Comparing Students' Learning Preferences Through Cluster Analysis: Implications for Higher Education

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Abstract
In response to the disruptive changes within society and technology, higher education institutions need to transform their content-centric curricula into learning pathways that effectively equip students for the workforce. Adapting to the challenges posed by evolving learner dynamics is a crucial approach for institutions to enhance their responsiveness to such changes. This research aims to investigate the categorization of potential students based on their learning preferences, study self-efficacy, and learning motivation. Furthermore, the study seeks to compare the attributes of students across these different clusters. The participants were secondary high school students from various school types in Thailand, using a multi-stage random sampling method for an online survey. Analyzing responses from 1137 students, a two-step cluster analysis identified three distinct clusters. The comparison of student characteristics among clusters showed significant differences according to the student's study self-efficacy, motivation, and learning preferences. Students in a cluster where the majority perceived their academic accomplishments to be at or above an average level exhibited significantly stronger preferences for non-traditional and traditional study approaches than the other clusters. The study also discussed how students' learning preferences and interests in academic disciplines are associated with their psychological attributes and perceived academic achievements. The distribution of cluster memberships holds significance for institutions, particularly in communicating innovative learning approaches to potential students.

Keywords: Learning Preferences, Motivation, Study-Self Efficacy, Cluster Analysis

Introduction

Amidst a social context that is highly volatile, uncertain, complex, and ambiguous, teaching curricula at various levels have turned the focus on creating "competencies and "learning outcomes" in replacing teaching formats and goals that focused on subject content. Higher education institutions (HEIs) have recently established new ways of acquiring skills to fill a gap between traditional higher education qualifications such as bachelor's, master's, or doctoral degrees and the skills that firms seek. Trends in self-paced, competency-based learning through terms such as Micro-credentials, Digital Credentials, and Alternative Credentials have been increasingly offered among HEIs. Although definitions and taxonomies to structure these targeted learning have yet to be widely agreed upon, they have changed the higher education delivery model (OECD, 2020).

Previous research indicated that students enroll in university with preconceived beliefs and expectations to acquire knowledge, develop competencies, and earn a degree according to formal education (Koul et al., 2012). As learners are in a dynamic context and do not belong to static characteristics, this study was conducted as a Scholarship of Teaching and Learning to explore patterns and groups of young learners' characteristics and preferences to further their learning journey at higher education. The focus was on the formal undergraduate level, where "traditional programs" increasingly shared the higher education market with emerging alternative approaches, which this paper termed "non-traditional programs."

In this paper, the term “traditional programs” involves learners enrolling in a university program that requires a time commitment of years, leading to the completion of a degree. This approach often includes a structured and fixed curriculum, set class schedules, and assessments. Degrees are widely recognized and accepted as a standard qualification for many professions. Meanwhile, the term “non-traditional programs” offers flexibility in duration and pacing. Learners might complete modules or courses to earn more minor, targeted credentials and study at their own pace. Additionally, a flexible pathway allows learners to accumulate accomplishments from smaller learning units to gain a certificate or a full degree. In this regard, the duration of an alternative or non-traditional program is often shorter than that of a formal higher education program that leads to the award of a degree. (Kato et al., 2020; Tanprasert, 2021; UNESCO, 2018).

Identifying learner characteristics and preferences patterns may contribute to developing the curriculum and teaching of higher education institutions that accommodate students' learning needs. Researchers have explored learner characteristics such as personality traits, cognitive and emotional aspects, and technology preferences to understand groups of learners. In this paper, the authors adopted self-efficacy and motivation as psychological characteristics under the study. Students’ efficacy, as a central determinant of the success of high school to university transitions, was explored in the academic context (Svartdal et al., 2021), and their motivation was explained through the framework of achievement goal (Elliot, 1999) herein, referred to as learning motivation. Past research found that self-efficacy and motivation are significant predictors of academic achievement (Chemers et al., 2001; Rhew et al., 2018). This study will consider the two characteristics of Thai high school students in answering the research questions that ask:

(1) Are there clusters of students based on their study efficacy, learning motivation, and learning preferences?
(2) Are there differences in students' study efficacy, learning motivation, and learning preferences between student clusters?

