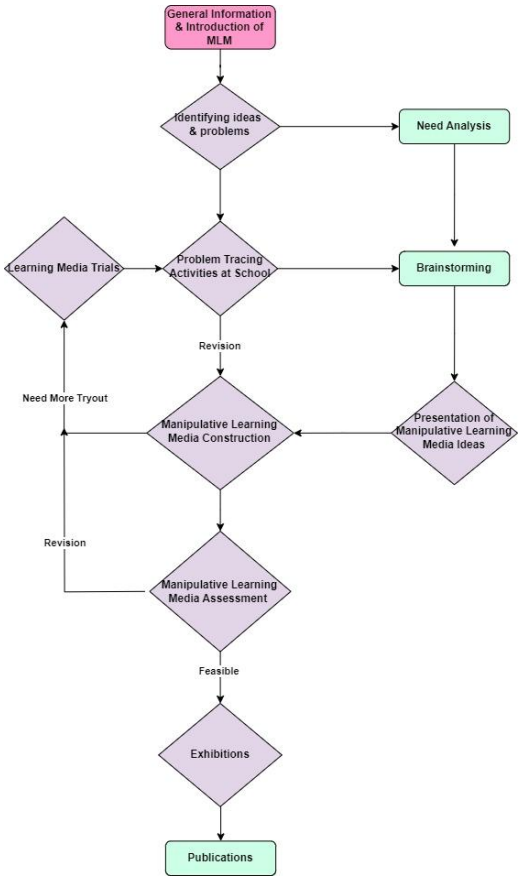

Figure 1. Learning Activities Design of MLM Course

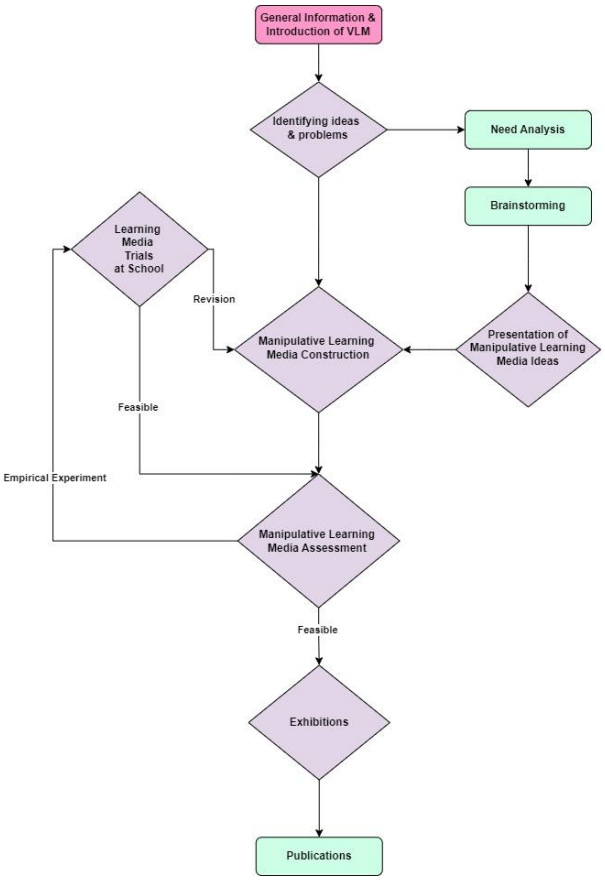

Figure 2. Learning Activities Design of VLM Course

The Manipulative Learning Media (MLM) course is designed to guide students through a structured, project-based cycle of developing concrete teaching aids for mathematics learning. Figure 1 shows that MLM course is addressed in which the learning process begins with an introduction to manipulative media and proceeds with identifying classroom-based problems and conducting a needs analysis. Students then brainstorm and present ideas for physical instructional tools, followed by iterative stages of construction, assessment, and revision. After trialing their media in school settings, students refine their designs before showcasing them in an exhibition. This process culminates in the publication of their work, allowing students to not only apply pedagogical theories but also experience authentic learning product development. Meanwhile, the Virtual Learning Media (VLM) course adopts a similar pedagogical structure but focuses on digital environments. Figure 2 represents learning trajectories how VLM course is conducted as exploring the fundamentals of virtual media, students identify educational challenges and brainstorm technology-integrated solutions. They develop digital tools such as interactive worksheets or simulations and validate their feasibility through school-based trials and empirical testing. Media products are then evaluated, refined, and presented in exhibitions. The course emphasizes digital literacy, creativity, and evidence-based design, offering students the opportunity to transform technological tools into meaningful learning experiences. Both courses aim to foster critical thinking, reflection, and a growth-oriented mindset through authentic, iterative, and collaborative learning tasks.

