Basic Science Alive: Linking science knowledge to clinical practice

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This paper describes an e-learning package, Basic Science Alive (BSA) that aims to facilitate undergraduate medical students' integration of basic science to clinical scenarios. The educational emphasis is on students constructing their own links between theory and practice and the process of peer review. There are three main components of the package: the writing of a short structured essay (presentation) demonstrating the linkage of basic science to a specific clinical scenario; the opportunity to review and comment on colleagues' presentations; and the value of receiving feedback through multiple choice questions (MCQs) and peer comments. This paper specifically focuses on the peer review element, including the perceived learning of the reviewee through receiving the comments, and the learning of the reviewer through interaction with the presentation and formulating feedback to the reviewer.

Background

Recent curricula reforms in an undergraduate medical school have required that basic science be integrated in the later clinical years of the course. Because the clinical years are largely experiential, and because students are distributed over a number of locations, we were naturally led to the development of a web-based learning tool that could be used by the students in a flexible manner. Basic Science Alive (BSA) is an e-learning platform to support the linkage of basic science with clinical practice. Using BSA, students are expected to interact with a clinical scenario, write and make public a presentation, and then receive peer reviews.

Four pedagogical ideals were felt to be important in the underpinning of this tool: constructionism; contextually rich stimuli; timely feedback; and collaborative learning through peer review.

1. Constructionism is a term coined by Seymour Papert and a learning theory inspired by constructivist approaches. This theory holds that constructivist learning (conceived as the active building of knowledge structures by the learner) "happens especially felicitously in a context where the learner is consciously engaged in *constructing a public entity*" (Papert, 1991, p. 1); in BSA the presentations are constructed public entities.

2. In order to maximise the authenticity and value of constructivist learning in the practical setting, there also needed to be contextually rich stimuli in order to emphasise relevance to practice. The importance of relevance to practice has been well documented (Rudland & Rennie, 2003; Biggs, 2003) with the use of contextually rich clinical scenarios (as used in BSA) being an important strategy for enhancing relevance.

3. The relationship between learning and feedback has been equally well researched. In order for students to maximise learning a number of feedback mechanisms had to be considered. The use of peer and staff review allows for timely feedback to be given (since all users of the system can provide feedback). Furthermore, feedback is given not only through peer review, but also through pre and post multiple-choice-questions (MCQs) that include specific feedback on the basic science concept.

4. Collaborative learning (Smith & MacGregor, 1992) for a team based professional was also felt to be of value, as was an element of peer review. Peer review has been found to enhance lifelong learning and to develop meta-cognitive skills (Topping, 1998; Boud & Falchikov 2006; Dochy, Segers & Sluijsmans, 1999). In addition, peer review is a professional obligation in the medical profession (Medical Council of New Zealand, 2007), and has been found to modify professional behaviour (Ilgen, Fisher & Taylor, 1979) and is thus seen as a possible strategy for maintaining good performance amongst doctors (West, 2002).

Whilst peer review by students is not new, (see Dochy *et al.* (1999) for a survey), much of the research has used peer review in a formative way, and has focused on the reliability and validity of student-assigned marks. For example, de Raadt, Toleman & Watson (2003) used peer assessment in a large class and reported that bias was reduced through anonymous reviewing and that variability was addressed by having very objective criteria that "focus on completeness of task rather than judgment of quality" (p. 161). While the tasks assessed by de Raadt et al. were relatively simple (e.g., constructing a document using a word processor), Lindblom-Ylänne, Pihlajamäki, & Kotkas (2006) considered a more complex assignment: an essay on the history of law. They compared staff-, self-, and peer-assessment and found little variability. In general, the literature is inconsistent regarding the variability and validity of peer-assessment compared with staff assessment (Topping, 1998), although it does appear that, with due care (e.g., clear criteria, appropriate training in how to review, sufficient reviewers per paper), these difficulties can be overcome (Cho, Schunn & Wilson, 2006).

Compared with paper-based reviewing, "e-reviewing" has a number of advantages (e.g. Mulder & Pearce, 2007; Rourke, Mendelssohn, Coleman & Allen, 2008): it automates the workflow (e.g., allocation of reviews, and returning reviews to the authors of the reviewed presentation); makes it easy for a reviewer to see other reviews of the presentation being reviewed; and mimics some of the peer review processes that will be part of ongoing clinical practice for professional doctors.