Literature Review

Study Efficacy

Self-efficacy is a belief in one's ability to organize and execute actions required to succeed in particular circumstances (Bandura, 1997). Efficacy influences a person's effort and perseverance when facing challenges and failures. Generally, an individual's self-efficacy is related to persistence and achievement. Previous studies addressed the evidence that self-efficacy affected performance in specific cognitive abilities (i.e., longer persistence and better strategies in solving mathematical problems) (see Chemers et al., 2001).

Study self-efficacy (SSE) is students' belief in their ability to successfully plan and implement student activities (Bandura, 1997). In an academic context, a previous study found self-efficacy influenced academic motivation as the choice of activities, level of effort, persistence, and emotional reactions. Students with high academic self-efficacy use more effective cognitive strategies in learning and are better at monitoring and regulating their efforts. Compared to students with lower academic self-efficacy, those with higher self-efficacy tended to be more enthusiastic about participating in activities, persevering through setbacks, and experiencing fewer negative feelings when they failed (Zimmerman, 2000). Although academic self-efficacy is related to past academic achievement, studies have found that interventions based on social cognitive theory in educational programs (e.g., embedding mastery experiences) may enhance self-efficacy (Svartdal et al., 2021).

Chemers et al. (2001) studied the association between academic self-efficacy in first-year college students' performance and adjustment and found that self-efficacy beliefs affect academic commitment. According to Klassen et al. (2008), study self-efficacy is one key factor for applying study skills into action. They found that undergraduate students with lower self-efficacy were more likely to procrastinate on daily academic work and had significantly lower GPAs. In the study of Svartdal et al. (2021), self-efficacy influenced the relationship between study habits and procrastination but with different effects as a predictor of performance at early versus later study stages.

Learning Motivation

An essential process in motivation, according to Socio-cognitive theories, is goal setting. Elliot and Church (1997) researched the trichotomous conceptualization of achievement goals and found empirical support for the framework (see Elliot & Church, 1997). Two types of performance goals - performance-approach and performance-avoidance goals - represent separate, independent achievement orientations. Performance goal is associated with a task that focuses on demonstrating competence relative to others or competition, whereas performance-avoidance goals focus on not performing poorly relative to others. For mastery goals, the individual focuses on developing competence through task mastery, relevance, or meaningfulness. These three types of achievement goals are competence-based goals that are widely adopted in educational studies. While mastery goals positively related to the facilitation of interest and negatively related to evaluation focus and harsh evaluation, performance-approach goals were positively related to evaluation focus, and performance-avoidance goals were positively related to evaluation focus and harsh evaluation (Elliot, 1999; Elliot & Church, 1997).

According to Schunk et al. (2007), the performance-oriented individual is driven by the desire for public recognition and how one's competence will be evaluated in relation to others. Students with performance orientation will be motivated to be seen as the best in the group but to avoid judgments of low ability. On the contrary, students with mastery orientation are motivated to learn under one's standards, acquire new skills, improve competence, and accomplish something challenging. In the views of Zentall and Morris (2010), task persistence and self-evaluation are two potential underlying components of motivation. Students who negatively self-evaluate might think they would fail before starting the task or select an easy task to prevent unfavorable outcomes or to hide their inability.

Although motivation towards learning is a personal characteristic, some prior research found that institutional characteristics can influence students' goal orientations. In the study of Koul et al. (2009), students from vocational colleges were significantly more performance and identification goal-oriented than the students from higher education institutions. Performance-oriented students would be likely to engage in social comparison. Students who value the university degree program relative to the diploma program in vocational colleges could feel inferior or superior to other students.

