Assessing the Outcomes of Team-Based Learning in Surgery

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Background: *Team-based learning (TBL) has been introduced into teaching of fourth and fifth-year medical students in the Department of Surgery, Faculty of Medicine Siriraj Hospital.*
Objective: *To investigate the outcomes of this instructional strategy.*
Material and Method: *We retrospectively reviewed data collected from TBL sessions during academic year 2013 and 2014, including (1) scores of individual and group readiness assurance tests (iRAT and gRAT), and (2) student survey composing of a 15-item five-point satisfaction rating and five open-ended questions.*
Results: *The analysis of 3,552 sets of iRAT and gRAT scores revealed average scores of 62 and 94%, respectively. Fifth-year students had higher scores than fourth-year students. From 888 questionnaires distributed, we received 775 questionnaires back (87% response rate). The satisfaction ratings yielded Cronbach's Alpha of 0.89. The rating ranged from 3.58 to 4.36 with average of 4.11.*
Conclusion: *TBL is a useful learning strategy for undergraduate surgical education that led to improved students' preparation for class and acquisition of important skills including self-directed learning, critical thinking, decision making, communication, and information literacy. Some areas for improvement were reading materials, class scheduling and involvement of more teachers.*

Keywords: *Team-based learning, Outcomes, Surgical education, Student satisfaction*

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Continuous improvement of science and technology has brought significant progress in surgery, leading to better surgical outcomes. Along with this improvement comes a significant expansion of surgical knowledge that medical students have to study to understand surgical patients. Furthermore, a traditional lecture that focuses on passing information to learners often fails to develop critical thinking and problem solving skills in learners. Thus, current approach in surgical education requires active learning strategies that stimulate students to apply their basic knowledge to solve surgical problems. Unfortunately, some students come to a class with inadequate preparation. A surgical teacher generally spends significant amount of time to review basic concepts for these unprepared students, leading to inadequate time to teach advanced concepts. One educational strategy that was designed to address this problem is a team-based learning.

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A team-based learning (TBL) is an active learning strategy in a small group format that provides students with opportunities to apply basic knowledge through a sequence of activities[1,2]. The key characteristics of team-based learning are: (1) collaborative learning in a team setting, (2) assurance that students review learning materials before coming to class, (3) using a majority of class time to solve problems in small groups, and (4) immediate feedback on their decision[1,3-5].

A classic form of team-based learning starts with providing students with pre-class reading assignment. All students would come to class with basic knowledge from studying these materials. The class starts with a multiple-choice questions test of individual student's basic knowledge (individual-readiness assurance test: iRAT). After submitting individual answer sheets for scoring, students work on the same set of multiple-choice questions test in groups in an open-book exam format (group-readiness assurance test: gRAT). Each group provides answer to the questions in a special answer sheet where students receive feedback immediately whether they get a correct

answer. If the group does not choose a correct answer, they have opportunities to choose other options until they get a correct answer, but their score will be reduced with more attempts (Immediate Feedback Assessment Technique: IF-AT). After submitting the gRAT answer sheets for scoring, a teacher leads a discussion of each item on iRAT and gRAT. A teacher then teaches the class core concepts of the topic. Students then work on an application exercise (a test of application of knowledge in the topic of interest) in groups. A teacher then leads a discussion on how to solve the problems in the application exercise[2,5,6].

TBL was first implemented in health professions education at the Baylor College of Medicine in 2001[7]. After that, TBL gained popularity in many schools throughout the world. The Department of Surgery Faculty of Medicine Siriraj Hospital has used TBL with medical students since year 2013. We first introduced TBL in the class of fourth year medical students in academic year 2013 in four topics: (1) preoperative evaluation of cardiovascular system, (2) preoperative evaluation and preparation of patients with systemic diseases, (3) ethical issues in surgical patients, and (4) intravenous fluid therapy in surgical cases. After successful implementation of TBL for fourth year students' classes, we expanded TBL sessions into the class of fifth year medical students in academic year 2014 in four topics: (1) patient safety, (2) palliative care, (3) postoperative care, and (4) critical appraisal of surgical literature. We have collected data on students' test scores and students' satisfaction survey in every group. We carried out this study to investigate the outcomes of this innovative learning strategy in order to gain insights on how to improve students' learning experience.