A description of Basic Science Alive

Basic Science Alive (BSA) is an e-learning site that allows students to write presentations, share them with peer and staff reviewers, and write reviews on peers' presentations. These presentations are template-structured overviews of a basic science concept related to a clinical scenario such as the following:

> Jonno, aged 19 years, has presented with some of the features of Marfan's syndrome, and some respiratory compromise as a result of his condition. Having elected to treat him conservatively, you admit him for observation. Later that evening you are called to the ward, as he is suffering from increased dyspnea with a respiratory rate of 24/min. He is only able to speak short sentences. On auscultation he has definite reduced air entry on the left side, with increased resonance to percussion. His sats are now 84% on 2L of O_2 via nasal prongs. You elect to place a chest drain, following discussion with your registrar. Summary: Jonno's pneumothorax has progressively increased, necessitating the placement of an intercostal chest drain.

After students are logged into the system (Figure 1, left side), they can select from a range of 32 concepts on which to write a presentation. Then they complete five MCQs related to the chosen concept before writing their presentation. After the presentation is written and submitted, students take the identical MCQs (for pre- and post-intervention comparison) and receive feedback on the pre- and post-tests showing the answers they had given for both tests, the correct answers, and their score. Once a presentation is submitted, reviewers are able to read and review the presentation. Reviews are completed using a structured template (Figure 1, right side). Once a review is given, the authors are able to read the comments and rewrite the presentation (if necessary).

The system was carefully designed to provide guidance and incentives that will maximise the number of presentations available for review and the number of times each presentation is reviewed. The following policies were adopted and implemented in the system:

- A student cannot review presentations until they have written a presentation (to maximise the number of presentations available for review).
- A student selects a concept, and is then allocated a presentation to review. The allocation mechanism is "fair" in that it ensures that the least-reviewed presentations are allocated.

