

A COMPARISON OF LEARNING ACHIEVEMENT IN MATHEMATICS FOR PRIMARY SCHOOL AMONG FIRST-YEAR UNDERGRADUATE STUDENTS MAJORING IN MATHEMATICS ADMITTED THROUGH DIFFERENT ADMISSION PATHWAYS

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ABSTRACT

As learning outcomes may differ across university admission pathways, this study examined this association in the course Mathematics for Primary School. The participants were 30 first-year undergraduate students enrolled in the Learning Management Science Program (mathematics major). Students were admitted through five pathways: Portfolio (PF), Mathematics–Science Teacher Preparation Program (MS), Allocated School Quota (QT), Central Admission System (CA), and Independent Direct Admission (DA). Learning outcomes were assessed across cognitive, psychomotor, and affective domains using formative assessments (70%) conducted weekly and a summative final examination (30%). One-way analysis of variance revealed statistically significant differences in overall learning achievement among students admitted through different pathways at the 95% confidence level ($F = 3.932, p \leq .05$). Post hoc analyses indicated significant differences between the PF and CA. However, no significant differences in mean learning achievement were found between the PF and MS, QT, or DA. Similarly, no significant differences were observed between the CA and MS, QT, or DA. The findings suggest that admission pathways are associated with variations in students' learning achievement in teacher education contexts. The selection process for first-year students should not rely solely on high academic scores. Instead, admission processes should also consider applicants' genuine motivation and their awareness of the profession they intend to pursue.

Keyword: Admission pathways, Learning achievement, Mathematics teacher education, Pre-service mathematics teachers, TCAS

I. INTRODUCTION

Higher education is a developmental process that supports learners' transition from upper secondary education to becoming individuals prepared for specialized professions. These graduates constitute a critical workforce that underpins the economic system and directly contributes to national development (Office of the Higher Education Commission, 2016, 28 pp. 1-3).

Thailand's higher education admission system has undergone several revisions, evolving from institution-specific entrance examinations to a centralized system and, more recently, to the Thai University Central Admission System (TCAS). These reforms were implemented to improve fairness, standardization, and alignment between admission criteria and disciplinary requirements. TCAS currently offers multiple admission pathways-such as portfolio-based, quota-based, and examination-based tracks-each reflecting different student characteristics and competencies (Association of University Presidents of Thailand, 2023, pp. 2-4). Accordingly, higher education plays a central role in integrating knowledge, skills, attributes, and values in alignment with the disciplinary and professional orientations of each field of study (Knight & Yorke, 2003, pp. 1-5). This role renders student development at the higher education level fundamentally different from that at the upper secondary level, which primarily emphasizes foundational knowledge. Although secondary education incorporates certain skills and attributes across subject groups, such development remains largely general and preparatory rather than specialized. Upon entering higher education, the nature of learning undergoes a substantial transformation. For example, medical students are required to develop clinical competence (Harden, 2016, pp. 1010-1012), engineering students must cultivate systems thinking abilities (Froyd & Ohland, 2005, pp. 148-152), and teacher education students need to develop instructional design skills and a deep understanding of learners (Darling-Hammond, 2006, pp. 23-30). Developing students' capacities in accordance with program-specific learning outcomes therefore relies heavily on the characteristics and preparedness of incoming students, as these factors directly influence the effectiveness of development at the higher education level (Astin, 1993, pp. 7-11). Consequently, student selection processes play a crucial role in determining the quality of educational outcomes.

Existing studies suggest that admission modalities are associated with distinct patterns of learning achievement. Selection methods based on centralized examinations tend to predict academic performance effectively during the early years of higher education, although their predictive power diminishes in later years (Mahidol R2R e-Journal, 2019, pp. 50- 54). In contrast, admission criteria incorporating GPAX have been linked to more sustained academic performance, particularly in health sciences, engineering, and teacher education programs (Mahidol R2R e-Journal, 2019, pp. 50-54). Similarly, GAT/PAT and subject-specific examination scores show positive associations with academic achievement, albeit with declining influence as students advance through their studies (Thonburi University Journal, 2022, pp. 35-38). These findings suggest that different admission pathways select students with diverse learning profiles, which subsequently influence their academic development in higher education. This result aligns with Input-Environment-Outcome (I-E-O) model (Astin, 1993, pp. 7-11), which highlights the importance of student inputs in determining educational outcomes.



