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Impact of an early clinical exposure project conducted by senior clinical students compared between participating and nonparticipating students

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Vanichnatee T, Sitticharoon C, Maprapho P, Keadkraichaiwat I, Charoenngam N, Praditsuwan R. Impact of an early clinical exposure project conducted by senior clinical students compared between participating and nonparticipating students. *Adv Physiol Educ* 42: 619–625, 2018; doi:10.1152/advan.00122.2018.—An early clinical exposure project conducted by clinical students aimed to promote direct clinical experience to preclinical students. The aim of this study was to determine the effects of the project on academic achievement and study attitudes and habits between participating and nonparticipating students before (*test 1*) and after the project (*test 2*) in the second preclinical year and at the end of the first semester of the first clinical year (*test 3*), with a subgroup analysis of the first (lowest) to third (highest) tertile of the score. Questionnaires were sent to the first clinical year students at *test 3* and asked the information retrospectively at *test 1* and *test 2* in second year preclinical and currently at *test 3*, with 83.86% (265/316) being returned. Mean percentile of scores was higher at *test 2* compared with *test 1* in the first tertile group of participating students. Motivation to study medicine (motivation), realization of application of preclinical knowledge to clinical study (application), understanding of clinical environment (environment), and lesson review after class (review) were higher for participating than nonparticipating students at *test 2* and/or *test 3*. Searching additional study information was higher at *test 2* compared with *test 1* only for participating students. This project could effectively promote application, motivation, environment, and review for participating vs. nonparticipating students at *test 2* and/or *test 3*. Effortless, intimate, and effective communication between clinical and preclinical students and a direct experience in early clinical exposure might be key success factors.

early clinical exposure; effective communication; preclinic; senior

INTRODUCTION

Medical students undertaking preclinical studies may become exhausted while coping with the large volume of study contents (11, 15, 19), leading to decreased motivation and inadequate self-directed learning (6). In addition, a failure to recognize the importance and relevance of the preclinical knowledge to their later clinical studies leads some students to lose their study interest and motivation (6). To facilitate medical study, self-regulated learning (SRL), the process by which individuals are metacognitively, motivationally, and behaviorally proactive in their learning (3), has played an increasingly role, as it enables one to make an effort to become a rational thinker rather than exhibiting irrational traits (12) and to become a life-long learner who can provide effective care to patients (3). SRL enables students to *1*) monitor their progress toward their own goals, leading to effective reflection of their learning approaches; *2*) view the interest of the learning task intrinsically and have high self-efficacy levels; and *3*) engage in and maintain their learning behaviors to the maximal level at which learning occurs (3). SRL consists of four processes, which are goal setting/forethought, self-monitoring, feedback loop, and controls, as well as four areas, which are cognition, context/environment, behavior, and motivation/affect (2, 7).

Motivation comprises intrinsic motivation, which refers to doing something because it is inherently interesting or enjoyable, and extrinsic motivation, which refers to doing something because it leads to a separable outcome (10). There are three general motivation constructs, including *1*) value (students' attitudes about the interest and importance of an academic task); *2*) expectancy (students' beliefs of their abilities to accomplish a task); and *3*) affect (students' emotional reaction to a task) (8).

For medical schools in Thailand, applicants usually graduated from high school at the age of 18–19 yr old, leading to lack of mature motivation or career considerations. This scenario is different from the 4-yr U.S. medical schools, where the applicants are 22–24 yr of age and have experienced actual clinician shadowing, which is considered as an essential preparatory step that must be undertaken during the applicants' regular undergraduate training. While the U.S. medical school applicants have already experienced clinical exposure from their own efforts, Thai medical applicants do not have this preparatory step to affirm their motivation or confidence in career choices. As a result, an intervention that enhances their motivation is needed. A previous study showed that an early clinical exposure project could increase study efficacy in preclinical students (9). Therefore, an increase in study motivation may facilitate medical students to achieve their academic goals (18).

