The Relationship between Kolb Learning Style and Academic Performances in Orthopedic Residents

Cherdsak Iramaneerat, M.D., Ph.D.*,**, Surin Thanapipatsiri, M.D.***, Thasaneeya Ratanaroutai Nopparatjamjomras, Ph.D.**, Thos Harnroongroj, M.D., M.Sc.***

*Department of Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University, **Siriraj Health Science Education Excellence Center, Faculty of Medicine Siriraj Hospital, ***Department of Orthopedic Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand.

ABSTRACT

Objective: The assimilating and converging Kolb learning style were reported to have positive correlation with critical thinking ability in Orthopedic resident. However, the relationship between Kolb learning styles and academic performance remained controversy. The objective of this study is to report the relationship between Kolb learning style and academic performance in Orthopedic residents.

Materials and Methods: The causal comparative cross-sectional study on 48 Orthopedic residents of academic year 2020 was conducted. The demographic characteristics of the participants were reviewed. The scores from the multiple choices question (MCQ) in-training examination, the objective structured clinical examination (OSCE) and the global performance rating scale were collected to represent academic performances of each Miller's pyramid of assessment level. The Kolb learning style inventory were allocated. The statistical analysis was performed and p < 0.05 was considered statistically significant difference.

Results: The response rate was 100%. There was no statistically significant difference of MCQ in-training examination, OSCE and global performance rating scale among each learning style as p=0.789, 0.493 and 0.407, respectively. The assimilating and converging styles were the 2 learning styles which had the academic performance scores above the average scores in all assessments.

Conclusion: This study could not demonstrate the significant difference of academic performances among Kolb learning style in Orthopedic residents. However, the assimilating and converging style had the consistent scores above average scores in all domains. The Orthopedic learning experience should focus on the development of reflective observation, abstract conceptualization and active experimentation to facilitate effective improvement in academic performance of the residents.

Keywords: Kolb learning styles; Orthopedic residents; academic performance (Siriraj Med J 2023; 75: 350-355)

INTRODUCTION

Orthopedic resident training requires the development of knowledge, skill and attitude in the limited 4-year time frame.[1] Effective experiential learning principle has been proved as an important learning process to enhance the competency development and improve critical thinking skill in Orthopedic resident.[2] The commonly used experiential learning in Orthopedic train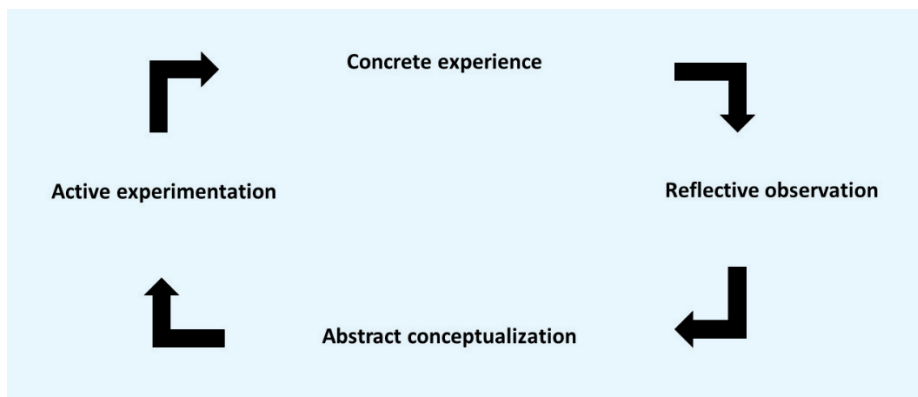ing is "Kolb learning cycle" which is compose of 4 sequential learning processes as concrete experience, reflective observation, abstract conceptualization and active experimentation (Fig 1).[2-5]

According to the "Kolb learning cycle", the learners could be divided into 4 different "Kolb learning styles" depended on the 2 commonly used learning processes as diverging (concrete experience-reflective observation), assimilating (reflective observation-abstract conceptualization), converging (abstract conceptualization-active experimentation), and accommodating (active experimentation-concrete experience).[6] Previous studies found that the 2 commonest Kolb learning styles in Orthopedic residents were mixed between converging (25.0% - 53.5%), assimilating (9.9% - 37.5 %) and accommodating (18.3% - 22.9%).[1,2] And, converging and assimilating was associated with good critical thinking ability as these 2 learning styles used abstract conceptualization as an important process of deep learning strategy.[2] Despite those mentioned studies, none had demonstrated the significant relationship between the Kolb learning styles and academic performance in Orthopedic resident.