It can be observed that different admission pathways influence students' learning effectiveness in different ways, depending on the instructional approaches employed by each faculty or academic field chosen by the students. Therefore, this study hypothesizes that students admitted through different admission pathways will demonstrate different learning outcomes across the domains of knowledge, skills, and attitudes. Accordingly, the study aimed to examine whether significant differences in learning achievement exist among first-year mathematics teacher education students admitted through five distinct TCAS pathways.

II. LITERATURE REVIEW

Student development in higher education is shaped by multiple interrelated factors, among which the characteristics and attributes of admitted students play a critical role. Admission modalities influence not only the academic preparedness of students but also their motivation, learning behaviors, and capacity for sustained development within specific disciplinary contexts. This perspective aligns with Astin's (1993, pp. 7-11) I-E-O model, which conceptualizes educational outcomes as the result of interactions between student inputs, learning environments, and institutional processes. Within this framework, student input-particularly prior academic performance and motivational characteristics-constitutes the initial condition that shapes subsequent learning trajectories and academic achievement. There was numerous research studies have shown the relation between input, environment, and output based on I-E-O model. Empirical evidence supports the central role of student input in predicting academic success. (Heaney & Fisher, 2011, pp. 65-70) applied the I-E-O model to examine student persistence within learning communities and found that both input and environmental factors significantly influenced the likelihood of academic success.

Research on specific admission pathways further illustrates the differentiated effects of student input. Studies on portfolio-based admissions indicate that in disciplines such as communication arts, architecture, and teacher education, students who present authentic prior work tend to demonstrate more continuous academic development, particularly in project-based learning contexts. These students often exhibit stronger intrinsic motivation and clearer commitment to skill development (Phayao University Health Sciences Research, 2021, pp. 58-62). Comparable patterns have been observed in quota-based admission systems, such as the Collaborative Project to Increase Production of Rural Doctors (CPIRD), where high motivation and structured institutional support contribute to positive academic and professional development (Collaborative Project to Increase Production of Rural Doctors, 2020, pp. 12-16). Furthermore, a comparative study of students admitted through all four TCAS rounds revealed statistically significant differences in academic achievement, with TCAS 3 students achieving the highest outcomes and TCAS 1 students the lowest (Phayao University Health Sciences Research, 2021, pp. 60-65). These findings indicate that different admission modalities may select students with distinct learning profiles and developmental potential. Beyond academic credentials, motivational factors have been consistently linked to learning effectiveness. Richardson & Watt (2006, pp. 35-40) reported that students entering teacher education programs with strong intrinsic motivations-such as interest in teaching and a desire to contribute to society-demonstrated clearer professional self-development trajectories. This conclusion was reinforced by Watt et al. (2012, pp. 795-800) in a cross-national study involving pre-service teachers from Australia, Germany, the United States, Taiwan, and Hong Kong, which found that intrinsic motivation and perceived professional value were significantly associated with higher engagement and long-term commitment to the profession. Studies in vocational and industrial education indicate that learner-related factors play a critical role in learning achievement. Chen & Chen (2022, pp. 6-9) found that learning motivation



significantly and positively influenced learning performance among higher vocational students. Similarly, Phungsuk et al. (2023, pp. 50-55) reported that learners' engagement behaviors and responsibility for self-directed learning were essential conditions for success in technology-enhanced learning environments. These findings highlight the significant role of student inputs in influencing effective outcomes across different educational programs. However, the literature also highlights limitations in the predictive power of admission criteria alone. Hudson (2013, pp. 775-778) found that competency development during practicum experiences depended primarily on the quality of mentoring and learning environments rather than on selection mechanisms. In contrast, Al-Asmar et al. (2021, pp. 4-6) demonstrated a significant positive relationship between high school GPA and graduating academic achievement among dental students, suggesting that GPA can function as a valid indicator of long-term academic success. Moreover, GPA has been shown to reflect not only academic performance but also learning motivation (Richardson et al., 2012, pp. 360-368; Robbins et al., 2004, pp. 270-275). Therefore, different programs require admission or selection methods that support effective student learning, and these methods may vary depending on the specific characteristics of each program or profession. This study aims to examine the extent to which different student admission modalities- representing diverse learner characteristics and attributes- affect learning success among pre-service mathematics teachers in the core course Mathematics for Primary School.

