Explicit constructivism: a missing link in ineffective lectures?

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Prakash ES. Explicit constructivism: a missing link in ineffective lectures? Adv Physiol Educ 34: 93–96, 2010; doi:10.1152/advan.00025.2010.—This study tested the possibility that interactive lectures explicitly based on activating learners’ prior knowledge and driven by a series of logical questions might enhance the effectiveness of lectures. A class of 54 students doing the respiratory system course in the second year of the Bachelor of Medicine and Bachelor of Surgery program in my university was randomized to two groups to receive one of two types of lectures, “typical” lectures (n = 28, 18 women and 10 men) or “constructivist” lectures (n = 26, 19 women and 7 men), on the same topic: the regulation of respiration. Student pretest scores in the two groups were comparable (P > 0.1). Students that received the constructivist lectures did much better in the posttest conducted immediately after the lectures (6.8 ± 3.4 for constructivist lectures vs. 4.2 ± 2.3 for typical lectures, means ± SD, P = 0.004). Although both types of lectures were well received, students that received the constructivist lectures appeared to have been more satisfied with their learning experience. However, on a posttest conducted 4 mo later, scores obtained by students in the two groups were not any different (6.9 ± 3 for constructivist lectures vs. 6.9 ± 3.7 for typical lectures, P = 0.94). This study adds to the increasing body of evidence that there is a case for the use of interactive lectures that make the construction of knowledge and understanding explicit, easy, and enjoyable to learners.

METHODS

A class of 54 students doing the respiratory system course in the second year of the Bachelor of Medicine and Bachelor of Surgery (MBBS) program of the Faculty of Medicine of Asian Institute of Medicine, Science and Technology (AIMST) University was randomized to two groups to receive one of two types of a block of three lectures on the regulation of respiration: “typical” lectures (n = 28, 18 women and 10 men) or constructivist lectures (n = 26, 19 women and 7 men). I told students that I was comparing two types of lectures but they did not know which type of lecture they were receiving. I requested them not to exchange handwritten notes until the block of lectures was completed, but I could not verify if they exchanged information and, if so, to what extent. That the two groups were comparable at baseline was ascertained with a pretest that contained some questions from previous lectures on respiration. The pretest scores of the two groups were comparable (P > 0.1; Table 1). What happened in the lectures? I prepared well for both types of lectures and delivered both of them enthusiastically. I really regret not having planned in advance to videotape these sessions, as this would have helped the reader make an independent assessment of what happened in the lectures, including the nature and extent of student participation in each type of lecture. However, I am sure that the reader can make out the fundamental difference between the typical lectures and the constructivist approach from the lecture slides [see Supplemental Material, Supplement 1 (typical lectures) and Supplement 2 (constructivist lectures)]. We don’t yet have the benefit of personal response systems to augment interactions during lectures, so my students did not have them in this study. The typical lectures were, for the most part, didactic; however, interactions were encouraged and did occur. Learners’ construction of knowledge was assumed, and questions that promoted interactions between students and me were much less frequent. However, in the constructivist lectures, we progressed through the topic using a series of logical questions that led at least some of the students to respond. This provided me with the opportunity to assess the participants’ “mental models” and clarify misconceptions as well as appreciate thinking along the right lines. I wish to add that I felt excited that we were together constructing a body of fundamental knowledge and understanding on the regulation of respiration (see also the student comments on the constructivist lectures in Table 4). Periodically, I explicitly summarized the collective understanding that I thought emerged in the classroom before passing on to the next subtopic. One can readily see from the slides that the constructivist approach featured considerable teleological speculation; however, these were developed into hypotheses, and there were questions on how such a hypothesis could be tested, what the principal observations of the resulting experiments were, and what they indicated about physiological mechanisms.

Prespecified end points. The effectiveness of lectures was assessed on the basis of student scores on a posttest (see Supplemental Material, APPENDIX 1: POSTTEST) conducted immediately after the conclusion of the last lecture. The posttest questions were written by me to assess student understanding of some of the core concepts covered by these lectures, and it was designed to be nearly fully objectively scorable. Additionally, students were requested to provide anonymous feedback of their perceptions on certain aspects of the lectures (see Supplemental Material, APPENDIX 2: FEEDBACK FORM) they received. Free text comments were also invited. To determine if there were differences between the two groups in the long term, the same posttest was also administered 4 mo after these lectures were given. However, students did not know that they were going to be given the same posttest 4 mo later. Students consented to participate in this
research, and the Faculty of Medicine Research and Ethics Committee of AIMST University approved this protocol.

