The concept-sharing approach: a teaching strategy to promote objective-oriented learning and academic performance in medical students

Sekh Thanprasertsuk,1,2 Tanoo Jumrustanasan,1 Laksanaree Somboonkusolsil,1,3 Sirawit Khwanjaipanich,1,4 Jirawin Sukkee,1 Pasakorn Watanatada,1 Shaun Peter Qureshi,5 and Saknan Bongsebandhu-phubhakdi1

1Department of Physiology, Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand; 2Chulalongkorn Cognitive Clinical and Computational Neuroscience Special Task Force for Activating Research (STAR), Chulalongkorn University, Bangkok, Thailand; 3Bhumibol Adulyadej Hospital, Bangkok, Thailand; 4Chonburi Hospital, Chonburi, Thailand; and 5Edinburgh Medical School, University of Edinburgh, Edinburgh, United Kingdom

Abstract

Traditionally teachers display the learning outline at the beginning and conclusions at the end of didactic teaching sessions, and students may find it difficult to understand how teaching activities relate to learning objectives and what they should study for assessments. We introduced the "concept-sharing approach" in our neurophysiology course. This approach explicates how the content relates with learning objectives throughout the entirety of each teaching session to help the students assimilate the learning material and direct their learning in an objective-orientated way. In this study, we aimed to examine satisfaction of the concept-sharing approach in medical students and to investigate the relationship between student perception of this teaching strategy and academic performance. The results demonstrated that most participants (74.1%) had a positive impression of this teaching strategy at the end of the course, which was significantly >50.7% at the beginning of the course (P < 0.001). The participants who agreed the concept-sharing approach was useful had significantly higher final assessment (P = 0.014) and end-of-course formative assessment scores (P = 0.001). The findings indicate that after experiencing this new teaching approach, medical students appreciate its utility and that students who engage with this approach are more likely to perform well in assessments. In summary, the concept-sharing approach is a simple teaching strategy which was favored by students and may promote academic performance.

academic performance; concept-sharing approach; learning objective; learning outline

INTRODUCTION

Clear learning objectives are vital for students to direct their learning and prepare for assessments (1–4). For effective learning, teaching and learning activities should be aligned with learning objectives and assessments, i.e., constructively aligned (5, 6). Constructive alignment is a principle applied to teaching design in which the learning activities or the contents that learners should engage are designated by the learning outcomes. Furthermore, the instructor must facilitate a learning environment that promotes students to engage in such activities or contents (5).

In a traditional class, the teacher usually displays the learning outline at the beginning and key-point conclusions at the end (7, 8). We noted from feedback that our students found it difficult to understand neurophysiology learning material, including knowing what should be learned and how to prepare for assessments. In response, we devised a new teaching strategy: the concept-sharing approach. This facilitates students’ learning by displaying the content outline consistently throughout the entire teaching session making it explicit how these relate to the learning objectives (Fig. 1, A–D). We implemented this teaching approach to promote students' academic performance. The idea of the concept-sharing approach parallels with the constructive alignment as students are facilitated on matching the learning activity, i.e., what are they learning now, to the intended objectives and outcomes, i.e., what should be learned, and ultimately what will be assessed (5).

The concept-sharing approach corresponds with two prominent learning theories: cognitive load theory and the multimedia theory (9). Cognitive load theory is based on the assumption that the learner’s working memory is limited (10). Appropriate design of instruction that promotes relevant cognitive loads and simultaneously reduces redundant loads is thus essential (9, 11). Our approach should help the students determine the contents that are relevant to the learning objectives. The multimedia theory is
based on the dual-channel principle, which states that learners have two separate channels for working memory: verbal and pictorial channels (12). Our approach is thus implemented by mapping topics in a progress bar at the bottom of each PowerPoint slide throughout the class (Fig. 1, C and D). Based on the dual-channel principle, the uses of graphics as topic maps should help promote learning (9, 12, 13).