III. RESEARCH METHODOLOGY

Participants

The population consisted of 30 first-year undergraduate students enrolled in the mathematics major of the Learning Management Science Program, Department of Industrial Education, Faculty of Industrial Education and Technology, King Mongkut's Institute of Technology Ladkrabang (KMUTL), during the first semester of the 2025 academic year. The participants were admitted through different admission pathways, including Portfolio admission ($n = 11$), Mathematics–Science Teacher Preparation Program ($n = 8$), Allocated School Quota ($n = 4$), Central Admission System ($n = 5$), and Independent Direct Admission ($n = 2$), yielding a total of 30 participants.

Variables and Definitions

Students admitted through the Portfolio pathway were coded as PF. Students admitted through the Mathematics–Science Teacher Preparation Program were coded as MS. Students admitted through the Allocated School Quota pathway were coded as QT. Students admitted through the Central Admission System were coded as CA. Students admitted through Independent Direct Admission were coded as DA. PF students were qualified based on their portfolio, academic records (GPAX), group activity, and a structured interview; MS students were qualified based on their portfolio, GPAX, and a traditional unstructured interview; QT students were qualified based on their portfolio, GPAX, the teacher professional aptitude test, and a traditional unstructured interview; CA students were qualified based on standardized national test scores submitted through the Thai University Central Admission System (TGAT, TPAT3, and TPAT5); and DA students were qualified based on their portfolio, GPAX, and a traditional unstructured interview.



Data Collection

Data were collected in the form of formative assessment scores, which accounted for 70% of the total course grade and were conducted on a weekly basis. The assessments included quizzes, questioning, self-assessment, and peer assessment implemented through a variety of learning activities. Criterion Score and Rubric-based scoring were used for evaluation, and feedback was provided on all student work to support their improvement in subsequent learning activities. These assessments focused on three domains with equal weight. The cognitive domain emphasized the analysis of mathematical content aligned with Grades 3 and 6 of primary education. The assessment content covered six mathematical strands: Numbers and Operations, Algebra, Geometry, Measurement, Statistics, and Probability. The assessments emphasized relationships and differences across grade levels through higher-order thinking skills, including identifying key ideas, interpreting weekly content, defining concepts based on provided information (comprehension), comparing and contrasting concepts, and applying understanding across grade levels to design learning activities that progress from simple to complex. In addition, the psychomotor domain, which is essential for the teaching profession, was assessed through communicative and collaborative competencies. The affective domain was evaluated based on students' attitudes, perspectives, and beliefs toward mathematics learning. The remaining 30% of the total grade was derived from a summative assessment (final examination). The examination is a subjective test that focused on analyzing students' learning difficulties transferred from Grades 3 and 6, connecting mathematical learning strands to national educational visions, and applying understanding of Grade 3 and Grade 6 content to design appropriate learning activities.

Data Analysis

Data were analyzed using descriptive statistics, including the mean and standard deviation, and one-way Analysis of Variance (ANOVA) to compare mean learning achievement among students admitted through different admission pathways at a 95% confidence level ($\alpha = .05$). When statistically significant differences were found, Scheffé post hoc tests were conducted. All analyses were performed using JASP statistical software.

IV. RESULT

Based on formative assessments from the population of 30 first-year undergraduate students enrolled in the mathematics major of the Learning Management Science Program in three domains conducted throughout the course, which accounted for 70% of the total course grade and were administered weekly, data were collected from various assessment activities. These assessments included quizzes, questioning, self-assessment, and peer assessment implemented through a variety of learning activities. Criterion scores and rubric-based evaluations were used to assess student performance, and feedback was provided on all student work to support students' improvement in subsequent learning activities. The descriptive statistics indicated differences in mean learning achievement across admission pathways. Students admitted through the PF pathway achieved the highest mean score ($M = 31.14$, $SD = 7.22$), followed by those admitted through DA ($M = 30.03$, $SD = 1.23$), MS ($M = 26.45$, $SD = 4.36$), QT ($M = 25.24$, $SD = 3.29$), and CA ($M = 18.98$, $SD = 1.77$). When learning outcomes across all three domains were analyzed collectively using one-way analysis of variance. **Table 1**, presents the results of the one-way analysis of variance (ANOVA) comparing students' learning achievement based on different admission methods. The findings indicate that there was a statistically significant difference in learning achievement among at least one of the groups that the mean learning achievement of students admitted through different admission pathways differed significantly at the 95% confidence



level ($F = 3.932$, $p = .014$). These findings suggest that different admission pathways are associated with differences in students' learning achievement. To further examine which groups differed from one another, a Scheffé post hoc test was performed.