A project entitled "Direct Experience in Early Clinical Exposure of Preclinical Students Conducted by Clinical Students" was conducted by senior medical students as peer trainers to strengthen preclinical study motivation by encouraging preclinical students to realize the importance and application of preclinical study content to their future clinical studies. This study aimed to determine the effects of the project on subsequent academic achievement, students' attitudes, and

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study habits by comparison of these factors between participating and nonparticipating students at three different time points, including before (*test 1*) and after the project (*test 2*) in the second preclinical year, and at the end of the first semester of the first clinical year (*test 3*). This project, conducted by senior clinical students, might be used as a novel approach of an early clinical exposure activity that leads to the facilitation of motivation in preclinical students.

MATERIALS AND METHODS

Study protocol. The study protocol was approved by the Siriraj Institutional Review Board (COA no. Si 743/2016). Written, informed consent was obtained from all participants.

Curriculum and course setup. The Doctor of Medicine program at the Faculty of Medicine Siriraj Hospital, Mahidol University, Thailand, is a 6-yr curriculum. Medical students are enrolled in the medical school directly after graduation from high school. The first year is a premedical year, which consists of basic sciences and general education subjects. The second and third years are the first and second preclinical years, respectively, of which subjects are taught via lectures, practical sessions, and group discussions by providing several clinical case scenarios related to study contents. In the first preclinical year, students learn gross anatomy, physiology, biochemistry, histology, neuroanatomy, embryology, and minor subjects. Subjects taught in the second preclinical year include pathology, clinical pathology, pharmacology, parasitology, microbiology, immunology, and minor subjects. The fourth, fifth, and sixth years are the clinical years.

The project "Direct Experience in Early Clinical Exposure of Preclinical Students Conducted by Clinical Students" description. The project entitled "Direct Experience in Early Clinical Exposure of Preclinical Students Conducted by Clinical Students" was conducted by clinical students in the 2018 class because they experienced a similar low-motivation problem when they were in the preclinical years. Once they were studying in the clinical years, they realized and appreciated the applicability of the preclinical knowledge and knew the importance of giving high attention during preclinical study. The seniors had high determination to help the juniors alleviate the problem of flagging motivation that they had experienced during their preclinical studies.

The clinical students persuaded preclinical students in the 2019 class to participate in the project. Its objectives were to *1*) encourage preclinical students to realize the importance of preclinical studies and its application to the clinical years; *2*) increase motivation of preclinical students toward preclinical studies; *3*) enable preclinical students to experience the clinical environment; *4*) develop in preclinical students the attitude of being a good medical practitioner; and *5*) build relationships between the junior and senior students.

The project began 2 mo after the start of the second preclinical year and lasted for 5 mo. The project was completed at the time before the last summative examination. *Test 1* refers to the time immediately before the beginning of the project, and *test 2* refers to the time immediately after the completion of the project in the second preclinical year. *Test 3* refers to the time at the completion of the first semester of the first clinical year.

There were 169 preclinical and 106 clinical students participating in this project. One clinical student brought one or two preclinical students to experience the clinical environment in six fields, including Internal Medicine, Surgery, Pediatrics, Obstetrics and Gynecology, Emergency Medicine, and Anesthesiology. Clinical students demonstrated *1*) how preclinical knowledge could be applied to a patient history, physical signs and symptoms, and laboratory results and their interpretation; and *2*) how to behave in front of patients, as well as orientation in various clinical environments.

One preclinical student could experience up to three sessions, depending on time availability. There were 30 students in each session. Thirteen percent (22/169) of students experienced three sessions, 46% (77/169) of students experienced two sessions, and 41% (70/169) of students experienced one session.

For the Internal Medicine and Pediatrics Departments, preclinical students experienced participation in ward rounds, history taking, physical examination, and case/laboratory discussion. For the Surgery Department, preclinical students experienced attending operating rooms and an acute care service. For the Obstetrics and Gynecology Department, preclinical students experienced attending a labor room, participation in ward rounds, and practicing pelvic examination on mannequins. For the Anesthesiology Department, preclinical students experienced observing anesthetic procedures. For the Emergency Medicine Department, preclinical students experienced observing emergency care.