Methods

Participants

The target populations were high school students in grades 10 and 11 from schools under the Ministry of Education (MOE) and Ministry of Higher Education, Science, Research and Innovation (MHESI) in Thailand. Public and private schools represent the school under MOE. Public school education in Thailand is free of charge for Thai nationals until grade 9. Public schools follow a standard, government-approved curriculum catered to students of all types. Resources are generally from their funding in private schools, and the tuition and fees are significantly higher than in public schools.

Under MHESI, the Engineering Science Classroom (ESC) and Demonstration School were included in the study. ESC is part of the Science Classrooms in University-Affiliated School Project (SCIUS) - a budget-funded project from MHESI. The primary mission of ESC is to build science, technology, and engineering human resources who have the skills to create and develop technology and innovation to meet the target industries according to the country's strategy. School administration and curriculum are associated with a university and used in teaching training programs for demonstration schools.

Samples were drawn from multi-stage random sampling. Finally, survey data was collected from 1,137 students. There were more female students (n=760, 66.8%) than male students (n=332, 29.2%). Over half of the students were Grade 10 (n=638, 56.1%), followed by students from Grade 11 (n=499, 43.9%). Equally, one-third of the students were from Demonstration and public schools (n=335, 29.5 %). The rest were from ESC (n=240, 21.1%) and private schools (n=227, 20 %).

Most students were from Science-Mathematics majors (n=789, 69.4%), while Mathematics-English majors and language majors were equally represented (n=174, 15.3%). Note that around one-third of Science-Mathematics students were from ESC (n=240, 30.4%), Mathematics-English students mainly were represented in Public school (n=82, 47.1%), and

Language-major students were closely distributed in Demonstration school (n=61, 35.1%) and private school (n=60, 34.5%).

Questionnaire

The online questionnaire comprised two parts. Part One used the checklist questions asking students to identify their characteristics, including age, year level, major, and perceived academic achievement. An open-ended question asks students about the discipline they would like to study in higher education or pursue as a career.

In Part Two, students were asked to rate 15 items on a 1-10 semantic differential scale. The questions were “How much are you interested in the characteristics of (study in higher education) listed below? Only the poles (1=Not interested and 10=very interested) were labeled. A principal components factor analysis was used because the primary purpose was to identify and compute composite scores for the factors underlying the items. Varimax and oblimin rotations identified two factors with an Eigenvalue > 1, explaining 59.39 % of the total variances for the items. Two factors were the preference for the traditional approach (three items), which accounted for 44.926 % of the total variance, and the non-traditional approach (twelve items), which accounted for 14.466% of the total variance. Sample items related to the traditional approach were "the length of study is generally semester-based to receive a degree certificate." Sample items related to the traditional approach were "Choose the study topic as you want, then submit evidence to evaluate whether you have the ability and do not care about the degree." Cronbach’s alphas for the traditional and non-traditional approach items were .76 and .96, respectively.

Next, the Student Study Efficacy Scale (SSES) was adapted from Svartdal et al. (2021) to measure students’ confidence in their ability to achieve desired academic outcomes. Items were rated on a five-point Likert scale (1=strongly disagree to 5=strongly agree). The three first items were reverse coded. Confirmatory factor analysis (CFA) was used to investigate the construct validity of the scales. The Root-mean-squared error of approximation (RMSEA) value = .09, Standardized Root Mean Square Residual (SRMR) = .00, Comparative Fit Index (CFI) = 1.00. The indicators show the model fit according to theoretical support. That means SSES comprises three aspects, including confidence in the utility of study skill habits (i.e., “I have little faith in my ability to study effectively”), general outcome expectations (i.e., “I am sure that I will accomplish the academic goals I have set for myself”), and persistence item (“When I have decided to complete something important to me, I continue even if it proves more difficult than I believed”). Cronbach’s alphas for the utility of study skill habits and general outcome expectations items were .82 and .46, respectively. In the present study, low reliability in the items related to the general outcome expectations aspect could be due to the neutrality or non-specific study contents that the items addressed. As Honicke and Broadbent (2016) noted, self-efficacy measures that contain content-specific scales are likely to gain higher levels of internal reliability than general self-efficacy scales. It should be noted that the questionnaire used the Thai language. The authors used back translation to re-translate items from Thai to English. The wrong words or sentences were corrected to match the original English version.

