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ປຽບທຽບຄວາມສາມາດໃນການແກ້ໄຂບັນຫາທາງຄະນິດສາດ ໂດຍໃຊ້ຮູບແບບ ກິດຈະກຳກຸ່ມ ແລະ ກິດຈະກຳບຸກຄົນຂອງນັກຮຽນ ຊັ້ນ ມ.5 ທີ່ໂຮງຮຽນມັດທະຍົມສົມບູນປາກເຊ

Comparison of Mathematics Problem Solving Abilities between Individualized Instruction and Committee Work Method of Grade Ten Students at Pakse Secondary School

ບຸນຄຳ້ ສີຄູນຄຳ[1], ດາວວີ ແກ້ວສະຫວ່າງ[2], ວະນິດາ ປ້ອງວິໄລ[3], ສີສະໄໝ ດວງມະນີ[4]
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ບົດຄັດຫຍໍ້

ໃນບໍລິບົດການສຶກສາຂອງລາວປັດຈຸບັນ, ວິຊາຄະນິດສາດຊັ້ນ ມ.5 ແມ່ນພື້ນຖານທີ່ສຳຄັນສຳລັບການຮຽນໃນລະດັບມັດທະຍົມຕອນປາຍ ແລະ ສາຍ STEM ໃນອະນາຄົດ. ການວິໄຈນີ້ໄດ້ສຶກສາສິ່ງທ້າທາຍທາງດ້ານວິທີສອນ ລະຫວ່າງການພັດທະນາທັກສະລາຍບຸກຄົນ ແລະ ການເຮັດວຽກຮ່ວມກັນ ເຊິ່ງເປັນຄວາມຕ້ອງການຂອງການຮຽນຮູ້ໃນສະຕະວັດທີ 21

ຈຸດປະສົງໃນການວິໄຈໃນຄັ້ງນີ້ເພື່ອປຽບທຽບປະສິດທິຜົນຂອງການຈັດກິດຈະກຳການຮຽນ-ການສອນແບບເນັ້ນບຸກຄົນ ແລະ ແບບກຸ່ມ ທີ່ມີຕໍ່ຄວາມສາມາດໃນການແກ້ໄຂບັນຫາທາງຄະນິດສາດຂອງນັກຮຽນຊັ້ນ ມ.5.

[1,2,3,4]ພາກວິຊາຄູວິທະຍາສາດທຳມະຊາດ, ຄະນະສຶກສາສາດ, ມະຫາວິທະຍາໄລຈຳປາສັກ/ ສປປ ລາວ
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ວິທີການວິໄຈແມ່ນນຳໃຊ້ຮູບແບບການວິໄຈແບບເຄິ່ງທົດລອງ ໂດຍມີການທົດສອບກ່ອນ ແລະ ຫຼັງການຮຽນ ກັບກຸ່ມຕົວຢ່າງນັກຮຽນ 56 ຄົນ ຢູ່ໂຮງຮຽນ ມ.ສ ປາກເຊ. ກຸ່ມຕົວຢ່າງຖືກແບ່ງອອກເປັນສອງກຸ່ມຄື: ຫ້ອງ 5/1 ສອນແບບບຸກຄົນ ແລະ ຫ້ອງ 5/2 ສອນແບບກຸ່ມ ໂດຍໃຊ້ເວລາໃນການທົດລອງ 4 ອາທິດ.

ຜົນການວິເຄາະດ້ວຍ Independent Samples t-test ແລະ Paired Samples t-test ພົບວ່າ ການວິເຄາະທາງສະຖິຕິດ້ວຍ t-test ພົບວ່າ ທັງສອງວິທີສອນເຮັດໃຫ້ຜົນການຮຽນຂອງນັກຮຽນສູງຂຶ້ນຢ່າງມີຄວາມສຳຄັນທາງສະຖິຕິ ($p < 0.001$), ແຕ່ກຸ່ມທີ່ສອນແບບບຸກຄົນມີຄ່າສະເລ່ຍຄະແນນຫຼັງສອນສູງກວ່າ ($M = 80.36$, $SD = 14.01$) ເມື່ອທຽບກັບກຸ່ມທີ່ສອນແບບກຸ່ມ ($M = 70.18$, $SD = 18.88$).