The participants were undergraduate students from the Mathematics Education study program at Universitas Negeri Makassar, South Sulawesi, Indonesia. A purposive sampling technique was used to select students who had completed the MLM course, with some also having enrolled in the VLM course. The total sample consisted of 85 students: 50 students who had taken only MLM and 35 students who had taken both MLM and VLM.

Data were collected using a self-developed Likert-scale questionnaire consisting of two main sections: growth mindset and opportunity to learn. The scale ranged from 1 (strongly disagree) to 4 (strongly agree). All items were validated through expert judgment and tested for internal consistency using Cronbach's Alpha, with reliability coefficients above 0.70 for both scales. The growth mindset scale consisted of 7 items developed based on Dweck's theory (Dweck, 2006), covering five indicators: (1) belief in the ability to grow intelligence, (2) attitude toward challenges, (3) perseverance, (4) acceptance of feedback, and (5) focus on learning processes. The OTL scale consisted of 11 items grouped into three components: (1) OTL in MLM: items reflecting opportunities for exploration, creativity, project-based tasks, and reflective thinking. (2) OTL in VLM: items measuring digital media creation, use of tools such as GeoGebra, and confidence in technology use. (3) General OTL: items assessing cumulative learning experiences and perceived personal development through project-based courses.

Descriptive statistics were used to examine the means and distribution of growth mindset and OTL scores across the two groups. Independent samples t-tests were conducted to identify significant differences between students who took only MLM and those who took both MLM and VLM. All statistical analyses were performed using SPSS (latest version) with a significance level set at 0.05.

Results and Discussion

In this section, it is explained the results of research and at the same time is given the comprehensive discussion. Results can be presented in figures, graphs, tables and others that make
the reader understand easily (Baier et al., 2019), (Flanagan et al., 2020). The discussion can be made in several sub-sections.

This study aimed to investigate the effect of opportunity to learn (OTL) on the development of students' growth mindset through the Manipulative Learning Media (MLM) course, and to examine whether continued learning through the Virtual Learning Media (VLM) course enhances this effect. The analysis focused on differences between students who completed only MLM and those who took both MLM and VLM, as well as the correlation between perceived learning opportunities and mindset growth. As the initial focus is to compare those who belong to the MLM class and the combination between MLM and VLM. For this reason, a comparison of opportunity to learn and growth mindset is shown in the following table 1.

Table 1. Comparison of Mean Scores for Growth Mindset and Opportunity to Learn

Group	N	Growth Mindset (M ± SD)	OTL (M ± SD)
MLM Only	47	3.47 ± 0.44	3.39 ± 0.54
MLM + VLM	54	3.58 ± 0.35	3.60 ± 0.57
t-test	-	t = -1.41, p = 0.161	t = -1.88, p = 0.064

Table 1 shows that the independent samples t-test revealed that students who completed both the MLM and VLM courses reported a higher growth mindset score (M = 3.58, SD = 0.35) compared to those who only completed the MLM course (M = 3.47, SD = 0.44). However, this difference was not statistically significant (t = -1.41, p = 0.161). Despite the non-significant result, the findings suggest that participation in the MLM course alone provides a substantial foundation for developing a growth mindset. This is consistent with Dweck's theory, which emphasizes that learning environments fostering effort, challenges, and feedback can strengthen the belief that intelligence and abilities are malleable through sustained practice and learning.