RESULTS

While I completed a block of three typical lectures in a total of ~90 min (~30 min each), to complete a block of three constructivist lectures took ~30 min more. Students that received the constructivist lectures did much better in the posttest conducted immediately after the lectures (6.8 ± 3.4 for in the constructivist lectures vs. 4.2 ± 2.3 for the typical lectures, means ± SD, \( P = 0.004 \) by Mann-Whitney U-test). Please note that in Table 1 median rather than mean scores are provided with 95% confidence intervals of the mean because the distribution of scores was apparently non-Gaussian. Although both types of lectures were well received, students that received the constructivist lectures had greater overall satisfaction with their learning experience (see students ratings in Tables 2 and 3). However, on a posttest conducted 4 mo later, scores obtained by students in the two groups were not any different (6.9 ± 3 for the constructivist lectures vs. 6.9 ± 3.7 for the typical lectures, means ± SD, \( P = 0.94 \), not significant). It is worth noting that between the first and the second posttest, the median score increased significantly (\( P < 0.01 \)) in the group that received the typical lectures, whereas the score of students that received the constructivist lectures remained stable (\( P = 0.9 \)). All tests were scored by E. S. Prakash (the author), who was blinded to the type of lecture that the students received.

DISCUSSION

Although the outcome on the second posttest did not differ significantly between the two groups, the fact that students who participated in the constructivist lectures did much better on the posttest immediately after the lectures suggests that an explicitly constructivist approach to lecturing does indeed better facilitate learning with understanding. In contrast, students that received typical lectures took longer to get even, in terms of scores on the posttest, with those that received the constructivist lectures. More importantly, from the comments of students who participated in the constructivist lectures, one can see that they found the constructivist lectures helpful. The results support the idea that explicit constructivism is a key principle for augmenting the effectiveness of lectures. These observations are not new, and the reader is referred to a review of research on constructivist-based strategies for large lectures by Geer and Rudge (4). However, I believe that for medical physiology educators who continue to use a predominantly didactic approach for lecturing or for those whose seek to facilitate learning with understanding but are constrained to use lectures as a major teaching method, the narrated experience and the accompanying supplement (see Supplemental Material, Constructivist lectures on the regulation of respiration) may provide a useful working example for planning and incorporating aspects of constructivist philosophy into lectures.

Constructivist learning environments and experiences have been extensively characterized (e.g., see Refs. 2, 4, 7, 10, 11, and 13). I wish to note that the constructivist lectures described in this study encompassed the following core features that stem from constructivist philosophy: consolidating prior knowledge; engaging learners with a series of logical questions that invite them to activate prior knowledge; negotiating the scientific method (question-predict-observe-explain), thereby providing a basis for future independent inquiry into the content and concepts brought out in the lectures; the explicit nature of the attempt to construct knowledge and understanding; and dialogue between the facilitator and participating students until flawed conceptions were refined. Finally, there was an opportunity for learners to obtain a sense of discovery, greater engagement in the learning process (as students comments suggest; Table 4), and ownership of learning. For example, when I asked the class the informal question “Where would you like to have these receptors? On the arterial or venous side of the circulation?,” a large number of students responded by saying that they would expect them to be on the arterial side of

<table>
<thead>
<tr>
<th>Item</th>
<th>Rating</th>
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<tbody>
<tr>
<td>How much were you involved in the lectures?</td>
<td>10</td>
</tr>
<tr>
<td>How much did the lectures facilitate understanding of the topic?</td>
<td>10</td>
</tr>
<tr>
<td>How logical were the lectures?</td>
<td>15</td>
</tr>
<tr>
<td>Did you find the need to take extra effort to memorize the content provided in these lectures?</td>
<td>1</td>
</tr>
<tr>
<td>How much would you recommend this type of lecturing?</td>
<td>13</td>
</tr>
<tr>
<td>What was your overall satisfaction with the lectures?</td>
<td>9</td>
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\( n = 28 \) students. Items were rated as follows: 5 = highest (most favorable) rating to 1 = lowest (least favorable) rating (see Supplemental Material, APPENDIX 2: FEEDBACK FORM).
the circulation because that would allow the chemoreceptors to verify whether the pH, Po2, and PCO2 of blood supplied to metabolizing tissues were optimal or not. And I replied, “You are absolutely right! Indeed, the chemoreceptors that sense arterial pH and Po2 are located in the aortic and carotid bodies, on the arterial side of the circulation.”