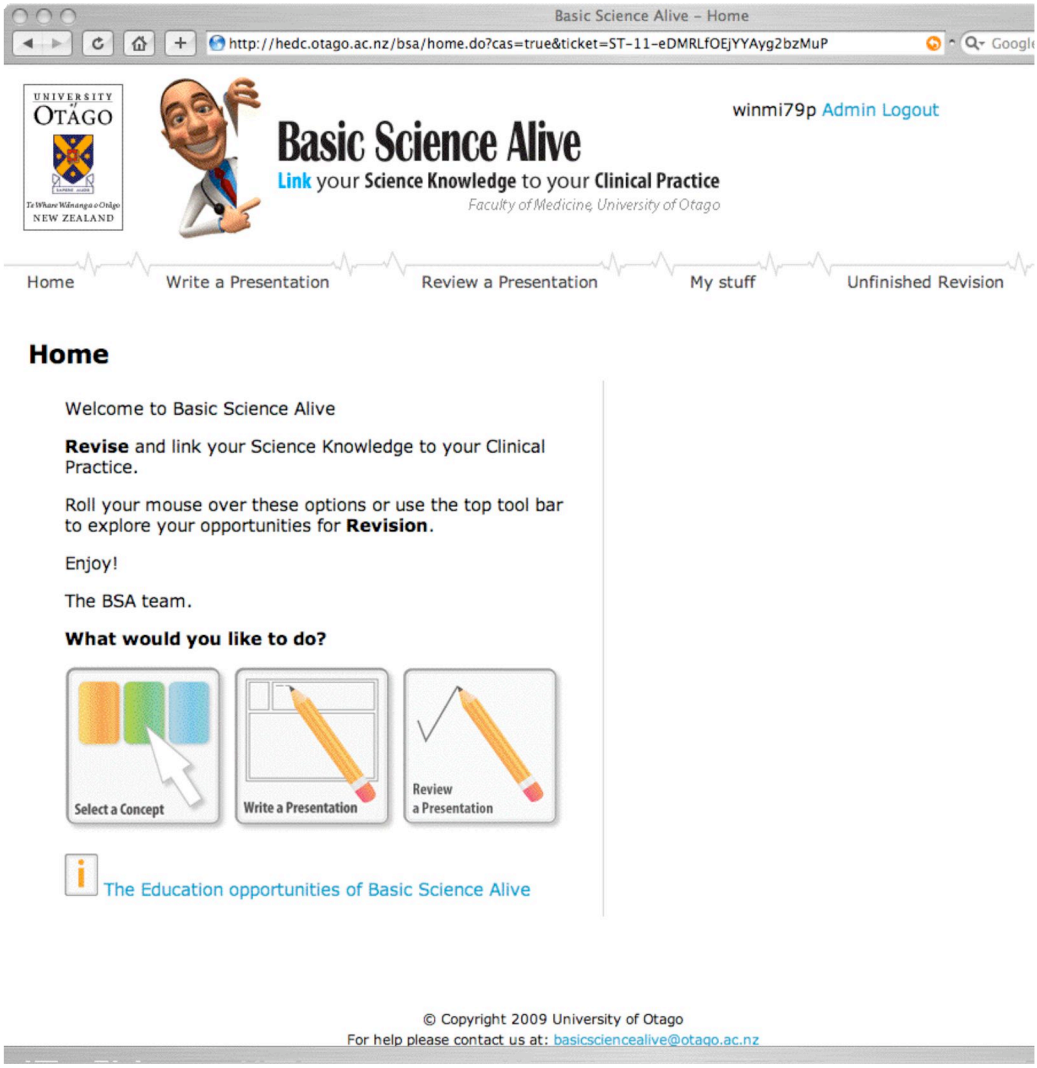

Figure 1: Basic Science Alive home page

- The student completes an MCQ test before they do a presentation or a review. However, they do not get feedback on the test until they have completed their presentation/review and done the post-test. This provides an incentive to complete the presentation/review.
- Another incentive to completing presentations/reviews is that a student can only have a small number (two) of incomplete presentations and reviews.
- The concepts available are organized around end of year 5 examinations which comprise an Objective Structured Clinical Examination (OSCE) and MCQ type examinations.

Another feature of the system is the use of pseudonyms (e.g. “Blue Basilisk” or “Pink Panther” in Figure 1, right). We want to keep students anonymous to reduce bias (de Raadt et al., 2003), but at the same time, since a student might review multiple presentations on a given topic, we need to distinguish between the presentations of different students on the same concept.

The system is a database driven web-application implemented in the Java programming language. The database contains four main datasets (users, presentations, reviews, and MCQs) along with the ability to store interaction information such as the number of attempts at writing presentations.

Methodology

This paper describes the initial evaluation of the BSA system. The specific objectives of this paper are to examine:

- the interaction of students with BSA, particularly with respect to the peer review element; and
- the value to learning of the peer review process, considering both formulating and receiving feedback.