The current undergraduate Doctor of Medicine degree in the Faculty of Medicine, Chulalongkorn University, Thailand consists of a 6-yr curriculum. The concept-sharing approach was introduced in the Neuroscience course in the second year of the curriculum. Our students had not been familiar with this approach and we had not known whether it would help promote academic performance as expected. Thus, we conducted a study to investigate student’s satisfaction with the concept-sharing approach and to investigate the relationship between student’s perception of this approach and their academic performance. Academic performance was measured by formative assessments and the final summative assessment. The formative assessment consisted of a “pretest” (conducted at the beginning of the course) and “posttest” (at the end of the course) (Fig. 2). We also aimed to explore potential relationships between student perception of concept-sharing approach and their characteristics such as preparation for class and self-assessment.
The pretest was held at the beginning of the neuroscience course. This consisted of 20 items of multiple-choice questions (MCQs) carried out using Kahoot! as an interactive platform (15). At the end of the pretest, the students were asked, in the same platform, about their perceptions at the beginning of the course including 1) their impression on the concept-sharing approach, 2) their preparation for pretest, and 3) self-assessment rating of pretest performance. Each perception question had three possible answer choices (Table 2). At the end of the course, we repeated this process for a neurophysiology posttest. This included 20 items of MCQs that were identical to the questions in pretest but in a different order. The schedule of the posttest had already been announced during the course orientation, but the student had not been informed that the questions would be the same as in pretest. After finishing 20 posttest MCQs, the students were asked their perceptions of the concept-sharing approach at the end of the course (Table 2). The final summative assessment was held at the midsemester after several courses had been completed.

The outcomes measured were assessment performance, based on scores from the formative pretest and posttests, and final summative assessment scores. A timeline of the study is shown in Fig. 2. Each outcome has a possible maximum score of 100 and a possible minimum score of 0. The final summative assessment had a conventional paper-based MCQ format with a total of 150 items, in which 71 items were in the field of neurophysiology (Table 1). The other major neuroscience topics included in the final assessment were neuroanatomy and neurobiochemistry. For the pretest and posttest, 20 s were given for answering each question that appeared on the Kahoot! screen. The students could not correct their answer for previous question as they progressed through the pretest and posttest.

Statistical Analysis

Demographic data of participants were recorded and descriptively analyzed. The descriptive statistics are shown as means ± SD. Chi-square or Fisher’s exact test was applied for analyses for relationship among student perceptions.
Table 2. Questions and answers for assessing student perceptions at the beginning and at the end of the course

| Questions                                                                 | Answers                  | Frequency, n (%) |
|---------------------------------------------------------------------------|--------------------------|-----------------|
| Impression on the concept-sharing approach:                               |                          |                 |
| The instructor should share the learning concept for each topic as an     |                          |                 |
| outline throughout the class.                                             |                          |                 |
| At the beginning of the course                                           | Agree 102 (50.7%)        |                 |
|                                                                           | Neutral 89 (44.3%)        |                 |
|                                                                           | Disagree 10 (5.0%)        |                 |
|                                                                           | (Missing data = 9)        |                 |
| At the end of the course                                                 | Agree 152 (74.1%)        |                 |
|                                                                           | Neutral 46 (22.4%)        |                 |
|                                                                           | Disagree 7 (3.4%)         |                 |
|                                                                           | (Missing data = 5)        |                 |
| Preparation:                                                             |                          |                 |
| How well did you prepare for pre/posttest?                               |                          |                 |
| Pretest                                                                   | Well-prepared 17 (8.2%)  |                 |
|                                                                           | Moderately prepared 43 (20.8%) |             |
|                                                                           | Not prepared 147 (71.0%) |                 |
|                                                                           | (Missing data = 3)        |                 |
| Posttest                                                                  | Well-prepared 39 (18.9%) |                 |
|                                                                           | Moderately prepared 144 (69.9%) |           |
|                                                                           | Not prepared 23 (11.2%)  |                 |
|                                                                           | (Missing data = 4)        |                 |
| Self-assessment rating:                                                   |                          |                 |
| How do you think your pre/posttest score will be?                         |                          |                 |
| Pretest                                                                   | Good 43 (20.7%)           |                 |
|                                                                           | Fair 26 (12.5%)           |                 |
|                                                                           | Poor 139 (66.8%)          |                 |
|                                                                           | (Missing data = 2)        |                 |
| Posttest                                                                  | Good 73 (35.6%)           |                 |
|                                                                           | Fair 111 (54.1%)          |                 |
|                                                                           | Poor 21 (10.2%)           |                 |
|                                                                           | (Missing data = 5)        |                 |

Pretest, beginning of course; posttest, end of course; n = 210 students.

One-way ANOVA with post hoc Tukey’s test was used to analyze the differences between scores among student groups categorized by the personal standpoints both at the beginning and at the end of the course. The level of significance was defined as $P < 0.05$. Cronbach’s alpha was employed for estimating the internal consistency of pretest, posttest, and final assessment. All statistical analyses were performed using IBM SPSS Statistics version 23.0.