For the number of preclinical students attending wards, Internal Medicine was visited by 77, Surgery by 47, Pediatrics by 45, Obstetrics and Gynecology by 36, Emergency Medicine by 22, and Anesthesiology by 21 students. After completion of the project, 90% of the students reported increased, whereas 10% of the students reported no change, in motivation in preclinical study. Furthermore, 91% of the students reported increased, 8% unchanged, and 1% decreased realization of the preclinical knowledge application. Mean scores for preclinical study, motivation, realization of the preclinical knowledge application, understanding of the clinical environment, and attitude toward a good medical practitioner were significantly higher at *test 2* than *test 1*.

Questionnaires. We followed up long-term attitudes and study habits of the students of the 2019 class by sending questionnaires to both participating and nonparticipating first clinical year students at *test 3*, with 83.86% (265/316) being returned. The age range was 20–22 yr old.

The questionnaire was presented as a self-report form written in Thai, which utilized box-ticking in 5 scales, including 1 = lowest, 2 = low, 3 = moderate, 4 = high, and 5 = highest, and an open-ended question asking for suggestions and comments of the project as the supporting material file. (The questionnaire is provided in Supplemental Table S1, which is available online at the *Advances in Physiology Education* website.)

The questionnaire was first reviewed by medical students to affirm its readability and clarity. It was then submitted, reviewed, validated, and approved by experts for rational analysis, readability, clarity, and comprehensiveness. The internal consistency (reliability) of data collection, which was calculated by Cronbach's α, was 0.932.

The questionnaire sought information regarding attitudes and study habits of students at three time points: *test 1*, *test 2*, and *test 3*. The students were asked to rate their feelings about the following topics: *1*) your motivation to study medicine (motivation to study medicine); *2*) you feel that the knowledge learned in preclinical years could actually be applied in the future clinical studies (realization of application of preclinical knowledge to future clinical studies); *3*) you feel that you have a good attitude toward being a doctor (attitude toward being a good medical practitioner); *4*) you understand the environment and the working system in the clinical years (understanding of the clinical environment); *5*) your level of attention paid during classes (the level of attention paid during classes); *6*) you feel that the content in the preclinical years is interesting (interest of preclinical contents); *7*) you review the lesson after classes (lesson review after classes); and *8*) you search for additional study information (searching for additional study information).

From total questionnaire respondents, there were 56% (148/265) participating students and 44% (117/265) nonparticipating student.

Academic achievement. Academic achievement, comprising the summative examination scores of particular subjects during the period at *test 1* and *test 2*, was obtained officially from the undergraduate Education Department. A summation of the summative examination scores for particular subjects at each time point was made and calculated to rank the students into percentiles, which were subsequently used to compare between groups of students.

Subgroup analysis. Subgroup analysis of students was made according to their mean percentile scores into the first (lowest), second (medium), and third (highest) tertiles to differentiate the effects of this project according to different levels of academic achievement.

Statistical analysis. Data from this study were analyzed by Statistical Package for Social Science (SPSS) version 18. A nonparametric test was used to analyze the ordinal variables in this study. A P value of <0.05 was considered statistically significant.

RESULTS

Comparisons of mean percentile scores. Comparisons of the mean percentile scores between participating and nonparticipating students, as well as between *test 1* and *test 2*, with subgroup analysis into the first, second, and third tertiles, are shown in Fig. 1. Mean percentile scores were not different between participating and nonparticipating students at *test 1* and *test 2* and were not different between *test 1* and *test 2* for both participating and nonparticipating students (Fig. 1*A*). For subgroup analysis, the first tertile group of participating students had higher mean percentile scores at *test 2* compared with *test 1*, whereas the third tertile group of participating students had lower mean percentile scores at *test 2* compared with *test 1* (Fig. 1*B*). There was no significant difference in mean percentile scores between *test 1* and *test 2* for nonparticipating students (Fig. 1, *A* and *B*).