Material and Method

Instructional strategy

We set up team-based learning sessions once a week. In the first week, we orientated students to this new instructional strategy and provided the reading materials for all four TBL sessions. The TBL classes started in the second week of their surgical rotations. The TBL sessions were scheduled on Thursday afternoon for fourth-year students and on Tuesday afternoon for fifth-year students. Each session took three hours. The class started with iRAT, followed by gRAT. After finishing these tests, an instructor led a discussion of the reasoning for each test item for half an hour. An instructor gave an interactive lecture on the topic for thirty minutes. After that, each group of students worked on an application exercise, which contained three cases requiring them to apply the knowledge obtained from reading materials combined with what they have learned from lecture. Students had forty minutes to choose the best response from four to six options provided in each case and provided their reasoning for their choice in an answer sheet. After submitting their answers, an instructor led a class discussion of an application exercise for half an hour and summarized the lesson.

Research design

We carried out a retrospective review of the data collected from TBL sessions of fourth and fifth year medical students during surgical rotations in academic years 2013 and 2014, including (1) scores obtained from iRAT and gRAT, and (2) end-of-class satisfaction survey. Our research protocol and survey questions have been reviewed and approved by the institutional review board (IRB) of Siriraj hospital.

iRAT

Individual readiness assurance test (iRAT) is a ten-item multiple-choice exam designed to assess learners' basic understanding of pre-class reading assignment. A student chooses one best response from five options provided in each item and marks the selected option in an answer sheet. Students have fifteen minutes to complete this test in a closed book environment without assistance from their friends.

gRAT

Group readiness assurance test (gRAT) uses the same set of test items as iRAT, but let students work together in groups in an open book exam environment. Each group has thirty minutes to complete this test. An answer sheet for gRAT is a special paper called scratch card which conceals a mark of correct option for each item under the solid grey bar which can be scratched off. Each group of students chooses one best response for each item by scratching off the solid grey bar on the option. If they do not see the mark of correct option, they have to discuss to seek the most appropriate answer from the remaining four options. They scratch off the solid grey bar until they find the mark of correct option.

Students' satisfaction survey

In order to evaluate students' acceptance of this new learning strategy, we developed a students' satisfaction survey, which were administered to all

students in the last session of their TBL activities for each academic year. The survey contained no identification and students could choose to participate voluntarily. Each survey contained two parts: (1) rating scale of students' satisfaction, and (2) open-ended questions.

The students' satisfaction rating employed fifteen items of five-point Likert scale rating, expressing their agreement with various aspects of TBL, where one meant strongly disagree, two meant disagree, three meant neutral, four meant agree, and five meant strongly agree. All fifteen items were written in a way that higher scores indicated better learning experience (Appendix A).

We also employed five items of open-ended questions to check students' opinion about TBL (Appendix B).

Analyses

In order to evaluate how well students prepared for TBL and how the group process helped their learning, we examined their iRAT and gRAT scores. A paired-samples t-test was used to determine the score improvement from iRAT to gRAT. We also carried out the comparison between fourth-year students and fifth-year students and between male and female students using independent-samples t-tests to check which group of students better prepared for classes.

The student satisfaction survey was analyzed in two parts. For the rating scale, we checked the reliability of scores using Cronbach's Alpha. We then examined the average rating of each item to determine which aspects of TBL that students satisfied the most and the least. We also compared the average satisfaction ratings between fourth-year students and fifth-year students using independent-samples t-tests to determine which group of students got better learning experience. For the open-ended questions, we conducted content analysis to extract major themes from students' feedback.

Results

iRAT and gRAT scores

The data contained scores obtained from 295 fourth-year students from academic year 2013, 298 fourth-year students, and 295 fifth-year students from academic year 2014, making a total of 888 participating students. Each student took four TBL sessions. Thus, there were 3,552 sets of iRAT and gRAT scores for analysis. Average iRAT and gRAT scores were 62 and 94%, respectively. A paired-samples t-test revealed significant improvement of scores from iRAT to gRAT with a mean difference of 32.27 percent, $t(3551) = 103.52$, $p < 0.01$.

When focusing on TBL sessions for fourth-year students, average iRAT and gRAT scores were 57% and 93%, respectively. This showed significant improvement of gRAT from iRAT scores with a mean difference of 35.58 percent, $t(2371) = 94.54$, $p<0.01$. When focusing on TBL sessions for fifth-year students, average iRAT and gRAT scores were 71 and 97%, respectively. This also showed significant improvement of gRAT from iRAT scores with a mean difference of 25.60 percent, $t(1179) = 51.01$, $p< 0.01$. Fifth-year students tended to have better preparation for TBL sessions as seen from higher iRAT and gRAT scores. The iRAT scores for fourth-year and fifth-year students were 57% and 71%, respectively, $t(3550) = 20.77$, $p< 0.01$. The gRAT scores for fourth-year and fifth-year students were 93% and 97%, respectively, $t(3526) = 18.37$, $p< 0.01$.