Limitations. There are several limitations that would potentially confound the interpretation of results. First, the same teacher (E. S. Prakash, the author) delivered both the typical and constructivist lectures. I thought that this would confound the outcomes less than if I were to have two different lecturers deliver the typical and constructivist lectures. The latter approach would inevitably have introduced a bias attributable to differences in the teaching abilities and philosophies of the two teachers. I wrote the posttest questions; however, readers can assess the validity of these test items. In the context of the stated hypothesis, one may wonder if I could have been as enthusiastic about delivering the typical lectures. In this regard, I regret not having videotaped these sessions. As noted earlier, videotaping these sessions would have additionally helped to document the differences in the nature and extent of student participation in the two types of lectures. I acknowledge that some of the concepts presented in these lectures, particularly in reference to the neural basis for the regulation of respiration, are oversimplified and/or hypothetical. This was intentional; indeed, the central neural substrates for respiratory control continue to be a subject of intense experimental research. The results of this study were obtained with a rather convenient class size of 25–28 students, and I don’t think it correct to readily extrapolate this to much larger classes.

Practice issues. Many practical implications of a constructivist philosophy of teaching have been suggested (2, 4, 6, 8–10, 13). I wish to highlight some issues in light of this experience. First, and quite obviously, constructivist teaching-learning experiences consume more time than instructive approaches because of the amount of interactions that may be required before the facilitator is convinced that a satisfactory conceptual model has emerged in the minds of learners. Furthermore, the level at which the lectures are pitched should, by definition, take into consideration prior knowledge of low achievers in that class of students so that the teaching-learning experience could be expected to benefit virtually every student in the class. For example, in this study, my audience was undergraduate students in the second year of the medical program, and I thought it appropriate to start building into the neural and chemical regulation of respiration by first asking a teleological question: Why we needed to breathe at all?

Third, a point-by-point comparison of the two PowerPoint files (typical vs. constructivist lectures) will indicate that the constructivist lectures were not intended and prepared to deliver all the facts that were delivered in the typical lectures. Rather, these lectures (whether typical or constructivist) were prepared and delivered as a means to facilitate the attainment of prespecified intended learning outcomes. The fact that students who received typical (more comprehensive) lectures did no better than those who received constructivist lectures in the second posttest suggests that where the intended outcome is learning with understanding, covering more content isn’t necessarily better. The issue of whether lectures (or comparable teaching-learning methods) in higher education should primar-
ily seek to cover content has rightly been the point of much discussion (1, 12, 14). Undoubtedly, the most significant effect the narrated experience has had on me as a medical physiology educator is drive me into more critically examining than ever before what I eventually want my students to be able to do (with what is learned) at the end of each lecture, a particular course, and then upon graduation from the MBBS program as a doctor and, in turn, use this renewed vision of intended learning outcomes to temper approaches to facilitating learning as well as the assessment of learning.

Fourth, many topics in physiology, the regulation of metabolism, and pathophysiology naturally lend to constructivist approaches. Finally, and perhaps most important, irrespective of whether a teaching-learning experience is designed to be “instructivist” or “constructivist” or something in between, the truth is that for learning to occur with understanding, the learner has to ultimately construct his/her own mental models of the external world (1, 8–10, 13). This implies that the usefulness of knowledge of constructivist approaches is not limited to designing constructivist teaching-learning experiences; rather, it is fundamental to understanding “meaningful learning.”

In conclusion, despite the limitations of this pilot study, the results indicate that it is possible to incorporate cardinal features of constructivism into designing and delivering lectures that make the construction of knowledge and understanding explicit, easy, and enjoyable to learners. I am certainly much more motivated now than before to take efforts toward using an explicitly constructivist approach to preparing and delivering lectures wherever possible. However, I believe the overall impact of this effort on student learning will be substantial only if entire courses (or major portions of it) are designed and delivered based on constructivist principles. More importantly, a substantial fraction of assessment of learning should focus on assessing if meaningful learning has occurred rather than test retention of the facts per se. This can then be eventually expected to foster a positive change in the minds of students who mistakenly think that learning is simply acquiring new information without necessarily understanding the potential or actual utility of learned knowledge. One surrogate of impact of such an approach that merits research is whether students would adopt a constructivist approach to learning during their own study time, in preference to rote learning.

ACKNOWLEDGMENTS

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DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the author(s).

REFERENCES