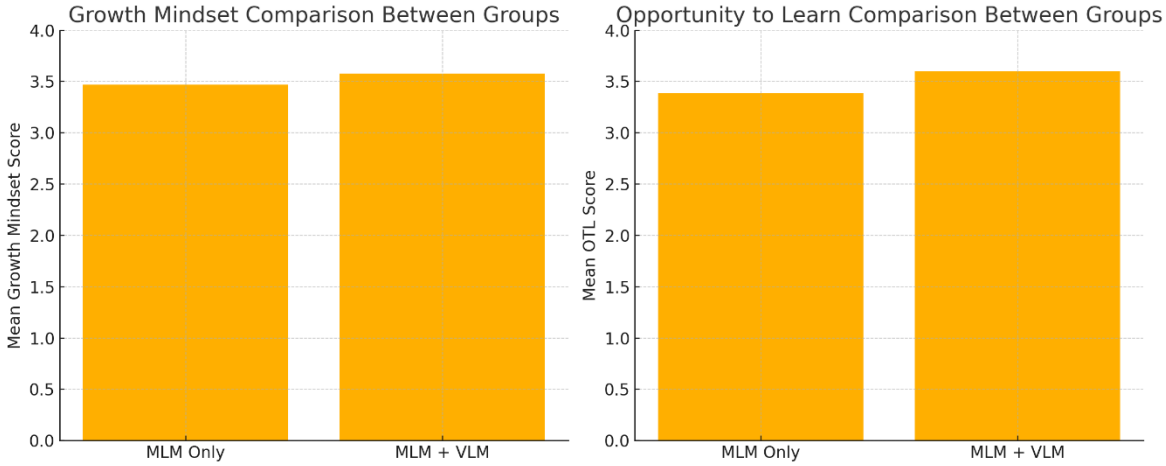

Figure 3. *Comparison of mean Growth Mindset scores between students who enrolled only in the Manipulative Learning Media (MLM) course and those who participated in both the MLM and Virtual Learning Media (VLM) courses. While the MLM + VLM group showed a slightly higher average score, the difference was not statistically significant (p = 0.161).*

Figure 4. *Comparison of mean Opportunity to Learn (OTL) scores between the MLM-only group and the MLM + VLM group. The MLM + VLM group demonstrated a higher perceived OTL, with the difference approaching statistical significance (p = 0.064), suggesting added instructional value through the integration of digital media tools.*

Figures 3 and 4 present a comparison of average scores in Growth Mindset and Opportunity to Learn (OTL) between two student groups: those who only completed the Manipulative Learning Media (MLM) course and those who completed both MLM and Virtual Learning Media (VLM) courses.

In Figure 3, the MLM + VLM group displays a slightly higher mean score in Growth Mindset (M = 3.58) compared to the MLM Only group (M = 3.47). However, the independent samples t-test confirmed that this difference is not statistically significant (p = 0.161). This suggests that the MLM course alone provides an effective foundation for cultivating a growth mindset, consistent with structured, reflective, and project-based learning principles aligned with Dweck's theory.

In contrast, Figure 4 reveals a more visible difference in Overall OTL scores between the groups. The MLM + VLM group reported a higher mean OTL score (M = 3.60) than the MLM Only group (M = 3.39), with the difference approaching statistical significance (p = 0.064). This indicates that the VLM course offered added value by enhancing students' perceptions of learning opportunities—particularly through digital tool engagement and technology-driven instructional tasks. These results underscore the role of extended, technology-integrated project-based instruction in enriching students' educational experiences and perceptions of learning accessibility.

Descriptive results revealed that students expressed strong positive perceptions of learning opportunities within the Manipulative Learning Media (MLM) course. High scores were reported for items such as *"The tasks in MLM helped me understand the material more deeply"* (M = 3.44, SD = 0.56) and *"The MLM course encouraged me to think critically and reflectively"* (M = 3.60, SD = 0.49). These findings affirm the importance of project-based learning in promoting cognitive engagement and reflective practice. According to Blumenfeld et al. (C et al., 1991), project-based environments that center on meaningful tasks allow students to actively construct knowledge, sustain motivation, and develop problem-solving skills. This aligns with Dweck's theory of growth mindset, which emphasizes that learning environments which provide challenges, effort-driven success, and iterative feedback foster beliefs in personal development and intelligence malleability (Dweck, 2006). Furthermore, these results resonate with the Opportunity to Learn (OTL) framework proposed by Kurz et al. (Kurz, 2011), where effective learning arises from meaningful access to curriculum through deep engagement, time on task, and task relevance.