The comparison of iRAT and gRAT scores between gender showed no significant difference. Mean iRAT scores of men and women were 62% and 61%, respectively, $t(3550) = 1.33$, $p = 0.19$. Mean gRAT scores of men and women were equal at 94%, $t(3550) = 0.08$, $p = 0.93$.

Satisfaction survey

From 888 questionnaires distributed, we obtained 775 questionnaires returned (response rate 87%). Among these returned questionnaires, 511 came from fourth-year students, and 264 came from fifth-year students.

1) Rating scale

The scores obtained from the satisfaction ratings were reliable. The Cronbach's Alpha was 0.89. The average score of each item was summarized in Table 1. The ratings ranged from 3.58 to 4.36, with an average rating of 4.11. The average satisfaction rating of fourth-year students (4.17) was slightly higher than rating of fifth-year students (3.99), $t(561) = 4.97$, $p<0.01$.

The three aspects of TBL that received highest ratings were item 3 (I think that TBL is a learning format that stimulates students to learn in an active learning style), item 5 (I have developed team working skills during the group activity), and item 15 (I support the Department of Surgery to continue TBL). On the other hand, the three lowest ratings were item 6 (The reading materials provided for TBL are useful academic articles that help improve my understanding of the

Table 1. The average scores of students' satisfaction ratings

Items	n	Mean	SD
1. The content being studied …	774	4.28	0.71
2. I gained knowledge and understanding…	773	3.98	0.72
3. I think that TBL is a learning format …	774	4.36	0.70
4. I have fun with team-based learning …	775	4.09	0.81
5. I have developed team working skills…	772	4.36	0.64
6. The reading materials provided …	774	3.58	0.90
7. The amount of reading being assigned…	773	3.71	0.89
8. I finished reading the assigned …	773	3.94	1.01
9. The amount of time provided for iRAT…	773	4.28	0.78
10. The amount of time provided for gRAT…	773	4.28	0.72
11. The amount of time provided for an …	774	3.95	0.90
12. The test content of items on …	774	4.06	0.80
13. The difficulty level of application ...	773	4.22	0.66
14. I received useful information …	763	4.23	0.71
15. I support the Department …	774	4.30	0.79
Overall Satisfaction	775	4.11	0.50

subject), item 7 (The amount of reading being assigned to study before each TBL is appropriate), and item 8 (I finished reading the assigned reading materials before coming to every TBL class).

2) Open-ended questions

Content analysis revealed four major themes of students' comments: (1) students' learning, (2) reading materials, (3) instructional approach, and (4) learning climate.

Students' learning:

Students have expressed that they have learnt a lot from the TBL sessions. They appreciated the understanding of all the topics that have been chosen into TBL format. Moreover, they indicated that they gained more than just knowledge in these topics. They mentioned many other skills, including team work, critical thinking, time management, self-directed learning, public discussion, and decision making.

"I have learnt how to work in group. I also learned that when we shared our understanding among friends in difficult subject, we had multiple perspectives. We could see that there may be multiple solutions. When we tried to analyze each solution, we learned even more".

"Learning in a group revealed multiple ways of thinking which help fulfilled what was missing from my own view. I have learnt how to think from my friends and applied these techniques to myself".

However, some students expressed their frustration in grasping some difficult concepts raised in the TBL sessions, such as ethical dilemma.

"Learning about ethical issues is difficult. It is hard to adapt these issues into normal daily life. Even when we understand the concepts, applying those concepts to individual patients is delicate and difficult to understand. There were many perspectives, comparing to other topics of medical knowledge which I could understand by myself".

Reading materials:

Many students complained about reading materials in term of content difficulty, language complexity, especially in the area involving social science such as ethical issues.

"Some of the reading materials are too difficult to understand. It took a long time to read".

However, some students expressed their appreciation of the pre-class reading materials, which helped them prepared for class. Others saw these challenging reading materials as their opportunity to practice their academic reading skill.

"Having the opportunity to study reading materials before coming to class makes me able to apply knowledge to solve problems in each class session".

