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RESEARCH ARTICLE

Learning styles and academic achievement among undergraduate medical students in Thailand

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Abstract

Purpose: This study aimed to explore the associations between learning styles and high academic achievement and to ascertain whether the factors associated with high academic achievement differed between preclinical and clinical students. **Methods:** A survey was conducted among undergraduate medical students in Chiang Mai University, Thailand. The Index of Learning Styles questionnaire was used to assess each student's learning style across four domains. High academic achievement was defined as a grade point average of at least 3.0. **Results:** Of the 1,248 eligible medical students, 1,014 (81.3%) participated. Learning styles differed between the preclinical and clinical students in the active/reflective domain. A sequential learning style was associated with high academic achievement in both preclinical and clinical students. A reflective learning style was only associated with high academic achievement among preclinical students. **Conclusion:** The association between learning styles and academic achievement may have differed between preclinical and clinical students due to different learning content and teaching methods. Students should be encouraged to be flexible in their own learning styles in order to engage successfully with various and changing teaching methods across the curriculum. Instructors should be also encouraged to provide a variety of teaching materials and resources to suit different learning styles.

Key Words: *Curriculum; Educational status; Medical students; Teaching materials; Thailand*

INTRODUCTION

Learning styles are the individual processes used for understanding and retaining information, thereby gaining knowledge or skills. While some evidence has indicated that learning styles differ between undergraduate medical students and postgraduate residents, limited data exist regarding whether learning styles differ among undergraduate students, although different teaching methods are employed in various stages of the curriculum. In the Faculty of Medicine, Chiang Mai University, Chiang Mai, Thailand, medical students usually learn in the classroom during the preclinical years, while in the clinical years of the program, the main teaching method is learning in clinical situations. Students develop clinical and professional skills by working as part of a multidisciplinary healthcare team in the hospital. If teaching methods differ between the preclinical and clinical stages, the associations between learning styles and high achievement may vary depending on the year of study. Students who fail to adapt to a new instructional context may also face academic difficulties. Therefore, this study aimed to ascertain whether learning styles differed between preclinical and clinical students, to explore correlations between learning styles and high academic achievement,

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and to determine whether such correlations differed between preclinical and clinical students. Our results may help medical instructors to supervise medical students who experience difficulties related to academic achievement.

METHODS

Participants

A cross-sectional survey was conducted among undergraduate medical students in Chiang Mai University, Thailand from March to May, 2013. The Faculty of Medicine of Chiang Mai University, situated in northern Thailand, is the first and largest medical school outside of Bangkok. Medical students in their first to sixth years were asked to complete the Index of Learning Styles (ILS) questionnaire during the orientation for the 2013-2014 academic year.

Measurements and definitions

The ILS questionnaire has been used to assess students' learning styles since 1988, is known to be a simple and easy-to-use tool, and is regarded as having wide applicability [1]. The instrument categorizes learning styles into four domains: first, the active/reflective domain distinguishes between preferring to process information actively through engagement in physical activity or discussion, as compared to processing information reflectively through introspection; second, the sensing/intuitive domain distinguishes between preferring to perceive information via sensory routes such as sight, sound, or physical sensation, versus the intuitive route that involves memories, ideas, or insights; third, the visual/verbal domain distinguishes between whether information is best perceived visually through pictures, diagrams, or demonstrations, or verbally through sounds, written and spoken words or formulas; and, fourth, the sequential/global domain evaluates whether a student progresses toward understanding sequentially, in a logical progression of small incremental steps, or globally, in a holistic manner involving large jumps. The ILS-Thai version, translated with permission, has a reliability coefficient (Cronbach's alpha) of 0.55 [2]. The ILS is a 44-item questionnaire that asks the respondent to choose one of two endings to a sentence that focuses on some aspect of learning. The scoring for each domain is 1, 3, 5, 7, 9, and 11, with 1 and 3 showing a balance along the continuum, 5 and 7 showing a moderate preference for one end of the continuum, and 9 and 11 a strong preference for one end or the other. The learning style preference for each domain is thus treated as a three-category variable consisting of the two polarities of the learning style and a balanced category.