Eighteen motivational items were adopted from Elliot (1999) and the Thai version from Paleenud et al. (2023). Items were rated on a five-point Likert scale (1=strongly disagree to 5=strongly agree). Confirmatory factor analysis indicates the model fit according to previous theoretical support: CFI = 1.00, RMSEA = .06, SRMR = .02. Sample items included “I am

striving to demonstrate my ability relative to others in this class." (performance approach goal), "My fear of performing poorly in this class is often what motivates me." (performance-avoidance goal), "In a class like this, I prefer course material that arouses my curiosity, even if it is difficult to learn." (mastery goal). Cronbach's alphas for the mastery goal, performance approach, and performance-avoidance items were .74, .77, and .86, respectively.

Results

Around half of the students perceived their academic achievement as average (n=633, 55.7%). Many said they were unsure or unable to rate their academic achievement (n=189, 16.6%). A minority of students perceived themselves as below-average (n=75, 6.6%) and as the top 10% of the class (n=67, 5.9%). Overall, students rated their study efficacy at the moderate level (*M*=3.41, *SD*=.62). The dimension of persistence had the highest scores (*M* =4.13, *SD*=.85), comparing to the general outcome expectations (*M* =3.64, SD=.72) and utility of study skill habits (*M* = 3.02, *SD*=.87). Students had higher scores in mastery motivation-learning approach (*M* =3.95, *SD*=.59) than performance motivation (*M* =3.13, *SD*=.84) and performance-avoidance (*M* =3.07, *SD*=.94). They indicated higher preferences in non-traditional learning approach (*M* =8.10, *SD*=1.50) than traditional learning approach (*M* =7.14, *SD*=1.81).

Patterns in Students' Learning Preferences, Study Efficacy, and Learning Motivation

Two-Step Clustering analysis resulted in three clusters of students including (1) Students who neither had a high preference for traditional approach nor non-traditional approach, low-to-moderate efficacy, and moderately mastery-motivated; (2) Students who had high favor for non-traditional learning, least likely of being performance-avoidant, having moderate mastery-motivation, with relatively high persistence; and (3) Students who had strong favor for non-traditional learning, high persistence in efficacy, most likely of being mastery-motivated, also potentially motivated by performance and performance-avoidance.

Students in Cluster One had the lowest preferences for the non-traditional learning approach (*M*=7.06, *SD*=1.74) and the traditional approach (*M*=6.15, *SD*=1.88) compared with students in other clusters. They had slightly low efficacy in study skill habits (*M*=2.66, *SD*=0.76) and moderate efficacy in terms of outcome expectation (*M*=3.14, *SD*=0.63) and persistence (*M*=3.38, *SD*=0.83). They belonged to a moderate level of mastery motivation (*M*=3.66, *SD*=0.54) than performance-avoidance (*M*=3.38, *SD*=0.74) and performance-motivation (*M*=3.24, *SD*=0.72).

In Cluster Two, students had higher preferences for the non-traditional learning approach (*M*=8.56, *SD*=1.01) than the traditional approach (*M*=7.21, *SD*=1.46). These students rated their efficacy according to study skill habits and outcome expectation at the moderate level (*M*=3.24, *SD*=0.81 and *M*=3.63, *SD*=0.60 respectively), except for the aspect of persistence that is rated at the higher level (*M*=4.38, *SD*=0.58). Among the three clusters, this group had the lowest scores for the performance- approach (*M*=2.49, *SD*=0.60) as well as the performance-avoidance approach (*M*=2.31, *SD*=0.73), while having moderate scores of mastery-motivated approach (*M*=3.85, *SD*=0.52).