RESULTS

All second-year medical students ($n = 304$) agreed to be included in the study. Ninety-four participants were excluded, leaving 210 participants in this study: 98 (46.7%) males and 112 (53.3%) females. The reasons for exclusion were absence from final assessment ($n = 3$), absence from pretest or posttest ($n = 29$), and internet connection or mobile device problems during pretest or posttest ($n = 62$). Means ± SD pretest, posttest, and final assessment scores were $38.8 ± 12.0$, $66.9 ± 15.4$, and $70.6 ± 13.5$ respectively. Cronbach’s alphas for pretest, posttest, and final assessment were $0.397, 0.827$, and $0.944$, respectively.

The proportion of participants who supported the concept-sharing approach at the beginning and at the end of the course was significantly different (50.7% vs. 74.1%, $P < 0.001$) (Table 2). There was no significant difference in scores between the groups categorized by perception of concept-sharing approach at the beginning of the course (Table 3). Such differences, however, were detected among the groups categorized by the perception of this approach at the end of the course. These includes the differences in the final assessment and the posttest scores (one-way ANOVA; $P = 0.01$ and $P = 0.001$, respectively) (Table 3). Post hoc Tukey’s tests showed that the students who supported our approach had higher final assessment ($P = 0.01$, 95% confidence interval [1.13, 11.56]) and posttest scores ($P = 0.002$, 95% confidence interval [2.88, 14.62]) than those who felt neutral to this approach (Fig. 3).

At the beginning of the course, most participants did not prepare for the pretest (71.0%) and rated themselves as having poor performance on the pretest (66.8%) (Table 2). The perception of concept-sharing approach was related to neither preparation for pretest (Fisher’s exact test; $P = 0.39$ (Fig. 4A)) nor self-assessment rating at the beginning of the course (Fisher’s exact test; $P = 0.27$) (Fig. 4B). At the end of the course, most participants moderately prepared for the posttest (69.9%) and rated themselves as having a fair performance on the posttest (54.1%) (Table 2). Nevertheless, students supporting our approach at the end of the course tended to self-rate as more prepared for posttest (Fisher’s exact test; $P = 0.06$) (Fig. 4C). Also, they likely had higher self-assessment rating for posttest (Fisher’s exact test; $P = 0.05$) (Fig. 4D).
DISCUSSION

We introduced the concept-sharing approach in our neuroscience course to facilitate student learning and to promote their academic performance. Our findings have demonstrated students’ satisfaction with the concept-sharing approach and the relationship between positive student perception of concept-sharing approach and academic performance. Most participants (74.1%) had positive perceptions of this teaching strategy at the end of the course, which was significantly greater than 50.7% at the beginning of the course. This may reflect that the concept-sharing approach is an acceptable intervention that is suitable for neurophysiology learning in medical students. The increase in satisfaction over time may indicate that students did not perceive the benefit of this new approach at the start, as it is different from their previous teaching and learning experiences, but they could understand its usefulness after being exposed to it. Additionally, the participants who supported the concept-sharing approach at the end of the course performed significantly higher in formative posttest and final summative assessments. Both these assessments had high reliability measuring by Cronbach’s alpha. This may suggest that students who engage with the concept-sharing approach perform better in assessments. The concept-sharing approach may successfully help students to understand the important learning points, and help them study these aspects in preparation for assessments.

The concept-sharing approach was intended to help student’s learning to become more objective-oriented. The idea of this approach corresponds with constructive alignment and with the cognitive load and the multimedia learning theories (5, 9, 13). Briefly, this approach involves an instructional design that facilitates the students in matching the learning content to the relevant objectives. We believe this is the first study examining the satisfaction of such an approach and the effect of this approach on academic performance. Displaying the content outline throughout the teaching session is a major strength of our strategy. Although we are aware of a similar approach in other...
learning platforms (e.g., e-books, open online courses), we have not encountered the same approach in didactic teaching sessions. However, our findings do correspond with literature on another strategy which relates objective-orientated teaching, the "Instructor-guided note," which has also been stated to improve academic performance (16, 17). Our approach is different from the instructor-guided notes in content and delivery method. We delivered the learning outline throughout each class, while the instructor-guided note focused on giving guided-notes or outline notes to the students directly (16, 17). To our best knowledge, the concept-sharing approach is an innovative strategy for lecture-based teaching in our country, which can be easily applied in both traditional lectures and online classes.