Since the questionnaire was completed during the orientation period of the new academic year, students entering their first year of medical school were excluded because they had not started undergraduate medical education. Each participant's year in medical school was reclassified as a binary variable that could be either preclinical or clinical. Students entering their second, third, and fourth years of medical school were classified as preclinical students, as they had completed their first, second, and third year of medical school, respectively. Those entering their fifth and sixth years were classified as clinical students. The previous academic year's grade point average (GPA) was obtained from registry records. The student's GPA was used to create a binary variable for high academic achievement, which was defined as having a grade point average of 3.0 or higher (maximum, 4.0).

Statistical analysis

The demographic characteristics, learning styles, and grade point average of each student were identified. Differences in learning styles as well as differences according to each domain were analyzed separately. Differences in learning styles between preclinical and clinical students were tested using the chi-squared test. Stratifying the preclinical and clinical students, the association between each domain of learning styles and high academic achievement was analyzed using logistic regression, adjusting for sex. Each dimension of learning styles was treated as a continuum, and was therefore tested for linearity and departure from linearity using the likelihood ratio test. In order to test whether associations between learning styles and high academic achievement differed between preclinical and clinical students, an interaction term between learning style and year of study (preclinical or clinical) was added into the regression model. A significant interaction term would suggest that the association between learning style and high academic achievement differed between the preclinical and clinical students.

Ethical approval

This study was approved by the Ethical Review Committee for Research in Human Subjects, Faculty of Medicine, Chiang Mai University. Informed consent was obtained from all participants.

RESULTS

Out of 1,248 eligible medical students, 1,014 (81.3%) participated in the survey. The overall proportion of female student was 53.1%. The highest median GPA, 3.62 (interquartile range, 3.38-3.78), was found among second-year medical students who had just finished their first year of medical school. The lowest median GPA, found among sixth-year medical students who had just finished their fifth year of medical school, was

3.01 (interquartile range, 2.68-3.39) in Table 1. Among preclinical students, 74.2% had a GPA of at least 3.0. Among clinical students, this proportion had decreased to 51.5%. The overall proportion of students with a GPA of at least 3.0 was 66.9%.

Learning style: differences between preclinical and clinical students

Overall, the majority of students had a balanced learning style in the active/reflective (56.5%) and sensing/intuitive (70.3%) domains. In the visual/verbal domain, a similar proportion of students were found to prefer visual (44.5%) and balanced styles (44.1%). In the sequential/global domain, most students preferred the sequential learning style (60.7%) (Table 2). The active/reflective domain significantly differed between preclinical and clinical students (Table 3).

Associations between learning styles and high academic achievement

Adjusting for sex and year of study (preclinical or clinical), the visual/verbal domain and the sensing/intuitive domain

Table 1. Demographics and grade point average by year of study (n = 1,014)

Year of study	Sex		Grade point average		Total number
	Male	Female	Mean (SD)	Median (interquartile range)	
Preclinical years					
Year 2 (n, %)	125 (51.9)	116 (48.1)	3.57 (0.28)	3.62 (3.38-3.78)	241
Year 3 (n, %)	100 (44.8)	123 (55.2)	3.13 (0.51)	3.17 (2.75-3.54)	223
Year 4 (n, %)	93 (41.9)	129 (58.1)	3.11 (0.49)	3.17 (2.75-3.47)	222
Clinical years					
Year 5 (n, %)	63 (45.3)	76 (54.7)	3.03 (0.48)	2.97 (2.67-3.47)	139
Year 6 (n, %)	95 (50.3)	94 (49.7)	3.03 (0.44)	3.01 (2.68-3.39)	189
Total	476 (46.9)	538 (53.1)	3.20 (0.49)	3.27 (2.83-3.60)	1,014

SD, standard deviation.