The objective of this study is to find out the relationship between Kolb learning style and academic performance in Orthopedic resident. The hypothesis in this study is converging and assimilating style which has positive relationship with critical thinking ability[2] will have positive relationship with the good academic performance.

MATERIALS AND METHODS

The design of this study was causal comparative cross-sectional study. The study was conducted under the approval of the institutional review board (COA no. Si 010/2021). The Orthopedic residents during academic year 2020 of single institute were included. And, the resident who did not desire to reveal the demographic or educational data as well as unwilled to do the questionnaire was excluded. Finally, there were 48 participants enrolled in this study without excluded sample.

The demographic profile of the participants were reviewed which included sex, age, the graduated medical school and the grade point average of graduated medicine degree. The 5-level Likert scale type native language

Kolb learning style inventory version 3.1 which was consisted of 48 learning habit phrases representing 4 different Kolb learning processes (concrete experience, reflective observation, abstract conceptualization and active experimentation) were allocated to participants to evaluate the Kolb learning style individually.[6] The consideration of Kolb learning style was categorized using cartesian graph by calculating of the score of concrete experience minus abstract conceptualization and reflective observation minus active experimentation (Fig 2). The content validity and internal consistency reliability of this questionnaire was acceptable with the Cronbach alpha co-efficient of 0.93.[6,7] The questionnaires were collected and analyzed by one well-trained author at the mid-academic year.
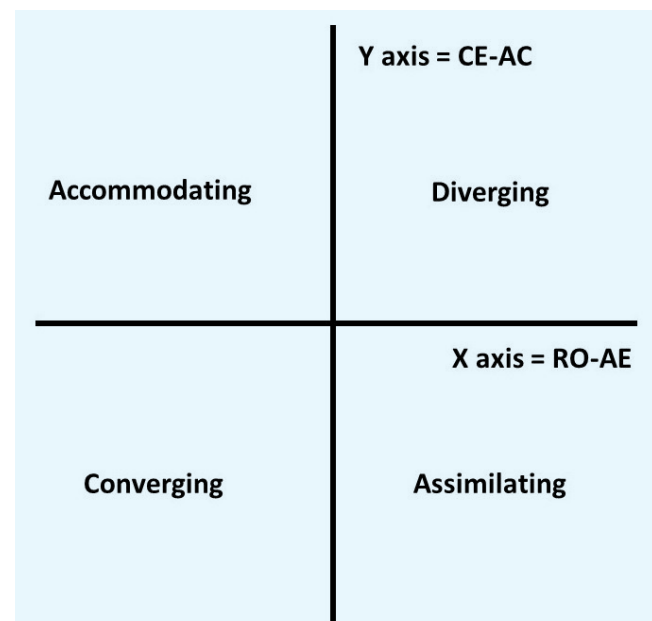
The academic performance assessments in this study included variety of levels according to Miller's pyramid of assessment. For the level of "knows" and "knows how", the academic performance was represented by the multiple choices question (MCQ) in-training examination. The test was composed of 100 MCQs included all Orthopedic subspecialties and basic science knowledge. The score was ranged from 0 to 100. For the level of "shows how", the objective structural clinical examination (OSCE) score was reviewed. The test included 9 stations (1 station per 1 sub-specialty) and the score was ranged from 0 to 100 on each test. So, the total score of OSCE was 900. And, for the level of "does", the global performance rating scale of the rotation along the whole academic year included 12 rotations (1 rotation per month) was examined. The score was ranged from 0 to 28. The scoring system was a 5-level Likert scale included 7 domains as moral-ethics, knowledge, psychomotor, intelligence, interpersonal, communication and responsibility skills. The MCQ in-training examination and OSCE were held at the 11-month of the academic year. All participants in every resident year did the same tests. While, the score of the global performance rating scale was reviewed at the first month of new academic year after all residents finished their all 12 rotations. The score reviews were performed altogether by two authors.