Further analysis showed a more substantial difference in overall OTL scores. Students who completed both the MLM and Virtual Learning Media (VLM) courses reported a higher OTL score (M = 3.62, SD = 0.38) compared to those who only enrolled in MLM (M = 3.44, SD = 0.39). Although the result approached statistical significance (t = -1.97, p = 0.054), it indicates that continued learning through VLM contributed additional value to students' educational experiences. The VLM course, which emphasized digital platforms such as GeoGebra and the design of virtual worksheets, extended students' opportunity to explore, create, and apply knowledge in technologically enriched contexts. This was reflected in the high score for the item *"VLM gave me the opportunity to explore the potential of digital learning"* (M = 3.67, SD = 0.47). These findings support the interpretation that while MLM offers a strong foundation for OTL through tangible and reflective tasks, the inclusion of VLM enhances learning by broadening access to digital exploration and reinforcing students' adaptive learning beliefs. This layered instructional design reflects the integrated effect of project-based pedagogy, opportunity to learn, and mindset-supportive learning ecosystems (Annetta et al., 2018; Dweck, 2006; Setiawan et al., 2024).

Descriptive results revealed that students expressed consistently positive perceptions of learning opportunities within the Manipulative Learning Media (MLM) course. For instance, the statement "The tasks in MLM helped me understand the material more deeply" received a mean score of M = 3.47 (SD = 0.59), while "The MLM course encouraged me to think critically and reflectively" achieved M = 3.57 (SD = 0.55). These findings affirm the pedagogical value of project-based learning in fostering cognitive engagement and reflective practice, aligning with Blumenfeld et al. emphasis on meaningful task-centered environments.

Building on this foundation, analysis of the Virtual Learning Media (VLM) course outcomes revealed that the statement "VLM gave me the opportunity to explore the potential of digital learning" earned a high mean score of M = 3.61 (SD = 0.58). This suggests that technology-enriched environments further enhance students' perceived learning opportunities, supporting Dweck's theory that environments offering challenge and feedback nurture the belief in the malleability of abilities.

Together, the integration of MLM and VLM reflects a layered instructional design where tangible, hands-on learning is complemented by digitally enriched experiences. This finding aligns with Kurz et al. Opportunity to Learn (OTL) framework, highlighting that structured access to cognitively rich, relevant, and reflective tasks can

cultivate adaptive and growth-oriented educational beliefs among pre-service teachers.

Table 2. Pearson Correlation between OTL and Growth Mindset

	Mindset Composite Score	OTL Composite Score
Mindset Composite Score	1	0.747
OTL Composite Score	0.747	1

Table 2 highlights a positive and strong correlation between Opportunity to Learn (OTL) and Growth Mindset, with a Pearson correlation coefficient of $r = 0.747$, $p < 0.001$. This statistically significant relationship suggests that students who perceived greater learning opportunities—particularly those involving exploration, critical reflection, and iterative project-based experiences—tended to report stronger beliefs in their ability to grow intellectually. As illustrated in the scatterplot (Figure 5), enhanced perceptions of access to meaningful and engaging learning tasks are closely associated with a greater endorsement of growth-oriented beliefs, reinforcing the importance of instructional environments that prioritize challenge, feedback, and sustained engagement.