Table 2. Number of students according to learning style by year of medical school (n = 1,014)

	Year 2 (%)	Year 3 (%)	Year 4 (%)	Year 5 (%)	Year 6 (%)	Total (%)
Domain 1						
Active	63 (26.1)	69 (30.9)	89 (40.1)	51 (36.7)	88 (46.6)	360 (35.5)
Balanced	152 (63.1)	134 (60.1)	118 (53.1)	79 (56.8)	90 (47.6)	573 (56.5)
Reflective	26 (10.8)	19 (8.5)	14 (6.3)	9 (6.5)	11 (5.8)	79 (7.8)
Missing	0 (0.0)	1 (0.5)	1 (0.5)	0 (0.0)	0 (0.0)	2 (0.2)
Total	241	223	222	139	189	1,014
Domain 2						
Visual	107 (44.4)	94 (42.2)	95 (42.8)	73 (52.5)	82 (43.4)	451 (44.5)
Balanced	105 (44.6)	94 (42.2)	104 (46.8)	52 (37.4)	92 (48.7)	447 (44.1)
Verbal	27 (11.2)	32 (14.3)	22 (9.9)	13 (9.4)	14 (7.4)	108 (10.6)
Missing	2 (0.8)	3 (1.3)	1 (0.5)	1 (0.7)	1 (0.5)	8 (0.8)
Total	241	223	222	139	189	1,014
Domain 3						
Sequential	143 (59.3)	123 (55.2)	136 (61.3)	86 (61.9)	128 (67.7)	616 (60.7)
Balanced	91 (37.8)	89 (39.9)	78 (35.1)	49 (35.2)	56 (29.6)	363 (35.8)
Global	6 (2.5)	11 (4.9)	7 (3.1)	3 (2.2)	4 (2.1)	31 (3.1)
Missing	1 (0.4)	0 (0.0)	1 (0.5)	1 (0.7)	1 (0.6)	4 (0.4)
Total	241	223	222	139	189	1,014
Domain 4						
Sensing	40 (16.6)	29 (13.0)	26 (11.7)	20 (14.4)	25 (13.2)	140 (13.8)
Balanced	163 (67.6)	159 (71.3)	165 (74.3)	94 (67.6)	132 (69.9)	713 (70.3)
Intuitive	36 (14.9)	34 (15.3)	26 (11.7)	25 (18.0)	32 (16.9)	153 (15.1)
Missing	2 (0.8)	1 (0.4)	5 (2.3)	0 (0.0)	0 (0.0)	8 (0.8)
Total	241	223	222	139	189	1,014

showed no association with high academic achievement. Weak evidence suggested that the association between the active/reflective domain and high academic achievement differed depending on the year of study (P = 0.05). A reflective learning style was associated with high academic achievement only in the preclinical years (Table 4). Among preclinical students, those with a reflective learning style were 2.23 times more likely than students with an active learning style to have a GPA of at least 3.0 (odds ratio [OR] = 2.23, 95% confidence interval [CI] = 1.08-4.64). However, this association was not observed among students in the clinical years of the curriculum. For the global/sequential domain, a sequential learning style was significantly associated with high academic achievement (P = 0.04). Compared to students with a sequential learning style, students with a balanced learning style and a global learning style were 19% (OR = 0.81, 95% CI = 0.61-1.08) and 50% (OR = 0.50, 95% CI = 0.23-1.07) less likely to have high academic achievement, respectively (Table 4).

Table 3. Number of students according to learning style by preclinical and clinical years (n = 1,014)

	Preclinical years (%)	Clinical years (%)	P-value
Domain 1			< 0.01
Active	221 (32.3)	139 (42.4)	
Balanced	404 (59.1)	169 (51.5)	
Reflective	59 (8.6)	20 (6.1)	
Domain 2			0.17
Visual	296 (43.5)	155 (47.5)	
Balanced	303 (44.6)	144 (44.2)	
Verbal	81 (11.9)	27 (8.3)	
Domain 3			0.09
Sequential	402 (58.8)	214 (65.6)	
Balanced	258 (37.7)	106 (32.2)	
Global	24 (3.5)	7 (2.2)	
Domain 4			0.41
Sensing	95 (14.0)	45 (13.7)	
Balanced	487 (71.8)	226 (68.9)	
Intuitive	96 (14.2)	57 (17.4)	

DISCUSSION

Our study found that some domains of learning styles differed between preclinical and clinical year students. An active learning style was more common in clinical-stage students, while a reflective learning style was more common in preclinical students. A sequential learning style was associated with higher academic achievement in both the preclinical and clinical stages, while a reflective learning style was only associated with high academic achievement in the preclinical years.