Table 1 Results of One-way Analysis of Variance (ANOVA) comparing learning achievement across admission pathways

Variance	Sum of squares	df	Mean square	F	p
between-group variance	477.3	4	119.31	3.932	.014
within-group variance	728.3	24	30.34		

Table 2, which presents the multiple comparisons of mean learning achievement using the Scheffé post hoc test, revealed that the comparison of mean differences among groups with different admission pathways showed a statistically significant difference between students admitted through the PF and those admitted through CA. However, no significant differences in mean learning achievement were found between the PF and MS, QT, or DA. Similarly, no significant differences were observed between the CA and MS, QT, or DA.

Table 2 Results of pairwise comparisons of mean learning achievement across admission pathways using the Scheffé post hoc test

	PF	MS	QT	CA	DA
μ	31.14	26.45	25.24	18.98	30.03
PF	31.14	-	4.69	5.90	12.17*
MS	26.45	-	1.21	7.48	-3.58
QT	25.24	-	-	6.27	-4.79
CA	18.98	-	-	-	-11.06
DA	30.03	-	-	-	-

Significant at the .05 level

V. CONCLUSION AND DISCUSSION

The results of this study indicate that admission pathways influence students' learning achievement in the course Mathematics for Primary School among students majoring in mathematics in the Learning Management Science Program. Statistically significant differences in learning achievement were found between students admitted through PF and those admitted through the CA, whereas differences among other admission pathways were not statistically significant. No significant differences were observed between PF and MA, QT, and DA. This may be because the selection processes in these pathways are similar, typically including a portfolio, academic records (GPAX), and an interview. Likewise, no significant differences were found between CA and the MA, QT, and DA groups. One possible explanation is that these pathways employ similar interview procedures, which are generally conducted as traditional unstructured interviews, whereas PF uses a structured interview. Another possible factor is the timing of the admission decision. The PF pathway requires applicants to apply earlier than other pathways. This earlier application period may reflect applicants' stronger passion or motivation to pursue a teacher education program. Such characteristics may partly explain the significant difference in learning outcomes observed between PF and CA. Therefore, the interview process should be emphasized and designed in a specific way. Additionally, interviewers should work as a team and receive proper training or preparation to conduct interviews in a professional manner. This strongly demonstrates the importance of inputs in the I-E-O model, which conceptualizes educational outcomes as the result of interactions among student inputs, learning environments, and institutional processes



(Astin, 1993, pp. 7–11). On the other hand, GPAX, which was not directly related to the interview process and for which all candidates met the required qualifications, was not found to be a significant factor in this study. This finding differs from previous studies suggesting that GPAX significantly predicts academic performance (Mahidol R2R e-Journal, 2019, pp. 52-55). An area in which students demonstrated relatively low performance was the cognitive domain, particularly in higher-order thinking skills, including interpretation, understanding mathematical meanings and concepts, summarization, application of understanding to instructional design, and knowledge synthesis through discussion. The development of these skills requires a strong foundation in long-term memory, enabling learners to connect prior knowledge with new concepts and to synthesize ideas through collaborative discourse. However, many students lacked behaviors associated with self-learning and intellectual curiosity (Phungsuk et al., 2023, pp. 53-56). Within this context, students who are able to adapt, possess positive attitudes toward learning, and demonstrate intrinsic motivation to develop themselves as future teachers are more likely to achieve meaningful learning outcomes (Phayao University Health Sciences Research, 2021, pp. 60–63; Richardson and Watt, 2006, pp. 38-41). This may partly explain why the PF-requiring self-awareness, clear goals, and prior engagement in activities related to the teaching profession—was associated with different learning outcomes compared to CA, which primarily relies on knowledge-based examinations (Watt et al., 2012, pp. 798-802).

Therefore, effective learning in teacher education relies on students' ability to understand their interests and envision their future professional roles. Providing opportunities for self-exploration and authentic experiences within admission criteria may help identify candidates who possess strong motivation and clear professional goals, thereby supporting effective learning and professional development in teacher education programs. Furthermore, admission requirements should assess candidates in ways that allow high school students to explore their interests and engage meaningfully with their learning experiences. These opportunities should extend beyond guidance counseling courses to include real-life experiences of significant duration that encourage self-exploration. If the Thai school curriculum cannot sufficiently facilitate such experiences, university admission strategies should provide a realistic picture of the teaching profession so that applicants can make informed decisions. Consequently, the selection of first-year students should not rely solely on high academic scores. Instead, admission processes should also consider applicants' genuine motivation and their awareness of the profession they choose to pursue.

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