Statistical analysis

The statistical analysis was done using IBM SPSS Statistics for Windows 21.0 (IBM Corp, Armonk, NY). The categorical data was presented as number, percentage and ratio. The Shapiro-Wilk test was used to evaluate the normality of the interval data. Mean and standard deviation (SD) was presented for normal distributed data. And, median and interquartile range (IQR) was presented for non-normal distributed data. The comparison of interval data was done using Analysis of the Variance (ANOVA) and Kruskal-Wallis H test depended on the data distribution. The statistically significant difference was considered as $p < 0.05$.

RESULTS

The response rate of the questionnaires was 100 %. The mean (SD) age of the participants was 30.4 (1.36) years old. There were 44 men (91.7 %) and 4 women (8.3 %). The mean (SD) GPA of medicine degree was 3.27 (0.33). The Kolb learning styles in Orthopedic residents included 18 assimilating (37.5 %), 12 converging (25.0 %), 11 accommodating (22.9 %) and 7 diverging (14.6 %). There was no statistically significant difference of learning styles among each resident year, p = 0.810. (Table 1)

The comparative analysis of the academic performance scores demonstrated no statistically significant difference of MCQ in-training examination, OSCE and global performance rating scores among each Kolb learning style as p=0.789, 0.493 and 0.409, respectively. However, it was shown that assimilating and converging styles had the mean academic scores above the total average scores for all 3 assessments. While, the diverging styles had the mean score above the average score only in global performance rating score. The accommodating style had the mean score below the average score for all examinations (Table 2, 3 and 4).

TABLE 1. The distribution of Kolb learning styles in Orthopedic residents.

Resident training year	Diverging	Assimilating	Converging	Accommodating
Fourth (12)	3 (25.0%)	5 (41.7%)	2 (16.7%)	2 (16.7%)
Third (12)	2 (16.7%)	5 (41.7%)	2 (16.7%)	3 (25.0%)
Second (12)	0 (0.0 %)	4 (33.3%)	4 (33.3%)	4 (33.3%)
First (12)	2 (16.7%)	4 (33.3%)	4 (33.3%)	2 (16.7%)
Total (48)	7 (14.6%)	18 (37.5 %)	12 (25.0%)	11 (22.9%)

* chi-square demonstrated no statistically significant difference of learning style in each training year as p=0.810.

TABLE 2. The relationship of Kolb learning styles and the multiple choices question (MCQ) in-training examination scores (n = 48).

Kolb learning styles	MCQ in-training examination scores Mean (SD)
Diverging (7)	56.3 (5.38)
Assimilating (18)	58.6 (9.38)
Converging (12)	57.4 (12.3)
Accommodating (11)	54.8 (9.54)
Total (48)	57.1 (9.61)

* One way ANOVA demonstrated no statistically significant difference of scores among each learning style as p=0.789.

TABLE 3. The relationship of Kolb learning styles and the objective structural clinical examination (OSCE) scores (n = 48).

Kolb learning styles	OSCE scores Mean (SD)
Diverging (7)	604.4 (62.2)
Assimilating (18)	639.6 (72.7)
Converging (12)	650.6 (79.2)
Accommodating (11)	612.8 (79.2)
Total (48)	631.1 (76.7)

* One way ANOVA demonstrated no statistically significant difference of scores among each learning style as p=0.493.

TABLE 4. The relationship of Kolb learning styles and the global performance rating scores (n = 48).

Kolb learning styles	Global performance rating scores Mean (SD)
Diverging (7)	24.7 (0.84)
Assimilating (18)	23.9 (1.81)
Converging (12)	24.0 (1.39)
Accommodating (11)	23.4 (2.05)
Total (48)	23.8 (1.67)

* One way ANOVA demonstrated no statistically significant difference of scores among each learning style as p=0.407.

DISCUSSION

According to the result of this study, there was no statistically significant difference of academic performance scores regarding to Kolb learning styles. As a result, the hypothesis of this study was rejected. However, there was an interesting finding that the assimilating and converging style had the mean academic performance scores above the average scores for all assessments.

The assimilating and converging style shared the similar concept of experiential learning as the using of "abstract conceptualization" for the gathering experiences.[1,2,7] The learning characteristics of these 2 learning styles could be defined as "deep learning strategy".[8,9] Deep learning strategy involved the effective learning processes as using intrinsic motivation, apparent understanding of the meaning of what was learnt, connecting the new to prior knowledge (constructivism) and critically evaluating of knowledge.[8] And, this learning strategy had been reported to be associated with good academic achievement.[8-10] Apart from "abstract conceptualization, these 2 learning styles also used "reflective observation" and "active experimentation" for the learning.