Table 4. Associations between learning styles and high academic achievement, defined as a grade point average was equal to or greater than 3.0 (n = 1,014)

Learning style	Model 1		Model 2		Model 3		P-value for interaction[c]
	Overall		Preclinical students		Clinical students		
	OR (95% CI)	P-value	OR (95% CI)	P-value	OR (95% CI)	P-value	
Domain 1		0.09[b]		0.01[b]		0.11[a]	0.03
Active	Reference		Reference		Reference		
Balanced (active/reflective)	1.34 (1.00–1.78)	0.05	1.44 (1.00–2.09)	0.05	1.23 (0.78–1.93)	0.37	
Reflective	1.28 (0.75–2.19)	0.37	2.23 (1.08–4.64)	0.03	0.43 (0.15–1.18)	0.10	
Domain 2		0.89[b]		0.90[b]		0.90[b]	0.77
Visual	Reference		Reference		Reference		
Balanced (visual/verbal)	1.03 (0.77–1.37)	0.86	1.09 (0.75–1.58)	0.64	0.93 (0.59–1.47)	0.77	
Verbal	0.92 (0.58–1.45)	0.73	0.89 (0.51–1.43)	0.68	1.03 (0.45–2.35)	0.95	
Domain 3		0.04[b]		0.01[b]		0.92[b]	0.26
Sequential	Reference		Reference		Reference		
Balanced (sequential/global)	0.81 (0.61–1.08)	0.14	0.68 (0.48–0.97)	0.04	1.11 (0.69–1.79)	0.67	
Global	0.50 (0.23–1.06)	0.07	0.44 (0.19–1.06)	0.07	0.64 (0.14–3.00)	0.58	
Domain 4		0.65[b]		0.83[b]		0.65[b]	0.19
Sensing	Reference		Reference		Reference		
Balanced (sensing/intuitive)	0.81 (0.54–1.21)	0.31	0.65 (0.28–1.11)	0.12	1.11 (0.58–2.11)	0.75	
Intuitive	0.88 (0.53–1.46)	0.61	0.91 (0.45–1.84)	0.80	0.86 (0.39–1.89)	0.70	

Each domain was modeled separately. Model 1 adjusted for sex and year of study (preclinical or clinical). Model 2 adjusted for sex and was restricted to students in the preclinical years only. Model 3 adjusted for sex and was restricted to students in the clinical years only.
[a]P-value for general association, reported because there was evidence of departure from linearity. [b]P-value for linear trend. [c]P-value for interaction between learning style and stage of medical school (preclinical or clinical).

Learning style: differences between preclinical and clinical students

In our study, we found that students in the preclinical and clinical stages had significantly different learning styles in the active/reflective domain. Although the majority had a balanced learning style in this domain, preclinical students were more likely to have a reflective learning style than clinical. The influence of learning content, teaching methods, and assessments may explain why learning styles differed between preclinical and clinical students [3]. The preclinical curriculum focuses on basic knowledge of medical sciences, which involves numerous complex details. As a result, the teaching methods unavoidably involved didactic lectures [4]. In our setting, the teaching methods used for preclinical students included lectures, problem-based learning, self-directed learning, and written reports. Students could have been more likely to be passive and may have preferred to observe and think through theories, thus spending more time working alone to understand the content. In contrast, clinical students were more likely to have an active learning style. This may have been because the pattern of teaching methods employed during the clinical years involve clinical and community-based learning. The basic knowledge gained in the preclinical years is usually applied to medical conditions during the clinical years. Students are also required to learn new skills during the clinical years. Teaching methods that include practice with patients in real situations may also have promoted a more active learning style [5]. A similar difference in learning styles between preclinical and clinical students was also observed in a recent study from Spain [4]. Previous research, from various settings, has found that some learning styles, such as theoretical, reflective, and assimilative, were likewise more commonly found in preclinical students [6]. Due to an excessive workload, clinical students may also be less inclined to develop a deep learning or reflective approach compared to the preclinical students [7]. We did not find differences in the other three learning style domains (visual/verbal, sequential/global, and sensing/intuitive) between preclinical and clinical students. A study from Sri Lanka similarly found no differences in learning styles between first and sixth year medical students [5]. This indicates that some teaching methodologies and core concepts may be similar across the preclinical and clinical stages.