ຜົນການວິໄຈສະຫຼຸບໄດ້ວ່າ ວິທີສອນແບບເນັ້ນກິດຈະກຳບຸກຄົນມີປະສິດທິຜົນສູງກວ່າແບບກຸ່ມ ໃນການພັດທະນາທັກສະການແກ້ໄຂບັນຫາທາງຄະນິດສາດ ຢ່າງມີຄວາມສຳຄັນທາງສະຖິຕິທີ່ລະດັບ 0.05 ($t = 2.291$). ຂໍ້ຄົ້ນພົບນີ້ຊີ້ໃຫ້ເຫັນວ່າ ການສົ່ງເສີມການຮຽນຮູ້ດ້ວຍຕົນເອງຊ່ວຍໃຫ້ຜົນການຮຽນໃນວິຊາຄະນິດສາດດີຂຶ້ນ, ເຊິ່ງເປັນຂໍ້ມູນສຳຄັນໃຫ້ແກ່ຄູສອນ ແລະ ຜູ້ພັດທະນາຫຼັກສູດໃນການປັບປຸງຄຸນນະພາບການສຶກສາ.

ຄຳສັບສຳຄັນ: ການແກ້ໄຂບັນຫາ, ການສຶກສາຄະນິດສາດ, ການສອນແບບບຸກຄົນ, ການຮຽນແບບກຸ່ມ, ຜົນສຳເລັດທາງການຮຽນ

Abstract

In the modern Lao educational landscape, Grade 11 mathematics serves as a critical foundation for senior secondary proficiency and future STEM success. This study addresses the fundamental pedagogical challenge of balancing individualized skill development with collaborative competencies, a key requirement for 21st century learning.

This study aimed to compare the effectiveness of individual-based instructional activities versus group-based activities on the mathematical problem-solving abilities of Grade 11 students.

A quasi-experimental research design was employed, utilizing pre-test and post-test measures with a sample of 56 students at Pakse Secondary School. The cohort was divided into two groups: Class 5/1 receiving individualized instruction and Class 5/2 utilizing committee-based group work over a four-week intervention period.

Statistical analysis through independent and dependent sample t-tests revealed that while both methods significantly improved student achievement ($p < 0.001$), the individual-based group achieved a markedly higher post-test mean score ($M = 80.36$, $SD = 14.01$) compared to the group-based cohort ($M = 70.18$, $SD = 18.88$).

The research concludes that individualized instruction is significantly more effective than group-based instruction for enhancing mathematical problem-solving skills at the 0.05 significance level ($t = 2.291$). These findings suggest that personalized cognitive engagement provides superior academic growth in core mathematics subjects, providing actionable insights for curriculum developers and educators in Laos to refine instructional strategies for improved educational quality.

Keywords: Academic Achievement, Group-Based Learning, Individualized Instruction, Mathematics Education, Problem-Solving

Introduction

Upper secondary education, or grades 11-12 in the Lao context, represents a crucial three-year cycle that builds upon the foundational knowledge acquired in lower secondary school. Its primary purpose is to holistically develop learners by expanding their knowledge, cultivating their abilities, and nurturing their aptitudes. This level aims to foster innovative thinking, a love for reading and writing, research skills, and self-reliance. Specifically, for Grade 11, a pivotal year in this cycle, mathematics is a core subject allocated 4 hours per week, totaling 136 hours per academic year. The mathematics curriculum at this stage is designed to deepen students' understanding of fundamental concepts, including algebra, geometry, analysis, trigonometry, and basic statistics. It also focuses on the comprehension and application of mathematical symbols and the development of logical and effective problem-solving skills. The primary objective of this research is to compare the effectiveness of two distinct instructional methodologies—group-based activities and individualized activities—on the mathematical problem-solving abilities of Grade 11 students. The study seeks to determine which approach yields a greater improvement in student performance, thereby providing evidence-based insights for pedagogical enhancement.