Comparisons of attitudes and study habits between participating and nonparticipating students. Comparisons of attitudes and study habits between participating and nonparticipating students at *test 1*, *test 2*, and *test 3* are shown in Fig. 2, with subgroup analysis into first, second, and third tertiles (Fig. 3). Students' attitudes and study habits in the aspect of motivation to study medicine (Fig. 2*A*), realization of the application of preclinical knowledge to future clinical studies (Fig. 2*B*), interest of preclinical contents (Fig. 2*C*), the level of attention paid during classes (Fig. 2*D*), understanding of the clinical environment (Fig. 2*E*), attitude toward being a good medical practitioner (Fig. 2*F*), and lesson review after classes (Fig. 2*G*), were higher at *test 2* compared with *test 1*, as well as at *test 3* compared with *test 1* and *test 2* for both participating and nonparticipating students ($P < 0.05$ all).

Motivation to study medicine was higher for participating than nonparticipating students at *test 2* ($P < 0.001$ all) (Fig. 2*A*) in the first, second, and third tertile groups ($P < 0.05$ all) (Fig. 3*A*).

Realization of the application of preclinical knowledge to future clinical studies was lower for participating compared with nonparticipating students at *test 1*, but was higher for participating compared with nonparticipating students at *test 2* and at *test 3* ($P < 0.05$ all) (Fig. 2*B*). For the first tertile group, this factor was comparable between participating and nonparticipating students at *test 1*, but was significantly higher for participating than nonparticipating students at *test 2* ($P < 0.05$) (Fig. 3*B*). For the third tertile group, this factor was lower for participating students than nonparticipating students at *test 1* ($P < 0.05$), but was comparable at *test 2* (Fig. 3*B*).

Participating students tended to rate higher scores of interest in preclinical contents than nonparticipating students at *test 2* ($P = 0.059$) (Fig. 2*C*), and this factor was rated significantly higher in the second tertile group of participating students than nonparticipating students at *test 2* ($P < 0.05$) (Fig. 3*C*).

For the level of attention paid during classes, the first tertile group of participating students rated higher scores than nonparticipating students at *test 2* ($P < 0.05$) (Fig. 3*D*).

Understanding of the clinical environment was higher for participating than nonparticipating students at *test 2* and *test 3* ($P < 0.001$ all) (Fig. 2*E*) in the first and third tertile groups ($P < 0.01$ all) (Fig. 3*E*).

There was no significant difference in attitude toward being a good medical practitioner between participating students and nonparticipating students (Figs. 2*F* and *3F*).

Lesson review after classes was higher for participating than nonparticipating students at *test 3* ($P < 0.05$) (Fig. 2*G*) in the third tertile groups ($P < 0.05$) (Fig. 3*G*).

Participating students rated higher scores for searching for additional study information at *test 2* compared with *test 1*, as well as at *test 3* compared with at *test 2* ($P < 0.001$ all) (Fig. 2*H*). However, for nonparticipating students, this factor was comparable between *test 1* and *test 2*, but was higher at *test 3* compared with *test 2* ($P < 0.001$) (Fig. 2*H*). There was no significant difference in this factor between participating students and nonparticipating students (Figs. 2*H* and *3H*).

DISCUSSION

This study aimed to determine the outcomes of the project entitled "Direct Experience in Early Clinical Exposure of Preclinical Students Conducted by Clinical Students" on the academic achievement, attitudes, and study habits between participating and nonparticipating students.

As for academic achievement, the mean percentile scores between participating and nonparticipating students were not different at *test 1* and *test 2* in the second preclinical year.