In the educational context application, the learning processes regarding to these 2 learning styles as reflective observation, abstract conceptualization and active experimentation should be promoted. The Kolb learning style in individual learner could be adapted regarding to the maturity and learning experience.[11] Effective reflective observation and abstract conceptualization could be utilized by encouraging a "reflection" process for all available Orthopedic learning experiences. A reflection is "a complex and deliberate process of thinking about and interpreting experience in order to learn from it". This learning tool could enhance deep integrated and lifelong learning to the learner.[12,13] A reflection could be divided into 3 different levels of complexity as descriptive, practical and critical reflection. A critical reflection was emphasized as the most beneficial type.[12,14] The important factors which could promote the effective reflection of the learners were suitable available time and environment.[12-14] The instructor should plan the strategy which could provide available time for the Orthopedic residents to do reflection. This included the effective time management that was preserved for doing this learning process or using the assisting learning tools which allowed the learners to do the reflection at the suitable time such as e-learning or e-portfolio especially in the high service workload situation.[14,15]

Supporting the active experimentation in Orthopedic learning experience could be managed in various ways. The introduction of simulation for development of the skill domain played an important role. The Orthopedic residents would be able to enhance their experiential learning gradually. The simulation allowed the residents to repeat their skill practice with safety environment.[16,17] Julthongpipat et al. studied the development of simulation model for transradial catheterization practice in 18 fellows. The results demonstrated that the fellows satisfied with the simulation model and this training method provided the benefit as increasing familiarity and confidence to their practice.[18] Many studies in the orthopedic field supported the benefit of using simulation in orthopedic learning experience. Angelo et al. reported the traditional learning combined with supportive simulation training and progressive assessment provided statistically significant better learning outcome compared with the traditional learning alone (p=0.011) for the arthroscopic shoulder joint surgery practicing in 44 orthopaedic residents.[19] Yari SS et al reported the statistically significant improvement of performance score (p=0.003 and 0.035) using virtual simulator for the teaching of knee and shoulder arthroscopy in 18 Orthopaedic residents.[16]

Apart from the simulation, formative real-time and authentic assessment could also support active experimentation experiences in orthopedic residents. One effective assessment tool which could be done for this purpose was an "entrustable professional activities" (EPAs). EPAs had become one of favorable assessment tool in the Orthopedic field.[20] Dwyer T et al. demonstrated that using EPAs combined with simulation training as a reliable assessment tool to assess the residents' cognitive and psychomotor competencies for the management of patient undergoing surgery for ankle fracture, intertrochanteric fracture and total knee arthroplasty.[21] The strength of EPAs was about the ability to do the assessment formatively which allowed the residents to gradually develop themselves along with the target each upgoing year.[22,23]

This study provided the new in-depth analysis in term of the relationship between Kolb learning styles and academic performance in every level of Miller's pyramid of assessment. Even though, this research could not demonstrate the statistically significant positive-negative relationship between learning style and academic performance. However, the finding that the assimilating and converging learners had academic performance scores above the average scores in all domains could bring the attention to the instructors to facilitate Orthopedic learning experiences involving in effective reflective observation, abstract conceptualization and active experimentation. The limitations of this study included the sample size from the single training center which posed the problem of external validity and the small sample size which led to

statistical underpower in some aspects. We recommended research as a multi-center study involving more numbers of samples which might bring more significant finding in the future.

CONCLUSION

This study could not demonstrate the significant difference of academic performance among each Kolb learning style in Orthopedic residents. However, the assimilating and converging style had the consistent scores of all academic performance domains above the average scores. In term of application, the Orthopedic learning experience should emphasize on the development of reflective observation, abstract conceptualization and active experimentation to facilitate effective Orthopedic competency development and improving academic performance.