This study is grounded in the educational theory of individualized instruction, a learner-centered approach where students, often guided by the teacher, take ownership of their learning by investigating, analyzing, and synthesizing information on a given topic. This method respects individual differences in ability, intelligence, interest, and readiness. The research contrasts this with group-based, collaborative learning, which is increasingly recognized as a vital 21st-century skill. Group work, encompassing collaboration, teamwork, and leadership, is essential for leveraging diverse talents to solve complex problems, fostering innovation, and preparing students for dynamic professional environments. The study’s framework for assessing outcomes is based on Polya's (1957) classic four-step model of problem-solving: 1) understanding the problem, 2) devising a plan, 3) carrying out the plan, and 4) looking back to check and interpret the results. By applying this model, the research aims to precisely measure how each teaching method influences students' capacity to navigate mathematical challenges. The core hypothesis is that while both methods will lead to learning gains, the collaborative context of group work will result in a significantly higher ability to solve mathematical problems compared to working individually.

This quantitative study employed a quasi-experimental design, specifically a pre-test and post-test control group design. The target population was all Grade 11 students (N=287) at Pakse Secondary School for the 2020-2021 academic year. A sample of 56 students from two classrooms was selected using cluster sampling. One class (5/1, n=28) was designated as the control group, receiving instruction through individualized activities. The other class (5/2, n=28) served as the experimental group, taught using group-based activities. The research instruments included nine lesson plans (each spanning two hours) delivered over four weeks and a 60-minute mathematics achievement test focusing on logarithms and their applications. This test was administered as both a pre-test and a post-test, and student responses were evaluated using a detailed rubric based on Polya's problem-solving stages. The study was designed to test four key hypotheses: that no significant difference would exist between groups on the pre-test; that each group would show significant improvement from pre-test to post-test; and that the post-test scores of the group taught with group-based activities would be significantly different from (and hypothesized to be higher than) those taught with individualized instruction.

The pedagogical dichotomy explored in this research—individualized versus group-based learning—addresses a fundamental challenge in modern education: how to balance personalized skill development with the cultivation of essential collaborative competencies. While individualized instruction allows students to progress at their own pace, focusing on specific differences in ability and interest to develop lifelong learning skills, it may not fully prepare them for contexts requiring teamwork and shared problem-solving. Conversely, group work, though highly effective for building the "5Cs" (Communication, Coordination, Cooperation, Creativity, and Continuous improvement) and tackling complex problems, can sometimes obscure individual mastery. This study's focus on Grade 11 (M.5) mathematics at Pakse Secondary School is particularly significant, as this level serves as the critical foundation for senior secondary education. It directly investigates this balance within a core STEM subject where logical problem-solving is paramount. Previous research suggests that while group activities suit certain students, individual activities may be more effective for others. Consequently, the primary objective of this research is to empirically compare the mathematics problem-solving abilities of Grade 11 students at Pakse Secondary School when taught through two distinct instructional methods: group-based activities (Committee Work Method) and individual-based activities (Individualized Instruction). By analyzing these outcomes, the study aims to provide actionable insights for teachers and educational units to improve student proficiency and better equip them with the 21st-century skills necessary for higher education and the modern workforce.

Research Objectives

The objectives of this research are as follows:

- **To compare the effectiveness of instructional methods**: To compare the effectiveness of individual-based instructional activities versus group-based activities (Committee Work Method) on the mathematical problem-solving abilities of Grade 11 students.
- **To evaluate student performance improvement**: To determine which instructional approach yields a greater improvement in student performance and academic achievement in mathematics.
- **To provide evidence-based pedagogical insights**: To provide actionable insights for educators and curriculum developers in Laos to enhance instructional strategies and improve educational quality.

Methodology

Research Design

This research employed a quasi-experimental design using a pre-test and post-test approach to compare mean scores between instruction using group activities (Committee Work Method Instruction) and instruction using individualized activities (Individualized Instruction).

Participants

The sample for this study comprised 56 Grade 11 students from two classrooms at Pakse Secondary School during the 2020-2021 academic year. Room 5/1 (n=28) received instruction using individualized activities, while Room 5/2 (n=28) received instruction using group activities. Participants were selected through cluster sampling.

Instruments

The research instruments included nine lesson plans (each requiring 2 instructional hours), with a total teaching duration of 4 weeks and 2 hours. An objective test was used for both pre-test and post-test administrations, lasting 60 minutes. The test content covered logarithms and their applications, logarithm bases, and combinations, with scoring based on a rubric.