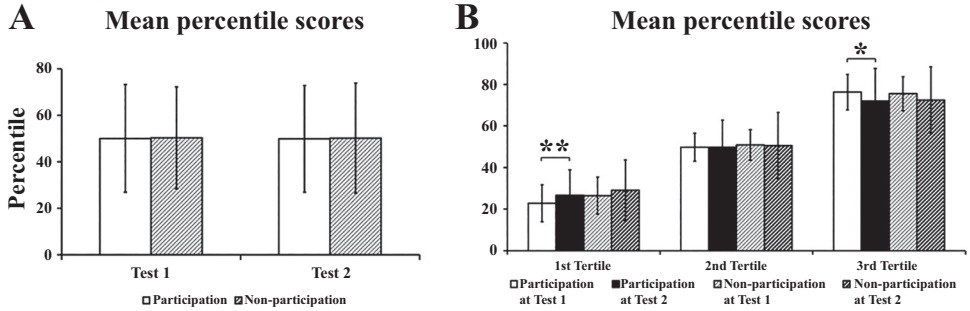

Fig. 1. Comparisons of mean percentile scores between participating and nonparticipating students at *test 1* and *test 2* in the second preclinical year. *A*: all students. *B*: subgroup analysis into first, second, and third tertiles. *Test 1* refers to the time immediately before the beginning of the project, and *test 2* refers to the time immediately after the completion of the project in the second preclinical year. Values are shown as means ± SD. *$P < 0.05$ and **$P < 0.01$ compared between participating students and nonparticipating students.