"I have the opportunity to practice reading English article, especially academic journal, and how to grasp important concepts from the large amount of information".

Instructional approach:

Many students were impressed with an instructional approach employed during TBL sessions. They appreciated the dedication and attention from teachers. They enjoyed learning from their groups. They also liked when a teacher listened to their opinions and clarify the issues that students did not understand. However, some students expressed their frustration when dealing with difficult or controversial test items.

"Some test items were controversial. There were many ways to think about that problem. Some test item had no best option. Students might arrive at the answer that was different from what a teacher expected. In such case, a teacher should open opportunity for students to discuss and explain more than usual".

Some students concerned about the timing of TBL sessions. Some suggested TBL sessions should be taught earlier so that they could apply the knowledge to help patients. Others suggested TBL sessions should be scheduled on Monday so that they had time to review the reading materials on Saturday and Sunday. Some students concerned about time management in each TBL session, especially time to work on test items, and the class session that finished late.

"Some items were very challenging and required significant amount of time to solve. Teachers should consider adjusting the amount of time provided in solving these challenging items".

One student raised concern about the appropriateness of using TBL format to teach ethics.

"Learning ethics is more relevant to personal experience than knowing theory. I want to see different teachers share their personal experiences in ethical cases. I want to hear discussion from many teachers more than reading a textbook chapter".

Learning climate:

Many students expressed their satisfaction with learning climate. They were impressed by a friendly learning environment that encouraged them to share knowledge among friends, and discuss their opinions while having snack. They liked the informality of teachers. They sensed the unity in their class when they exchanged their perspectives in solving cases. Quite a few of them mentioned the use of scratch card.

"I liked learning in a group when searching for an answer on a scratch card during gRAT".

"I liked this non-stressful learning climate where we could learn while having snacks. I got useful knowledge that few people would teach. My learning experience during TBL has been very good".

Discussion

This study has revealed our early experience with implementing TBL in undergraduate surgical education. Although making changes in instructional design in a large class in a major department required significant amount of efforts from teachers and students, this study has demonstrated that learning outcomes were worth the efforts. We witnessed students with better prepared learning. Students reviewed the reading materials before coming to class as demonstrated by iRAT scores of 57 and 71% for fourth-year and fifth-year students, respectively. Both male and female students were equally well prepared for class. A better iRAT scores among fifth-year medical students might be due to their greater learning experience. Understanding how TBL works and equipped with more clinical experience, they would probably know how to prepare themselves for class, what kinds of information in the reading materials they should focus, and how to apply the information from reading materials to solve clinical problems. However, it is also possible that better scores were a result of easier test items.

With better prepared students, we also witnessed the amount of learning that was much more than what happened in a traditional classroom. We noticed collaborative learning. While solving test items on gRAT and application exercises together, students exchanged their opinions, teach one another, and improved their understanding of lessons together. We observed that this group process improve their test score significantly (average score improvement of 32 percent). This corresponded with findings from prior studies on iRAT and gRAT score comparison[6]. However, an important caveat on this score improvement is that it might not be an impact of an improved understanding through collaborative learning strategy alone, but might also be an impact of an open book exam format. Some test items that relied on recall of some information from the reading material might show increased scores in gRAT just because students could look it up during gRAT.

What make the TBL even more worthwhile are the learning outcomes that go beyond just information gathering. Students acquired self-directed learning, critical thinking, decision making, communication, public discussion, and information literacy skills through this class experience. This concurs with the findings from prior studies[8-12]. This

broader and deeper learning experience during TBL could be explained by the opportunity the students have in reconstructing knowledge and building their own cognitive structure, as suggested by constructivist learning theory[13-16].

Our analysis revealed two key success factors for the improved learning experience in our TBL: instructional design and learning climate. The TBL format provided several instructional strategies that facilitate learning, including (1) student accountability, (2) feedback, and (3) team work.

Compared to other active learning formats, students in TBL prepared themselves for classes much better. Many active learning strategies employ group work but only some students in the group actively engage in learning because students are accountable for the work in group. In TBL, students are individually accountable for their learning. If a student does not read the assigned materials, he/she would get low iRAT scores. Our analysis showed that majority of students agreed with the statement that they finished reading the assigned reading materials before coming to class.

The use of immediate feedback assessment technique during gRAT provides an active learning environment with minimal resource. Many students mentioned that they liked a scratch card. With the feedback received, the group employed team working skills to reach a solution. The whole class could engage in an active discussion on various issues with only one instructor.