REFERENCES

1. Richard RD, Deegan BF, Klena JC. The Learning Styles of Orthopedic Residents, Faculty and Applicants at an Academic Program. J Surg Educ. 2014;71(1):110-8.
2. Harnroongroj T, Thanapipatsiri S, Nopparatjamjomras TN, Iramaneerat C. The Relationship Between Learning Styles, Academic Achievement, and Critical Thinking Skills Among Orthopedic Residents. Proceeding of Graduate Research Forum. 2022
3. Sand JN, Elison-Bowers P, Wing II TJ, Kendrick L. Experiential Learning and Clinical Education. Psychology. 2014;18(4):1-7.
4. Kolb DA. Experiential learning: Experience as the source of learning and development. Englewood Cliffs. New Jersey. Prentice-Hall; 1984.
5. McCarthy M. Experiential Learning Theory: From Theory to Practice. Journal of Business & Economics Research. 2016;14(3): 91-100.
6. Lerdlop W. Learning Styles of Students in the Faculty of Science and Technology. Suan Sunandha Rajabhat University, Bangkok. Bangkok: Suan Sunandha Rajabhat University; 2011.
7. Kolb AY, Kolb DA. The Kolb Learning Style Inventory Version 3.1 2005 Technical Specifications. Experiential Based Learning Systems [Internet]. 2005 [Cited 2022 November 30]. Available from: http://www.learningfromexperience.com/.
8. Hayat AA, Shateri K, Amini M, Shokrpour N. Relationships between academic self-efficacy, learning-related emotions, and metacognitive learning strategies with academic performance in medical students: a structural equation model. BMC Med Educ. 2020;20:76.
9. Piumatti G, Guttormsen S, Zurbuchen B, Abbiati M, Gerbase MW, Baroffio A. Trajectories of learning approaches during a full medical curriculum: impact on clinical learning outcomes. BMC Med Educ. 2021;21:370.
10. Kusurka RA, Croiset G, Galindo-Garre F, Ten Cate O. Motivational profiles of medical students: Association with study effort, academic performance and exhaustion. BMC Med Educ. 2013; 13:87.
11. Quillin RC, Cortez AR, Pritts TA, Hanseman DJ, Edwards MJ, Davis BR. Surgical resident learning styles have changed with work hours. J Surg Res. 2016;200:39-45.
12. Mamede S, van Gog T, Moura AS, de Faria RM, Peixoto JM, Rikers RM, Schmidt HG. Reflection as a strategy to foster medical students' acquisition of diagnostic competence. Med Educ. 2012;46(5): 464-72.
13. Hatton N, Smith D. Reflection in teacher education: Towards definition and implementation. Teaching and Teacher Education. 1995;11(1):33-49.
14. Robertson K. Reflection in professional practice and education. Aust Fam Physician. 2005;34(9):781-3.
15. Branch WT, Paranjape A. Feedback and reflection: teaching methods for clinical settings. Acad Med. 2002;77:1185-8.
16. Yari SS, Jandhyala CK, Sharareh B, Athiviraham A, Shybut TB. Efficacy of a virtual arthroscopic simulator for Orthopaedic surgery residents by year in training. Orthop J Sports Med. 2018;6(11):2325967118810176.
17. Aim F, Lonjon G, Hannouche D, Nizard R. Effectiveness of virtual reality training in Orthopaedic surgery. Arthroscopy. 2016;32(1):224-32.
18. Julthongpipat K, Dumavibhat C, Towashiraporn K, Patpituck P. Development of Simulation Model for Transradial Catheterization Practice for Physicians. Siriraj Med J. 2022;74(9):570-4.
19. Angelo RL, Ryu RKN, Pedowitz RA, Beach W, Burns J, Dodds J, et al. A proficiency-based progression training curriculum coupled with a model simulator results in the acquisition of a superior arthroscopic Bankart skill set. Arthroscopy. 2015; 31(10):1854-71.
20. Wadey DM, Dev P, Buckley R, Walker D, Hedden D. Competencies for Canadian Orthopaedics surgery core curriculum. J Bone Joint Surg Br. 2009;91(12):1618-22.
21. Dwyer T, Wadey V, Archibald D, Kraemer W, Shantz JS, Townley J, et al. Cognitive and psychomotor entrustable professional activities: Can simulators help assess competency in trainees. Clin Orthop Relat Res. 2016;474:926-34.
22. Van Loon KA, Driessen EW, Teunissen PW, Scheele F. Experiences with EPAs, potential benefits and pitfalls. Medical Teacher. 2014;36(8):698-702.
23. Pinilla S, Lenouvel E, Cantisani A, Kloppel S, Strik W, Huwendiek S, et al. Working with entrustable professional activities in clinical education in undergraduate medical education: a scoping review. BMC Med Educ. 2021;21:172.