In the last cluster, students preferred the non-traditional learning approach (*M*=8.74, *SD*=1.03) and the traditional approach (*M*=8.18, *SD*=1.51). This group had the most robust preferences for non-traditional learning among the three clusters. They had moderate efficacy

in their study skill habits (*M*=3.17, *SD*=0.95) and outcome expectation (*M*=4.22, *SD*=0.51) but high efficacy in the aspect of persistence (*M*=4.67, *SD*=0.49) compared to other student groups. This group had the highest scores of motivation aspects: mastery-motivated approach; *M*=4.40, *SD*=0.44; performance-motivated approach (*M*=3.78, *SD*=0.78); performance-avoidance (*M*=3.63, *SD*=0.78).

Differences in Students' Study Efficacy, Learning Motivation, and Learning Preferences Between Clusters

Table 1 showed significant differences according to the study efficacy and learning motivation between the three clusters. Students in Cluster Three had the highest efficacy among the three clusters in two areas: outcome expectation: $F(1137)= 312.298$, $p <.01$, $\eta 2 = 0.355$; persistence: $F(1137)= 405.637$, $p <.01$, $\eta 2 = 0.417$). For the area of study skill habits, students in Cluster Two had higher efficacy than the other groups (*M*=3.24, *SD*=0.81). However, the difference is not significant: $F(1137)= 56.163$, $p <.01$. Students in Cluster Three had the highest scores of motivation-learning approach in all dimensions, mastery: $F(1137)= 209.672$, $p <.01$, $\eta 2 = 0.270$); performance: $F(1137)= 357.797$, $p <.01$, $\eta 2 = 0.387$); performance-avoidance: $F(1137)= 338.165$, $p <.01$, $\eta 2 = 0.374$). Students in Cluster Three have higher preferences for both traditional approach (*M*=8.18, *SD*=1.51) and non-traditional approach (*M*=8.74, *SD*=1.03) than other clusters and the difference is significant: traditional: $F(1137)= 141.965$, $p <.01$; non-traditional: $F(1137)= 187.211$, $p <.01$. Except for the slight mean difference (0.18) of preferences of non-traditional approach between Cluster Three and Cluster Two that is not significant.

Table1: *Means, Standard Deviations, and One-Way Analyses of Variance in Study-Efficacy, Learning Motivation, and Learning Preferences between Clusters*

Characteristics	Cluster 1 (n= 383)	Cluster 2 (n= 407)	Cluster 3 (n= 347)	Total (n=1,137)	*F*	*P*
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*		
Self-efficacy						
Utility of study skill habits	2.66 (0.76)	3.24 (0.81)	3.17 (0.95)	3.02 (0.88)	56.16	.000
General outcome expectations	3.14 (0.63)	3.63 (0.60)	4.22 (0.51)	3.64 (0.72)	312.29**	.000
Persistence	3.38 (0.83)	4.38 (0.58)	4.67 (0.49)	4.13 (0.85)	405.63**	.000
Motivation						
Mastery	3.66 (0.54)	3.85 (0.52)	4.40 (0.44)	3.95 (0.59)	209.67**	.000
Performance	3.24 (0.72)	2.49 (0.60)	3.78 (0.78)	3.14 (0.85)	357.79**	.000
Performance-avoidance	3.38 (0.74)	2.31 (0.73)	3.63 (0.78)	3.07 (0.95)	338.16	.031

Differences in Student Cluster Membership

A Chi-Square Goodness of Fit Test was performed to determine whether the student cluster membership proportion differed. As shown in Table 2, student cluster membership significantly differed according to the school type, $X^2(6, N=1,137) =24.05$, $p=.001$; major, $X^2(4, N=1,137)= 16.82$, $p=.002$; and perceived academic achievement, $X^2(6, N=1,137)=70.32$, $p=.000$. The proportions also differed by students' interest to study higher education in Health, $X^2(2, N=1,137) =11.14$, $p=.004$ and Natural Science-Math, $X^2(2, N=1,137) =9.28$, $p=.01$. The distribution of students who did not address particular interest were also significantly different among clusters, $X^2(2, N=1,137) =16.34$, $p=.000$.