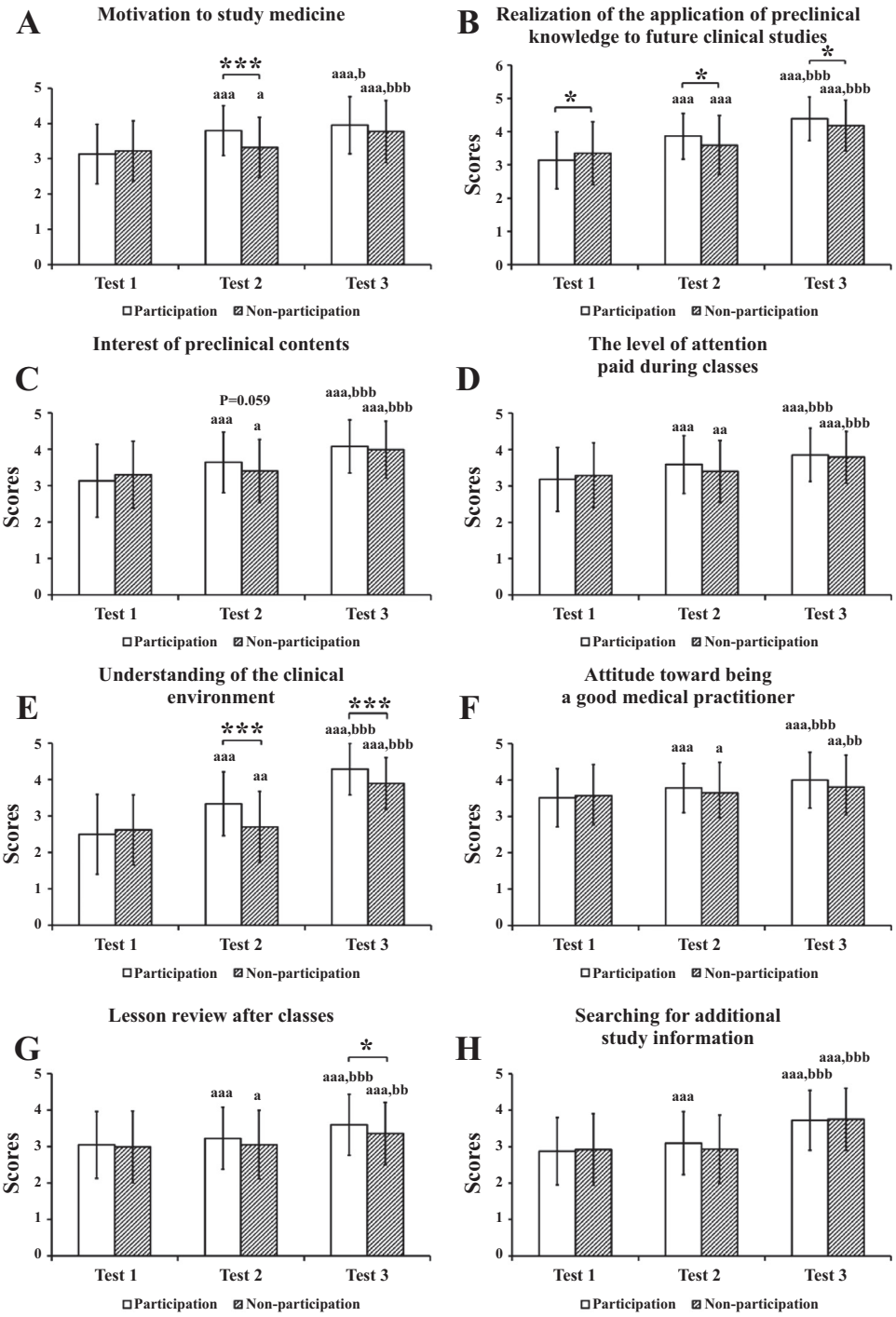

Fig. 2. Comparisons of attitudes and study habits between participating and nonparticipating students in aspects of motivation to study medicine (*A*), realization of the application of preclinical knowledge to future clinical studies (*B*), interest of preclinical contents (*C*), the level of attention paid during classes (*D*), understanding of the clinical environment (*E*), attitude toward being a good medical practitioner (*F*), lesson review after classes (*G*), and searching for additional study information (*H*) at *test 1*, *test 2*, and *test 3*. *Test 1* refers to the time immediately before the beginning of the project, and *test 2* refers to the time immediately after the completion of the project in the second preclinical year. *Test 3* refers to the time at the completion of the first semester of the first clinical year. Values are means ± SD. $^{*}P < 0.05$ and $^{***}P < 0.001$ compared between participant and nonparticipant. $^{a}P < 0.05$, $^{aa}P < 0.01$, and $^{aaa}P < 0.001$ compared at the time before the project. $^{b}P < 0.05$, $^{bb}P < 0.01$, and $^{bbb}P < 0.001$ compared at the time after the project.

Interestingly, we found that the mean percentile scores of the participating students were significantly higher in the first tertile group but significantly lower in the third tertile group compared with those of the nonparticipating students. These results suggest that the project could enhance academic outcomes of the low academic achievement group. However, the lower percentile score of the third tertile group for participating students might be because of the increase in the percentile score of the first tertile group. Percentiles are means of ranking data, so when one factor is increased, another factor will be decreased. Still, we could not conclude which one was primarily increased or decreased; as a result, consideration of the results with other parameters might be able to reveal the direction of the results.

For attitudes and habitual factors, both participating and nonparticipating students had higher motivation to study medicine, realization of the application of preclinical knowledge to future clinical studies, interest in the preclinical contents, the level of attention paid during classes, understanding of the clinical environment, attitude toward being a good medical practitioner, and lesson review after classes at *test 2* compared with *test 1* and at *test 3* compared with *test 1* and *test 2*. These