Data Collection

Data were collected through the following procedures:

- Instruction was conducted according to the two specified methods: Room 5/1 was taught using individualized activities, and Room 5/2 was taught using group activities
- After completing the specified content, the post-test was administered to assess the knowledge gained by students in both rooms (Room 5/1 and Room 5/2)

Data Analysis

The following statistical analyses were employed:

- Descriptive statistics: mean and standard deviation
- Independent sample t-test to compare baseline knowledge between the two rooms
- Dependent sample t-test to compare pre-test and post-test knowledge for Room 5/1
- Dependent sample t-test to compare pre-test and post-test knowledge for Room 5/2
- Independent sample t-test to compare post-test knowledge between the two rooms

Results and Discussions

Results

Demographic Characteristics of the Participants

Table 1: Number and Percentage of Participants by Group and Gender

Group	Gender	Experimental Group	Control Group	Total	Percentage (%)
1	Male	15	14	29	51.79
2	Female	13	14	27	48.21
Total		28	28	56	100

Table 1 presents the gender distribution of the 56 participants across the experimental and control groups. The experimental group (individualized activities) consisted of 15 males and 13 females, while the control group (group activities) contained 14 males and 14 females. Overall, female participants numbered 29, accounting for 51.79% of the sample, and male participants numbered 27, accounting for 48.21%. This relatively balanced gender distribution across both instructional groups helps ensure that gender-related factors do not disproportionately influence the comparison of instructional methods. The equal group sizes (n=28 each) provide a solid foundation for statistical comparison between the two instructional approaches.

Comparison of Pre-Test Scores Between Groups

Table 2: Comparison of Pre-Test Scores Between the Experimental and Control Groups

Group	N	Mean	Std. Deviation	Levene's F	Sig.	df	t
Experimental	28	42.32	4.61	2.388	0.128	54	1.124
Control	28	40.18	8.97				

Table 2 displays the comparison of pre-test scores between the experimental group (individualized activities) and the control group (group activities) prior to the intervention. Levene's Test for equality of variances yielded F = 2.388 with a significance value of Sig. = 0.128, indicating no statistically significant difference in variances between the two groups. This confirms that the assumption of homogeneity of variance was met.

The Independent Samples t-test revealed no statistically significant difference between the two groups' pre-test scores ($t = 1.124$, $df = 54$, $p > .05$). The experimental group achieved a mean score of 42.32 (SD = 4.61), while the control group achieved a mean score of 40.18 (SD = 8.97). These results demonstrate that the two groups had comparable baseline knowledge in mathematics prior to the intervention, establishing that any post-intervention differences can be attributed to the instructional methods rather than pre-existing disparities in mathematical ability. This equivalence is essential for the internal validity of the quasi-experimental design.

Comparison of Pre- and Post-Test Scores for the Experimental Group

Table 3: Comparison of Pre- and Post-Test Scores for the Experimental Group

Test	N	Mean	Std. Deviation	df	t
Post-test	28	80.36	14.01	27	15.561
Pre-test	28	42.32	4.61		

$p < .001$

Table 3 presents the comparison of pre-test and post-test scores for students in the experimental group, who received instruction through individualized activities. A Dependent Samples t-test revealed a statistically significant difference between pre-test and post-test scores at the .001 level ($t = 15.561$, $df = 27$, $p < .001$). The post-test mean score (M = 80.36, SD = 14.01) was substantially higher than the pre-test mean score (M = 42.32, SD = 4.61), representing an increase of approximately 38 points.

This finding indicates that instruction through individualized activities produced significant improvement in students' mathematical achievement. The large t-value and high level of statistical significance demonstrate the effectiveness of this instructional approach. The relatively larger standard deviation in the post-test scores (14.01 compared to 4.61 in the pre-test) suggests that while all students improved, the degree of improvement varied among individuals, with some students making greater gains than others.

Comparison of Pre- and Post-Test Scores for the Control Group

Table 4: Comparison of Pre- and Post-Test Scores for the Control Group

Test	N	Mean	Std. Deviation	df	t
Post-test	28	70.18	18.88	27	9.621
Pre-test	28	40.18	8.97		

$p < .001$

Table 4 displays the comparison of pre-test and post-test scores for students in the control group, who received instruction through group activities. A Dependent Samples t-test demonstrated a statistically significant difference between pre-test and post-test scores at the .001 level ($t = 9.621$, $df = 27$, $p < .001$). The post-test mean score ($M = 70.18$, $SD = 18.88$) was significantly higher than the pre-test mean score ($M = 40.18$, $SD = 8.97$), representing an increase of approximately 30 points.