Table 2: *The proportion of Students' Year Level, School Type, Major, Perceived Academic Achievement, and Higher Education Field of Interest between Clusters*

Characteristics		N	Cluster 1 (n= 383)	Cluster 2 (n= 407)	Cluster 3 (n= 347)	X^2	*P*
			% within characteristics				
Year level	Grade 10	638	35.1	34.3	30.6	1.754(2)	.416
	Grade 11	499	31.9	37.7	30.5		
School type	ESC	240	31.7	44.2	24.23	24.050(6)**	.001
	Demonstration	335	32.2	40.9	26.9		
	Public	335	35.2	29.3	35.5		
	Private	227	35.7	29.1	35.2		
Major	Science-Math	789	31.3	38.8	29.9	16.825(4)**	.002
	Math-Eng	174	38.5	24.1	37.4		
	Language	174	39.7	33.9	26.4		
Perceived academic achievement	Below average	75	50.7	26.7	22.7	70.325(6)**	.000
	Average	633	33.6	39.1	28.3		
	Above average	240	20.4	30.4	49.2		
	Not sure	189	43.9	38.6	17.5		
Field of interest (ISCED-referenced)	Health	393	27.7	36.9	35.4	11.144(2)**	.004
	Engineering	136	25.7	43.4	30.9	5.389(2)	.068
	ICT	29	31.0	34.5	34.5	.230(2)	.892
	Art & Humanities	112	33.9	41.1	25.0	2.208(2)	.332
	Education	3	0	66.7	33.3	1.822(2)	.402
	Natural Science-Math	35	22.9	60.0	17.1	9.284(2)**	.010
	Business Administration & Law	98	35.7	29.6	34.7	1.897(2)	.387
	Social Sciences	65	43.1	38.5	18.5	5.226(2)	.073
	Agriculture	9	44.4	22.2	33.3	.802(2)	.670
	Service	54	44.4	18.5	37.0	7.465(2)	.024
	Do not know	203	45.8	28.6	25.6	16.340(2)**	.000

***p <.01.*

Half of the students (50.7%) who perceived their academic achievement as below average and 43.9% of students who were not sure to rate their academic achievement represent Cluster One. Almost half of the students (49.2%) perceive they are above average, however, overwhelm the population in Cluster Three. The most extensive distribution of students who perceive they are at the average (39.1%) is in Cluster Two. Most students will likely opt for Health discipline in their higher education (n=393). They are closely represented in Cluster Two and Cluster Three (36.9% and 35.4% respectively). Around forty percent (41.1%) who reported their interest in Engineering belong to Cluster Two, followed by Cluster One (33.9%). Many students do not identify any discipline, and almost half (45.8%) are in Cluster One.

Almost half of the ESC students (44.2%) and Demonstration students (40.9%) are in Cluster Two, while a minority of them are in Cluster Three (ESC, 24.23%; Demonstration, 26.9%). At the same time, students from Public and Private schools are closely distributed in Cluster One (Public, 35.2%; Private, 35.7%) and Cluster Three (Public, 35.5%; Private, 35.2%). Regarding students' majors, the largest number of students in Science-Math are in Cluster Two (38.8%), while the rest of them are evenly distributed in Cluster One (31.3%) and Cluster Three (29.9%). The highest proportion for math-English and language students is Cluster One (Math-English, 38.5%; language, 39.7%).