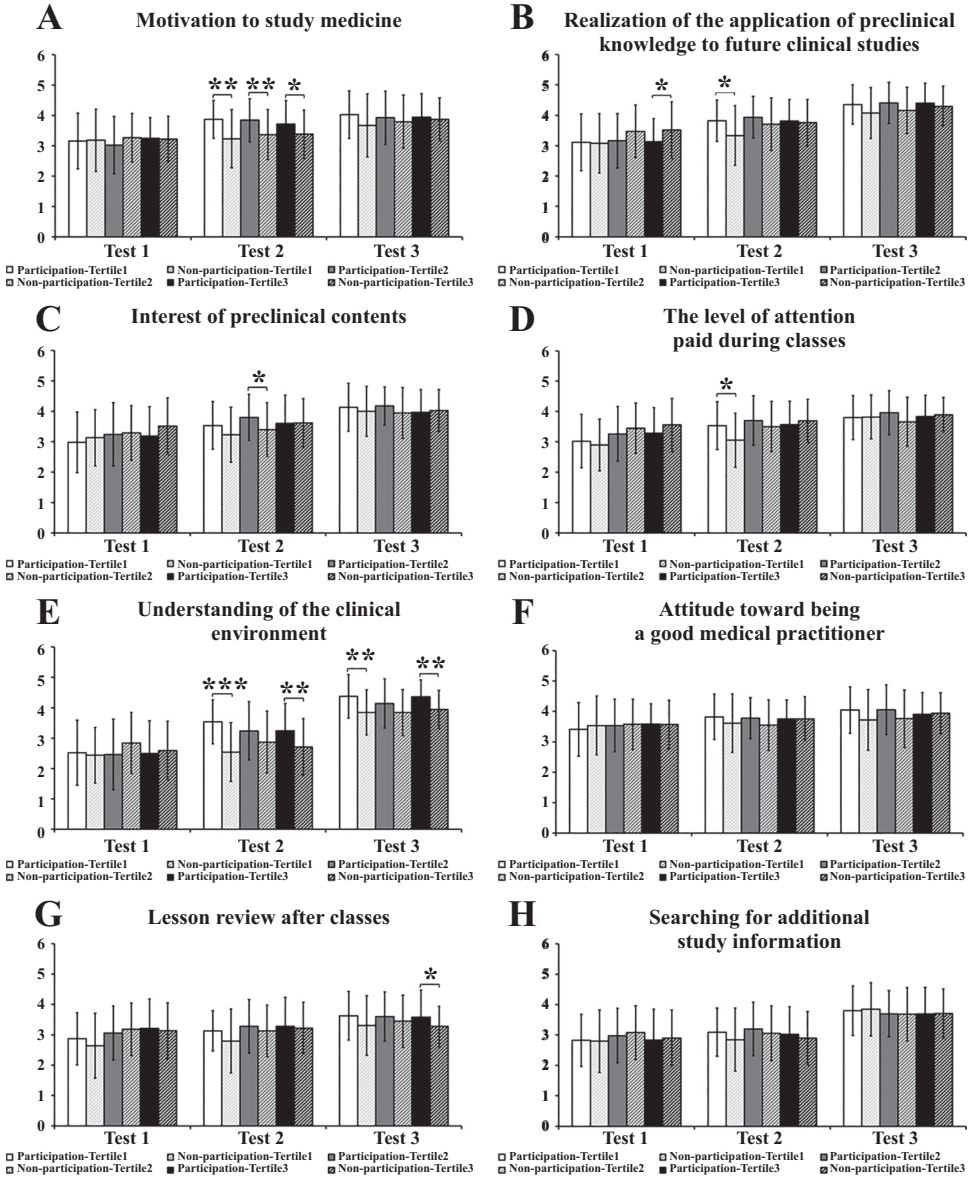

Fig. 3. Comparisons of attitudes and study habits between participating and nonparticipating students with subgroup analysis into the first, second, and third tertiles in aspects of motivation to study medicine (*A*), realization of the application of preclinical knowledge to future clinical studies (*B*), interest of preclinical contents (*C*), the level of attention paid during classes (*D*), understanding of the clinical environment (*E*), attitude toward being a good medical practitioner (*F*), lesson review after classes (*G*), and searching for additional study information (*H*) at *test 1*, *test 2*, and *test 3*. *Test 1* refers to the time immediately before the beginning of the project, and *test 2* refers to the time immediately after the completion of the project in the second preclinical year. *Test 3* refers to the time at the completion of the first semester of the first clinical year. Values are means ± SD. $*P < 0.05$, $**P < 0.01$, and $***P < 0.001$ compared between participant and nonparticipant.

results suggest that these factors increase along with an increase in medical study, whether there is an intervention or not. Indeed, a previous study revealed that the SRL level of clinical medical students was intrinsically higher than that of preclinical medical students (16), and it is believed that SRL develops naturally as students proceed to higher medical years (3, 16). The increase in the level of these factors in *test 2* compared with *test 1* for nonparticipating students might be because of two reasons. First, there might be a self-selection bias, as nonparticipating students probably feel that participating in the project would not benefit them, or they might already know what will be presented or learned. The second reason might be that case scenario and case discussion taught, incorporated with preclinical knowledge during the second year preclinical study, lead to increased motivation for nonparticipating students.