Team work is a crucial aspect of TBL. One of the top ratings in our satisfaction survey was item 5 (team working skills development). Almost all students appreciated the learning climate in their group. We assembled the students' group according to the basic principles of group formation, including diversity and equality of group members, a long-term team, and teacher formation of groups[1]. These principles have worked well and resulted in appropriate group dynamic to foster learning.

Another success factor was learning climate. To promote a learning environment that students could discuss difficult cases and show their misunderstandings of concepts, teachers must provide a safe environment that students would not feel threatened. Students' comments suggested that they felt save in the TBL classroom. They appreciated when a teacher listened to their opinions in a non-judgmental way. They liked the support of their friends while discussing the cases.

Another aspect that this study added to literature was the validation of a rating scale for assessment of TBL. Our analysis revealed that this rating scale provided internally consistent ratings, with Cronbach's Alpha of 0.89, which was comparable to existing TBL questionnaire which reported Cronbach's Alpha in the range of 0.85 to 0.95[17,18]. Comparing students' satisfaction in our TBL classes with others, our students were a bit more satisfied (average satisfaction rating of 4.11 out of a 5-point scale) with this active learning strategy than students from other classes[8,18,19].

This study also revealed several aspects of TBL that could be improved. First of all, the reading materials should be reviewed. The three lowest satisfaction rating items were related to reading materials. Furthermore, an item with the largest standard deviation was item 8. Although the majority of students agreed with the statement that they finished reading study material before coming to every TBL class, 9% of respondents did not agree to the statement (15 strongly disagree and 52 disagree). Students would like to read easier and shorter materials. Class scheduling should be considered. If TBL classes could be moved to Monday, students might have time to review reading materials over weekend. Flexibility in testing time should be considered. Teachers should review if there were many complicated test items, the time provided for tests should be adjusted. Finally, students would like to hear discussion from more teachers. They would like to learn multiple perspectives in solving cases not only from other students, but also from many teachers.

The findings from this study help us understand the benefits of TBL and support the trend of growing uses of TBL[9,20]. To maximize the benefits, teachers should continue employing various useful learning strategies of TBL in a friendly learning environment, while adjusting some details to improve students' satisfaction, including reviewing reading materials, adjusting class schedule, and recruiting more teachers to facilitate the discussion.

There are some limitations in this study. First, not all the satisfaction questionnaires were completed and returned for analysis. Although the response rate of 87% was quite high, it was possible that those who did not return the questionnaire might have different viewpoints from others. Second, improving students' satisfaction should also be balanced with learning goals and feasibility as well. Students' voice should be brought to the discussion, but what changes should be made need to be discussed under learning principles.

For example, students might want to reduce the amount of reading materials, but the reduction should not be done to the extent that would result in inadequate content coverage. Third, the outcomes of this study were only short term indicators and did not indicate actual learning of individual students. The improved scores from iRAT to gRAT reflected group effort. The comments and ratings obtained from survey only gave students' perspective, but did not indicate actual learning. Actual test of improved skills and understanding of students after completion of TBL activities might yield more convincing evidence that students had learned important concepts and skills from the TBL.

Conclusion

A TBL is a useful learning strategy for undergraduate surgical education. It led to improved students' preparation before class. It promoted the acquisition of important skills, including self-directed learning, critical thinking, decision making, communication, public discussion, and information literacy skills. It provided safe learning environment where students were encouraged to discuss their ideas and challenge teachers' ideas. However, some areas for improvement were revealed, including reading materials, class scheduling, and involvement of more teachers.

What is already known on this topic?

TBL is an active learning approach that helped improve students' learning through the use of collaborative learning, assurance of students' readiness, in-class problem solving, and timely feedback.

What this study adds?

Using TBL in undergraduate surgical education resulted in an active classroom that produced many learning outcomes. A scale for learning satisfaction in a TBL class has been developed and proven to be internally consistent with Cronbach's Alpha of 0.89. Students were generally satisfied with their TBL experience. Key features that impressed students were instructional design and learning climate. The reading materials should be carefully selected so that they were not too long or too difficult. Scheduling a TBL class should be carefully done so students had time to review reading materials before class. Multiple perspectives from teachers during class discussion should be provided.

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Potential conflicts of interest

None.