It is important to consider the strengths and potential limitations of the concept-sharing approach. For example, one may argue it interferes with self-directed learning by reducing the expectation of the student to independently assimilate key concepts with reference to learning objectives. One study on the impact of instructor-guided note reported that the provided note eliminated the need for summarizing learning contents in >90% of the participants (16). Despite that, many participants in the same study believed the provided note facilitated their learning and encouraged them to be more productive and active. Instructor guidance and support during problem-based learning session were also reported to promote self-directed learning (i, 18). In addition, our findings have demonstrated students who supported the concept-sharing approach at the end of the course were more likely to have higher self-preparation and higher assessment scores. Although the self-preparation score was self-rated, and therefore highly subjective, this finding suggests that the concept-sharing approach does not necessarily reduce students’ perceived need for their own personal preparation. In the future, it will be important to consider how the concept-sharing approach can be incorporated in a method that makes important learning explicit while still encouraging students to be self-directed in their learning.

Another important consideration is that the concept-sharing approach possibly does not promote academic performance for all students. Participants who supported the concept-sharing approach had significantly higher academic performance, which may imply that only students who can appreciate it are likely to go on to perform well academically. Our results also showed that students who did not find the concept-sharing approach useful at the end of the course tended to self-rate themselves as more unprepared and had lower self-assessment ratings (Fig. 4, C and D). Several studies have demonstrated that preparation for class and self-assessment ability influence academic performance (19–22). Interestingly, the group that did not agree the concept-sharing approach should be used (n = 7) tended to have higher final assessment scores despite lower posttest scores (although not statistically significant). This may reflect that students in this group did not appreciate the concepts shared by course instructors but were able to find their own way of assimilating learning material in time for the final assessment.

The study benefited from its robust and replicable design that allowed us to demonstrate the satisfaction of the concept-sharing approach in medical students and to consider how this approach can affect academic performance. However, the study design was limited by being unable to directly demonstrate the effects of the concept-sharing approach on academic performance. We could not divide our students into groups with and without the concept-sharing approach intervention (e.g., a randomized controlled trial) without causing unequal access to a learning opportunity. Using the score from the previous year as a comparison was also inappropriate as there were year-by-year differences in terms of both the students and the assessment. Practically, it would not have been possible to retrospectively recruit these past students to the study and gain informed consent. Despite this restriction we were able to ascertain the positive relationship between those who agreed with use of the concept-sharing approach (and therefore likely engaged more with it) and academic performance.

Another potential limitation was the use of the Kahoot! Platform for the pretest and posttest formative assessments, which might not be a true reflection of academic performance since the students could not go back to correct answers for previous questions. However, we used this software since the students were able to see the correct answer and explanation instantly question-by-question, thereby obtaining immediate feedback (23). Furthermore, the pretest assessment was also found to have low reliability measuring by Cronbach’s alpha. This is unexpected as most students did not prepare for the pretest and were unfamiliar with neuroscience content at the beginning of the course. Nevertheless, the low reliability of the pretest did not essentially interfere with the interpretation of our results. Lastly, as this study was focused in the neuroscience course, it is possible that the study findings are not generalizable to other disciplines. Future work should investigate the applicability of this strategy to other medical fields.

Future work should seek to investigate direct effects of the concept-sharing approach on academic performance, e.g., comparison of performance before and after implementation in another course. It would also be fruitful to investigate the effects of the concept-sharing approach within other medical disciplines (not only neuroscience). This research should also explore how the concept-sharing approach affects students’ ability to direct their own learning.

Conclusions

This study investigated student satisfaction with a novel concept-sharing approach to teaching medical students and its relationship to academic performance in an undergraduate medical neurophysiology course. The concept-sharing approach was viewed favorably by many students and might help promote academic performance in medical students. We therefore suggest that the concept-sharing approach may be useful and acceptable for undergraduate medical teaching.

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DISCLOSURES

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

AUTHOR CONTRIBUTION

S.T., T.J., L.S., S.K., J.S., and S.B.-p. conceived and designed research; S.T., P.W., and S.B.-p. performed experiments; S.T., T.J., and S.B.-p. analyzed data; S.T., T.J., L.S., S.K., J.S., S.P.Q., and S.B.-p. interpreted results of experiments; S.T. and S.B.-p. prepared figures; S.T., T.J., L.S., S.K., and J.S. drafted manuscript; S.T., T.J., L.S., S.K., J.S., P.W., S.P.Q., and S.B.-p. edited and revised manuscript; S.T., T.J., L.S., S.K., J.S., S.T., P.W., and S.B.-p. approved final version of manuscript.

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