When compared between participating and nonparticipating students, we found that participating students rated a higher score than nonparticipating students in aspects of motivation to study medicine at *test 2* in the first, second, and third tertiles; understanding of the clinical environment at *test 2* and at *test 3* in the first and third tertiles; and lesson review after classes at *test 3* in the third tertile. Notably, realization of the application of preclinical knowledge to future clinical studies was rated lower for participating students at *test 1*, but it was rated higher for nonparticipating students at *test 2* and at *test 3*. This factor was comparable at *test 1* but was significantly higher for participating than nonparticipating students in the first tertile group, and it was lower for participating students at *test 1* but was comparable to that for nonparticipating students at *test 2* in the third tertile group. In addition, at *test 2*, interest in the preclinical contents had a trend to be higher for participating than nonparticipating students, with a significant result found in the second tertile group. The level of attention paid during classes was significantly higher for participating than nonparticipating students in the first tertile group at *test 2*. Remarkably, searching for additional study information was

increased at *test 2* compared with *test 1* only for participating students, indicating that this factor was enhanced only for participating students immediately after completion of the project. As a result, this project appears to enhance attitudes and study habits toward the medical profession for participating rather than nonparticipating students. Some of our results were consistent with a previous study showing that early real patient contacts had positive effects on students' motivation, their understanding of the effects of illness on patients' lives, professional socialization, memory processes, knowledge construction, and clinical reasoning (5).

This project, enabling participating students to be exposed early to a direct clinical environment, leading to realization of the interest and importance of preclinical knowledge, seems to increase the intrinsic value of motivation, as evidenced by increased motivation to study medicine in these students. A previous study showed that increased intrinsic value of motivation, such as increased intrinsic interest and perception of the importance of the study, is strongly positively associated with cognitive self-strategies and self-regulation of the learning components of SRL (16). In our study, increased level of attention paid during class, lesson review after class, and searching for additional study information for participating students might correspond with increased cognitive self-regulatory strategies and self-regulation of learning components of SRL. The increase in mean percentile scores in the low academic achievement students after participating in the project might be explained by the evidence that SRL is positively associated with academic achievement (1, 4, 13, 14, 17).

The key success factors of this project might be that it was conducted by senior clinical students with direct experiences, real patient contacts, clinical exposure of preclinical students, leading to the realization of the importance and application of preclinical knowledge in clinical studies. Furthermore, as senior students have recently had experiences in both clinical and preclinical years, they understood how to apply the preclinical contents to clinical studies, letting them share their experiences, knowledge, and feelings with their junior students understandingly. Moreover, junior students could readily, intimately, and effectively communicate with senior students without age, language, or qualification barriers and have courage to ask questions and discuss matters with the seniors.

Furthermore, the ratio of the number of junior to senior students was very low (1:1–2), so seniors could give their full attention to take care of their juniors. The junior students were impressed with the sincerity and warmth of their senior peer mentors, making the preclinical students fully engaged and cooperative during the activities and ultimately deriving significant benefits.

However, this research has some limitations, including selection bias and the use of a retrospective, self-reported questionnaire. For the selection bias, the students who participated in the project might have a high enthusiasm to learn and adapt themselves to different situations, which might enhance the effects of this project. Furthermore, the questionnaire was sent out at *test 3*, but the students were asked data retrospectively in the second preclinical year, which might lead to data inaccuracy. In addition, students' attitudes and behaviors were determined by a self-reported questionnaire, not by professors, which might not report what really happens.

Conclusion. In conclusion, the early clinical exposure project conducted by clinical students could enhance motivation to study medicine, realization of the application of preclinical knowledge to future clinical studies, interest of preclinical contents, the level of attention paid during classes, understanding of the clinical environment, lesson review after classes, and searching for additional study information for participating preclinical students. This project could possibly increase the mean percentile score of the first tertile of participating students. Effective communication between the preclinical and the senior peer students and early clinical exposure might be the key success factors.

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DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the authors.

AUTHOR CONTRIBUTIONS

T.V., C.S., P.M., N.C., and R.P. conceived and designed research; T.V., C.S., and P.M. performed experiments; T.V., C.S., P.M., and I.K. analyzed data; T.V., C.S., P.M., and I.K. interpreted results of experiments; T.V., C.S., P.M., and I.K. prepared figures; T.V., C.S., P.M., and I.K. drafted manuscript; T.V., C.S., P.M., I.K., N.C., and R.P. edited and revised manuscript; T.V., C.S., P.M., I.K., N.C., and R.P. approved final version of manuscript.

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