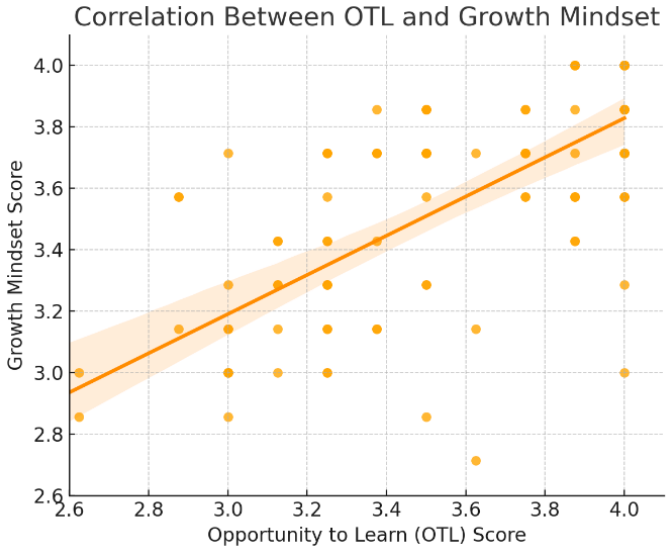

Figure 5. *Scatter plot illustrating the relationship between students' Opportunity to Learn (OTL) scores and their Growth Mindset scores. The positive and statistically significant correlation ($r = 0.747$, $p < 0.001$) indicates that higher perceptions of learning opportunities are associated with stronger growth-oriented beliefs. The trendline and confidence interval suggest a consistent upward relationship between these two constructs.*

As illustrated in Figure 5, these findings highlight the importance of not only measuring students' perceptions of learning opportunities, but also examining how such opportunities are structurally embedded within the learning environment. In the Manipulative Learning Media (MLM) course, students participate in iterative cycles of designing, constructing, and refining tangible media. This hands-on engagement fosters deeper exploration of mathematical concepts, promotes critical thinking, and provides meaningful formative feedback. These instructional experiences cultivate persistence, reflective practice, and a sense of agency—hallmarks of a growth mindset as proposed by Dweck.

Complementing this, the Virtual Learning Media (VLM) course extends learning into the digital domain. Students are encouraged to navigate platforms such as GeoGebra, design interactive virtual worksheets, and adapt instructional strategies using digital tools. This integration of technology enhances both the accessibility and adaptability of the learning process.

Consistent with the Opportunity to Learn (OTL) framework by Kurz et al., the impact of these learning experiences is amplified when instructional activities align with curriculum goals and are delivered through authentic, cognitively demanding tasks. The statistically significant and strong correlation observed between OTL and Growth Mindset ($r = 0.747$, $p < 0.001$) supports the interpretation that well-structured, multimodal learning environments not only increase perceived access to learning but also reinforce students' beliefs in their capacity to grow and improve intellectually.

From the OTL perspective, Kurz et al. (Kurz, 2011) and Schmidt and McKnight (Cogan & Schmidt, 2015) note that curriculum access alone is insufficient; students must be engaged through high-quality, sustained, and purposeful tasks. The near-significant difference in OTL scores between groups suggests that the addition of digital components in the VLM course offered expanded and diversified learning opportunities. The integrated use of physical and virtual media allowed students to experience rich and complementary learning contexts.

Furthermore, these findings support existing research in teacher education. Setiawan et al. (Setiawan et al., 2024) and Annetta et al. (Annetta et al., 2018) emphasize the importance of reflective, structured, and technologically enhanced learning environments in building adaptive learning beliefs. This study also resonates with Megawanti et al. (Megawanti et al., 2024), who found that growth in mathematics mindset is closely tied to instructional design that promotes metacognitive awareness and exploratory learning.

Taken together, the results emphasize the significance of well-structured, project-based learning environments in shaping both students' perceived opportunity to learn and their internal beliefs about the learning process. The Manipulative Learning Media (MLM) course lays a robust foundation through tangible, hands-on experiences that foster critical thinking and conceptual understanding. Building upon this, the Virtual Learning Media (VLM) course expands students' digital competencies and deepens reflective engagement through technology-enhanced tasks. These findings highlight the value of integrating both physical and virtual learning modalities within teacher education programs to cultivate future educators who are not only confident and adaptable, but also firmly grounded in a growth-oriented mindset.

These belief transformations suggest more than individual motivation—they represent a readiness to adopt a reflective and adaptive stance essential for professional teaching practice. In mathematics education, where misconceptions and learning challenges are common, fostering such resilience is especially critical.

Conclusion

This study examined how opportunity to learn (OTL) through project-based courses—Manipulative Learning Media (MLM) and Virtual Learning Media (VLM)—influences the development of a growth mindset among pre-service mathematics teachers. The findings showed that while the MLM course alone provided strong learning opportunities that supported foundational aspects of growth mindset, the continuation into the VLM course offered extended benefits, particularly in terms of technological exploration and digital engagement.