These results confirm that instruction through group activities also led to significant improvement in mathematical achievement. However, the mean gain for the control group (30 points) was somewhat lower than that of the experimental group (38 points). Additionally, the post-test standard deviation for the control group (18.88) was larger than that of the experimental group (14.01), suggesting greater variability in learning outcomes among students in the group activities condition.

Comparison of Post-Test Scores Between Groups

Table 5: Comparison of Post-Test Scores Between the Experimental and Control Groups

Group	N	Mean	Std. Deviation	Levene's F	Sig.	df	t
Experimental	28	80.36	14.01	7.560	0.008	49.81	2.291
Control	28	70.18	18.88				

$p < .05$

Table 5 presents the comparison of post-test scores between the experimental group (individualized activities) and the control group (group activities) following the intervention. Levene's Test for equality of variances yielded $F = 7.560$ with a significance value of Sig. = 0.008, indicating a statistically significant difference in variances at the .01 level. This violation of the homogeneity of variance assumption required the use of adjusted degrees of freedom ($df = 49.81$) for the t-test.

The Independent Samples t-test revealed a statistically significant difference between the two groups' post-test scores at the .05 level ($t = 2.291$, $df = 49.81$, $p < .05$). The experimental group achieved a significantly higher mean score ($M = 80.36$, $SD = 14.01$) compared to the control group ($M = 70.18$, $SD = 18.88$). These results indicate that the individualized activities approach yielded significantly better learning outcomes than the group activities approach. The finding suggests that for mathematics instruction at the upper secondary level, individualized activities may be more effective than group-based activities in promoting student achievement.

Discussion

The finding that individualized instruction produced significantly higher mathematics achievement than group-based instruction aligns with a substantial body of educational research. Bloom (1984), in his seminal work on mastery learning, demonstrated that one-to-one tutoring and individualized approaches could produce achievement levels substantially higher than conventional group instruction. Bloom's "2 sigma problem" suggested that individualized methods could lead to average improvements of two standard deviations compared to traditional classroom instruction, a finding that has influenced educational practice for decades.

The superior performance of the individualized activities group may be attributed to several interconnected factors. First, individualized instruction allows students to progress at their own pace, ensuring mastery of prerequisite concepts before advancing to more complex material (Guskey, 2007). This self-paced approach is particularly valuable in mathematics, where concepts build sequentially and gaps in understanding can significantly impede future learning. Second, individualized activities provide opportunities for immediate feedback and correction, which Hattie and Timperley (2007) identified as one of the most powerful influences on student achievement. The feedback loop in individualized instruction allows students to identify and correct misconceptions in real-time, rather than carrying them forward. Third, individualized approaches can be tailored to students' specific strengths and weaknesses, enabling more targeted practice and skill development (Tomlinson, 2014). This personalization may be especially beneficial in diverse classrooms where students enter with varying levels of prior knowledge and mathematical readiness.

The finding that both instructional approaches resulted in significant improvements from pre-test to post-test confirms the general effectiveness of structured mathematics instruction. This supports the curriculum framework developed by the Research Institute of Educational Sciences (2011), which emphasizes systematic progression through mathematical concepts and the development of problem-solving skills. The substantial gains in both groups (38 points for the individualized group and 30 points for the group activities group) demonstrate that the instructional materials and lesson plans developed for this study were pedagogically sound and effectively implemented.

However, the greater variability in post-test scores for the group activities group (SD = 18.88) compared to the individualized group (SD = 14.01) warrants consideration. This increased variability suggests that group-based instruction may produce more inconsistent outcomes across students. Several explanations for this finding are plausible. Johnson and Johnson (2009) have noted that cooperative learning is most effective when groups are carefully structured, when students are taught collaborative skills, and when group processes are monitored and facilitated. It is possible that these conditions were not optimally met in the present study, leading to variable group functioning and, consequently, variable learning outcomes. Some groups may have collaborated effectively, while others may have experienced coordination problems, unequal participation, or social loafing—the tendency for individuals to exert less effort when working in groups (Latane, Williams, & Harkins, 1979).