Discussion

The findings showed patterns of student characteristics between clusters. Cluster One comprised most students who needed to be more sure of their academic performance level and over half of the students who viewed themselves as below average of their peers. Compared to other groups, they had low efficacy in study skill habits and moderate efficacy in outcome expectation. These students might need help to target their learning effectively and are less motivated to pursue any specific plan in continuing higher education because low study self-efficacy might negatively affect ambition, motivation, effort, and persistence (Bandura, 1986). Classroom anxiety (i.e., fear of failing and being negatively evaluated) is an essential aspect of negative motivation and self-efficacy (Bandura, 1997). Koul et al. (2012) found that classroom anxiety was positively associated with performance-avoidance goals toward learning biology and physics in male students. When students are not highly motivated to achieve specific academic goals, their choices and expectations in the transition to higher education could be very flexible. They were more likely to be less determined whether to follow the structure of a degree program or progress their study at their own pace. This was also consistent with the findings that this cluster significantly had more students who did not address particular interest in any discipline when furthering higher education than the other two clusters. For most of the language students who were clustered in this group, their motivation to initiate learning and sustain the learning process would be challenged by disruptive technology (Sumakul et al., 2022). The advancement of technology affects how teachers teach and students learn, particularly in language teaching and learning in the context of language learning (Dörnyei & Ryan, 2015). In addition, students' preferences might be dynamic and challenging to specify since language skills are transferable skills that can work across degrees and career paths.

Meanwhile, Cluster Three students with the strongest preferences for traditional and non-traditional learning reported a high degree of study efficacy and mastery of learning motivation. Two distinct learning approaches could be appealing options for developing competency due to students' confidence in their abilities. This aligned with the extensive distribution of Cluster Three students who perceived their academic achievement was above average and reported high study efficacy. For mastery-oriented students, traditional undergraduate degree programs or self-paced, competency-based learning approaches could match their study interests. For them, learning achievement was less likely to depend on the specific predetermined approach but on the relevance and meaningfulness of learning (Elliot, 1999). As these students indicated the moderate motivation in performance-oriented and performance-avoidance, negative or positive results of their expected learning could influence their decision to choose experiences in traditional undergraduate programs or other alternative credentials.

Although students in Cluster Three had the highest preferences for non-traditional learning, the slight difference between Cluster Three and Cluster Two was insignificant. Their preferences aligned well with low performance and performance-avoidance orientation. They tended to be less likely driven by competing for achievement and had less anxiety about avoiding failure in learning while feeling motivated to learn for their mastery. These students were not likely to pursue higher education with a priority of completing a degree with an impressive grade-point average (GPA). An appealing approach should allow them to fulfill their meaningful learning rather than to compare or compete with other students. This was consistent with the study of Abramovich et al. (2013) that argued for reframing badge use in educational deployment to be more intrinsic, in which students would use a badge to present

evidence of their learning and growth. Half of the ESC and Demonstration school students were clustered when considering the cluster membership from the school type. That means most preferred to pursue learning that allowed them to acquire skills in a less structured environment than traditional undergraduate degree programs offered. The predominant goal orientation could vary with learning opportunities and emphasis in different institutions (Koul et al., 2009). However, ESC and Demonstration school curricula are associated with the university and are under MHESI; students could be fostered, to a certain degree, through the school environment and curriculum that are affiliated with the university.

Implications

The large number of Science-Math students represented in clusters that addressed high preferences for non-traditional approaches indicated the opportunity that alternative learning platforms might apply to science and technology education. Higher education institutions aiming to deploy alternative learning approaches might prioritize Cluster Two students who explicitly preferred the non-traditional approach. In Cluster Two, most students were from Engineering Science Classrooms (ESC) and Demonstration schools where teaching and curriculum are associated with the university. Higher education institutions should enhance synchronization between the schools and universities to prompt students' interest and promote students' accessibility to non-traditional learning. As language-major students reported lower confidence and preferences for any learning approaches, approaching them with communication that empathizes with their concerns would be helpful, facilitating students to set academic goals, explore study choices, and review potential learning paths.

Limitations of the Study

The authors were aware of the potential limitations in generalizing findings across diverse populations. The study did not include students from international schools whose curricula adhere to a wide range of frameworks, such as American, Canadian, and Australian curricula.

Given the complexity of learner characteristics, consider adopting an interdisciplinary approach that incorporates insights from psychology, sociology, and other relevant fields to provide a comprehensive understanding of learners.

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