Associations between learning styles and high academic achievement

Our study found that a sequential learning style was associated with high academic achievement, compared to the balanced and global learning styles. A sequential learning style was common in our study population. A strategic learning approach, which shares similar characteristics with the sequential learning style, has also been commonly found among medical students in Asia [7]. Students must acquire a considerable amount of medical knowledge and skills throughout the course of their education. Approaching learning in a sequential manner can assist them to remember strategically and logically, consequently helping students to obtain better scores in examinations [8,9]. A reflective learning style was associated with higher academic achievement only in the preclinical years. This style seems to match well with the learning content and teaching methods of the preclinical years [10].

No associations between other learning style domains and high academic achievement were found. This was similar to other studies exploring associations among similar learning style domains and academic achievement [11]. Some domains of learning styles may not have been associated with high academic achievement for multiple reasons. First, each individual could have used a mixture of different learning styles across different domains [10]. Second, academic achievement as defined through GPA may not reflect the real-world performance of learning outcomes [12]. Furthermore, even in the same year, each subject experienced a variety of teaching methods and assessments, each suitable for different learning styles. Lastly, this study may have been underpowered to detect such associations.

The study had several limitations. Causal interpretations cannot be drawn between learning styles and high academic achievement due to its cross-sectional design; however, it is more likely that learning styles influence academic achievement. Due to cross-cultural issues, gender differences, and differences in the learning content, associations between learning styles and academic achievement may differ depending on the setting [13,14]. These issues should be further explored in future research. Using GPA as measurement of achievement may also limit the generalizability of this study to other populations, where different methods and standards of assessment may exist.

The findings of this study suggest that awareness of learning styles may be useful for both students and instructors. Knowing their own learning styles can help students to improve their engagement with various teaching and learning activities in the curriculum, and can promote the individual's professional lifelong learning. No learning style is best, and students should be encouraged to use and adapt themselves to different styles in various learning situations, rather than using only their most preferred style [15]. The faculty should promote effective learning by encouraging students to be aware of their own learning styles and assisting them to adopt methods appropriate to their style [16]. Furthermore, the faculty should also help students develop other learning styles in order to adjust to different methods of teaching [4]. Specifically, students with a prominently global learning style should be assisted in building a more bal-

anced and sequential style to help cope with the complexities and abundance of knowledge required to practice medicine [14]. Although no association was found between the active/reflective domain and GPA during the clinical years, a reflective learning style supports deep understanding, which is important to professional lifelong learning. Therefore, a reflective learning style should be encouraged by promoting reflective methods of engagement in clinical teaching. Knowing the learning style of the students can help staff and faculty to create more appropriate courses, which promotes flexibility in teaching methods, and to improve the variety of teaching resources in order to help students achieve their educational goals [4].

In conclusion, learning styles were found to differ between preclinical and clinical students, potentially due to different learning content and teaching methods. A sequential learning style was associated with higher academic achievement in both preclinical and clinical students. A reflective learning style was only associated with higher academic achievement in preclinical students. Students should be encouraged to know their own learning styles and develop flexibility in this regard, in order to improve their engagement with various and changing teaching methods across the undergraduate medical curriculum. Instructors are also encouraged to understand the different learning styles of their students and to provide a variety of teaching materials and resources that suit different learning styles, in order to help students achieve their educational goals.

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CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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SUPPLEMENTARY MATERIAL

Audio recording of abstract.

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