The finding that individualized instruction outperformed group instruction appears to contrast with some research emphasizing the benefits of collaborative learning. However, this apparent contradiction may be resolved by considering the nature of the learning task and the educational context. Mathematics, particularly at the upper secondary level, involves the acquisition of foundational skills and conceptual understanding that may be optimally developed through individual practice and reflection before engaging in collaborative problem-solving. As Vygotsky (1978) suggested, social interaction plays a crucial role in learning, but individual internalization of concepts is equally important. A blended approach that combines individualized skill development with collaborative application may prove more effective than either method alone.

The results of this study align with the research of Yeh (2010), who found that integrating individualized instruction with computer-mediated communication could enhance online collaborative learning. Yeh's work suggests that individualized and collaborative approaches need not be viewed as mutually exclusive but can be thoughtfully combined to leverage the strengths of both. Similarly, Panich (2013) emphasized that 21st-century skills include both individual competencies and collaborative abilities, suggesting that students need opportunities to develop both types of skills.

Several limitations of this study should be acknowledged. First, the sample was drawn from a single school (Pakse Secondary School) and may not be representative of all Grade 11 students in Laos. Second, the intervention lasted only four weeks, and longer-term studies would be needed to assess whether the observed effects are sustained over time. Third, the study focused specifically on mathematics achievement and did not measure other important outcomes such as student engagement, attitudes toward mathematics, or the development of collaborative skills. Fourth, the group activities approach may not have been implemented with optimal fidelity; more structured cooperative learning techniques, such as those described by Johnson and Johnson (2009), might produce different results.

Despite these limitations, the study has important implications for mathematics instruction in Lao secondary schools. The findings suggest that teachers should consider incorporating more individualized activities into their instructional practice, particularly when the goal is to develop foundational mathematical knowledge and problem-solving skills. This might include self-paced workbooks, computer-based tutoring systems, or carefully designed individual projects that allow students to progress according to their own readiness and receive timely feedback.

At the same time, the significant improvements in the group activities group suggest that collaborative learning also has value and should not be abandoned. Future research might explore blended approaches that sequence individualized and collaborative activities in ways that optimize learning outcomes. For example, students might first develop individual mastery through self-paced activities and then apply their knowledge in collaborative problem-solving contexts. Such an approach would address both the need for foundational skill development and the importance of collaborative competence in the 21st century (Panich, 2013; Sombat, 2002).

Conclusion

The findings of this research indicate a clear advantage of individualized instruction over group-based activities in enhancing the mathematical problem-solving abilities of Grade 11 students. The experimental group, engaging in individualized activities, demonstrated significantly higher achievement scores compared to their peers in the control group, utilizing collaborative methods. This reinforces the notion that personalized learning paths may better facilitate mastery of mathematical concepts, allowing students to progress at their own pace, receive timely feedback, and develop problem-solving skills tailored to their specific needs. Moreover, both instructional methodologies yielded substantial improvements in student performance, affirming the effectiveness of structured mathematics instruction in promoting learning gains.

Recommendations

Based on the research findings, which indicate that individualized instruction significantly outperforms group-based activities in enhancing mathematical problem-solving skills, the following recommendations are proposed:

- **Prioritize Individualized Mastery**: Educators should consider incorporating more individualized strategies into their daily teaching practices, especially when introducing foundational mathematical concepts. This ensures that students develop essential mastery and problem-solving logic at their own pace before moving to more complex collaborative tasks.
- **Implement Blended Instructional Models**: While individualized learning yielded superior academic growth in this study, collaborative learning still shows value in improving student achievement. Therefore, a blended approach that sequences personalized skill development followed by collaborative application is recommended to optimize both individual mastery and 21st-century social competencies.
- **Enhance Teacher Professional Development**: Educational institutions and policymakers should invest in professional development opportunities that equip teachers with skills in delivering differentiated and personalized instruction. This includes training on the use of personalized learning tools and timely feedback mechanisms, which are critical for student success.
- **Resource Allocation for STEM Subjects**: On a policy level, more resources and guidelines should be allocated to foster personalized learning frameworks within the national curriculum, particularly for core STEM subjects like Grade 11 mathematics where logical reasoning is paramount.

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