Although the difference in growth mindset scores between the MLM and MLM and VLM groups was not statistically significant, both

groups demonstrated high average scores, suggesting that the structured and reflective nature of MLM was already effective in fostering growth-oriented beliefs. More notably, the OTL scores showed a near-significant difference favoring the MLM and VLM group, indicating that continued project-based engagement through digital platforms enhances students' perceptions of meaningful learning opportunities.

The positive and moderately strong correlation between OTL and growth mindset ($r = 0.639$) further confirms that well-designed instructional environments—those grounded in challenge, creativity, and reflection—can play a significant role in shaping students' learning beliefs. These findings are in line with Dweck's theory of growth mindset, Blumenfeld's model of project-based learning, and Kurz's OTL framework, which together emphasize the importance of intentional, feedback-rich, and authentic learning contexts.

The development of growth mindset through structured opportunity to learn is not only beneficial for student engagement but is instrumental in shaping reflective, resilient, and professionally adaptive mathematics teachers (Nasrullah & Bachtiar, 2021; Ruslan et al., 2018). Embedding such experiences in teacher preparation ensures they are equipped to navigate the complexities of real classroom contexts. The results of this study provide valuable insights for curriculum developers and educators in mathematics teacher education. First, it is recommended to maintain and enhance the project-based structure of the MLM course, ensuring it remains a platform for reflective and hands-on learning. Second, institutions should consider formally integrating digital media development (such as in VLM) as a core part of teacher preparation, to equip students with the mindset and technological competence required in modern classrooms.

Future studies may employ longitudinal or mixed-method approaches to investigate how sustained project-based learning over time influences mindset development and instructional identity formation among pre-service teachers.

References

Alrajeh, T. S. (2021). Project-based Learning to Enhance Pre-service Teachers' Teaching Skills in Science Education. Universal Journal of Educational Research, 9(2), 271–279. https://doi.org/10.13189/ujer.2021.090202

Annetta, L. A., Lamb, R., Vallett, D., & Shapiro, M. (2018). Project-Based Learning Progressions: Identifying the Nodes of Learning in a Project-Based Environment. In Contemporary Technologies in Education (pp. 163–181). Springer International Publishing. https://doi.org/10.1007/978-3-319-89680-9_9

Baier, F., Decker, A.-T., Voss, T., Kleickmann, T., Klusmann, U., & Kunter, M. (2019). What makes a good teacher? The relative importance of mathematics teachers' cognitive ability, personality, knowledge, beliefs, and motivation for instructional quality. British Journal of Educational Psychology, 89(4), 767–786. https://doi.org/10.1111/bjep.12256

C, P. B., Soloway, E., Marx, R. W., Krajcik, J. S., Guzdial, M., & Palincsar, A. (1991). Motivating Project Based Learning: Sustaining the Doing, Supporting thr Learning. In Educational Psychologist (Vol. 26, Issues 3 & 4, pp. 369–398).

Cogan, L. S., & Schmidt, W. H. (2015). The concept of opportunity to learn (OTL) in international comparisons of education. In Assessing mathematical literacy (pp. 207–216). Springer.

Denuga, D. D., & Nkengbeza, D. (2022). Pre-Service Teachers Experience in Project-Based Learning Approach: A Case Study of

Two Campuses of the University of A (UNA). Open Journal of Social Sciences, 10(04), 121–132. https://doi.org/10.4236/jss.2022.104009

Dweck, C. S. (2006). The New Psychology of Success. In Random House.

Elliott, S. N., Kurz, A., Tindal, G., & Yel, N. (2017). Influence of Opportunity to Learn Indices and Education Status on Students' Mathematics Achievement Growth. Remedial and Special Education, 38(3), 145–158. https://doi.org/10.1177/0741932516663000

Flanagan, A. M., Cormier, D. C., & Bulut, O. (2020). Achievement may be rooted in teacher expectations: examining the differential influences of ethnicity, years of teaching, and classroom behaviour. Social Psychology of Education, 23, 1429–1448. https://doi.org/10.1007/s11218-020-09590-y

Kaldi, S., & Zafeiri, S. (2023). Identifying reflective modes in pre-service teachers' written reflections on the implementation of project-based learning during the school practicum. Frontiers in Education, 7(February), 1–13. https://doi.org/10.3389/feduc.2022.1072090

Kurz, A. (2011). Access to What Should Be Taught and Will Be Tested: Students' Opportunity to Learn the Intended Curriculum (S. N. Elliott, R. J. Kettler, P. A. Beddow, & A. Kurz, Eds.; Handbook o).