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Appendix A

Items on the students' satisfaction rating scale

(1) The content being studied during team-based learning is useful.
(2) I gained knowledge and understanding of content well during team-based learning.
(3) I think that team-based learning is a learning format that stimulates students to learn in an active learning style.
(4) I have fun with team-based learning activities.
(5) I have developed team working skills during the group activity.
(6) The reading materials provided for team-based learning are useful academic articles that help improve my under standing of the subject.
(7) The amount of reading being assigned to study before each team-based learning session is appropriate.
(8) I finished reading the assigned reading materials before coming to every team-based learning class.
(9) The amount of time provided for iRAT is appropriate.
(10) The amount of time provided for gRAT is appropriate.
(11) The amount of time provided for an application exercise is appropriate.
(12) The test content of items on iRAT and gRAT is appropriate. The tests helped stimulate me to apply what I have studied to solve problems.
(13) The difficulty level of application exercise is appropriate. The application exercise stimulated students to apply knowledge to solve problems.
(14) I received useful information to improve my learning skills.
(15) I support the Department of Surgery to continue team-based learning.

Appendix B

Open-end questions used in students' satisfaction survey

(1) What is the most useful thing that you have learned from team-based learning?
(2) What is the most impressive thing that you experienced from team-based learning?
(3) What is the thing that you would like to change the most in team-based learning?
(4) What is/are the topic(s) that you would like to study in team-based learning format in the future?
(5) Are there any other suggestions to improve team-based learning?

การประเมินผลการจัดการเรียนรู้ทางศัลยศาสตร์ด้วยกระบวนการทำงานเป็นทีม

เชิดศักดิ์ ไอรมณีรัตน์, อรทัย สำราญพานิชย์, สุภนิดา เปศะรัตน์, มัสชา อนันตการณ์ชัย

ภูมิหลัง: ภาควิชาศัลยศาสตร์คณะแพทยศาสตร์ศิริราชพยาบาลได้นำการเรียนรู้ด้วยกระบวนการทำงานเป็นทีมมาใช้ในนักศึกษาแพทย์ชั้นปีที่ 4 และ 5

วัตถุประสงค์: เพื่อประเมินผลลัพธ์ของการจัดการเรียนรู้ด้วยวิธีการนี้

วัสดุและวิธีการ: ผู้นิพนธ์รวบรวมข้อมูลย้อนหลังจากห้องเรียนที่ใช้กระบวนการเรียนรู้ด้วยกระบวนการทำงานเป็นทีมในปีการศึกษา 2556 และ 2557 ได้แก่ (1) คะแนนสอบวัดความพร้อมก่อนเรียนรายบุคคลและรายกลุ่ม และ (2) แบบสอบถามนักศึกษาที่ประกอบด้วย ข้อคำถามวัดระดับความพึงพอใจห้าระดับ 15 ข้อ และคำถามปลายเปิด 5 ข้อ

ผลการศึกษา: การวิเคราะห์คะแนนสอบวัดความพร้อมก่อนเรียนจำนวน 3,552 ชุด พบว่าคะแนนเฉลี่ยรายบุคคลและรายกลุ่มมีค่าร้อยละ 62 และ 94 ตามลำดับ นักศึกษาแพทย์ชั้นปีที่ 5 มีคะแนนสูงกว่านักศึกษาแพทย์ชั้นปีที่ 4 จากแบบสอบถามที่แจกไป 888 ชุด มีผู้ส่งแบบสอบถามคืน 775 ชุด (อัตราการตอบกลับร้อยละ 87) คะแนนระดับความพึงพอใจมีค่าสัมประสิทธิ์อัลฟ่าของครอนบาค 0.89 ระดับความพึงพอใจมีค่า 3.58 ถึง 4.36 โดยมีค่าเฉลี่ย 4.11

สรุป: การเรียนรู้ด้วยกระบวนการทำงานเป็นทีมเป็นกลยุทธ์ในการจัดการศึกษาศัลยกรรมระดับก่อนปริญญาที่มีประโยชน์ นำไปสู่การเตรียมตัวของนักศึกษาก่อนเข้าเรียนที่ดีขึ้น และช่วยสร้างทักษะที่สำคัญหลายประการ รวมถึงการเรียนรู้ด้วยตนเอง การคิดวิเคราะห์ การตัดสินใจ การสื่อสาร และการรับรู้ข้อมูล สิ่งที่ควรพัฒนาบางประการได้แก่ เอกสารประกอบการสอน การจัดตารางเวลาเรียน และการมีส่วนร่วมของอาจารย์ที่มากขึ้น