Megawanti, P., Supriyati, Y., & Tjalla, A. (2024). Development of mathematical mindset scale for mathematics education students. International Journal of Evaluation and Research in Education , 13(4), 2139–2147. https://doi.org/10.11591/ijere.v13i4.27845

Nasrullah, N., & Bachtiar, Muh. Y. (2021). Inovasi Pembelajaran Daring dan Dampak Bagi PAUD Selama Pandemi Covid-19. Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini, 6(2), 1007–1019. https://doi.org/10.31004/obsesi.v6i2.1411

Ortiz, E., Eisenreich, H., & Tapp, L. (2019). Physical and Virtual Manipulative Framework Conceptions of Undergraduate Pre-service Teachers. International Journal for Mathematics Teaching and Learning, 20(1), 62–84. https://doi.org/10.4256/ijmtl.v20i1.116

Ruslan, R., Alimuddin, A., & Nasrullah, N. (2018). Developing Alternative Assessment of Mathematical Performance for Vocational Students. Innovation of Vocational Technology Education, 14(1), 32. https://doi.org/10.17509/invotec.v14i1.11045

Saubern, R., Urbach, D., Koehler, M., & Phillips, M. (2020). Describing increasing proficiency in teachers' knowledge of the effective use of digital technology. Computers & Education, 103784. https://doi.org/10.1016/j.compedu.2019.103784

Setiawan, R., Indradewi, R. S., & Zainul, R. (2024). Development of growth mindset in higher education in support of the World-Class University. International Journal of Evaluation and Research in Education, 13(6), 3806–3817. https://doi.org/10.11591/ijere.v13i6.30145

She, H. C., Stacey, K., & Schmidt, W. H. (2018). Science and Mathematics Literacy: PISA for Better School Education. In International Journal of Science and Mathematics Education (Vol. 16, pp. 1–5). Springer Science and Business Media LLC. https://doi.org/10.1007/s10763-018-9911-1

Song, D., Kim, P., & Karim, A. (2012). SMILE in science classroom. The Annual Convention of the Association for Educational Communications and Technology, 386–392.

http://aectorg.yourwebhosting.com/publications/proceedings/2012.asp

Ummah, S. K., Inam, A., & Azmi, R. D. (2019). Creating manipulatives: Improving students' creativity through project-based learning. Journal on Mathematics Education, 10(1), 93–102. https://doi.org/10.22342/jme.10.1.5093.93-102

Wouters, P., van Nimwegen, C., van Oostendorp, H., & van Der Spek, E. D. (2013). A meta-analysis of the cognitive and motivational effects of serious games. Journal of Educational Psychology, 105(2), 249–265. https://doi.org/10.1037/a0031311

Wulandari, T. C., & Qamar, K. (2018). Project-Based Learning: Road to Make Connection between Concept and Skills in Mathematics Manipulative Media. Mathematics Education Journal, 2(1), 19. https://doi.org/10.22219/mej.v2i1.5798

Yeager, D. S., Hanselman, P., Walton, G. M., Murray, J. S., Crosnoe, R., Muller, C., Tipton, E., Schneider, B., Hulleman, C. S., Hinojosa, C. P., Paunesku, D., Romero, C., Flint, K., Roberts, A., Trott, J., Iachan, R., Buontempo, J., Yang, S. M., Carvalho, C. M., … Dweck, C. S. (2019). A national experiment reveals where a growth mindset improves achievement. Nature, 573(7774), 364–369. https://doi.org/10.1038/s41586-019-1466-y

Zhang, J., Cogan, L. S., & Schmidt, W. H. (2019). Measuring Textbook Content Coverage: Efficient Content Analysis with Lesson Sampling. In Educational Measurement: Issues and Practice (Vol. 39, Issue 2, pp. 74–84). Wiley. https://doi.org/10.1111/emip.12300