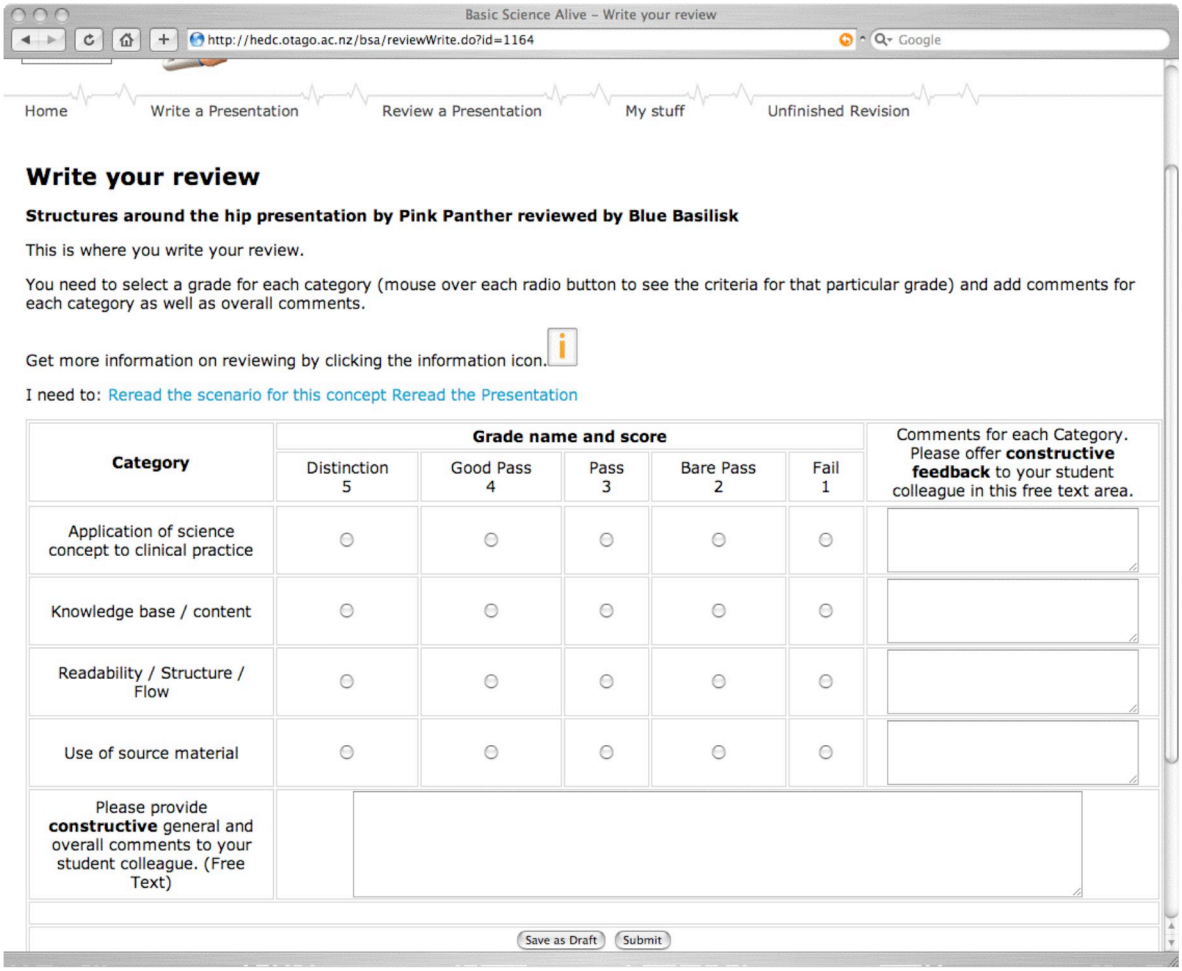

Figure 2: Review template

The preliminary evaluation focused on three students' views on the practice of peer review. The students were observed interacting with the system and were asked specific questions regarding the peer review element.

A more comprehensive evaluation is underway and ends in November, 2009. BSA was/is available to volunteer medical students (fourth and fifth years from a six year programme). These students were invited through a formal presentation and an e-mail with an embedded link.

Data was/will be collected through the following methods:

- a written survey pertaining to themes such as students' perceptions on the nature of learning that took place, and the quality of feedback given by peers and staff members;
- a log of the students' online behaviour (e.g. number of presentations and reviews completed) offering a proxy measure of aspects valued by students;
- the results of the pre- and post-tests, taken as proxy measures of students' knowledge of the relationship between basic science and clinical practice;
- the marking and constructive feedback from the reviewers; and
- the overall usefulness of the BSA system as a revision tool for examinations (5th-year students), using both performance and survey data.

The quantitative data from the survey and the log of activity will be analyzed using percentages and frequencies. Free text comments will be coded by at least two of the authors adopting a modified grounded theory approach. The results of pre and post tests and any significant differences will be analyzed using a suitable statistical test (such as the Wilcoxon test).

These analyses will be presented at the conference.

Results

The three students (S1-S3) involved in the initial evaluation all agreed that the overall concept of the BSA system was sound and that it would be a useful revision tool. They were notably engaged with the practice MCQs.

Regarding peer review, while there was a consensus that receiving a peer's feedback was "helpful", two issues stood out as being potentially challenging: firstly, two of the students expressed that they would feel uneasy reviewing a peer's presentation. For example, S3 expressed her wish not to stand out from her peers:

> You don't want to put yourself in a spot (…) be interpreted as being much higher above them.

Similarly, S3 expressed the fear of being perceived as being overly-critical of her peers and that, while she was happy to highlight the strengths of her peers' presentations, she would be deliberately vague in pointing out weaknesses (e.g. "I'm not entirely sure if I understood"). Both S2 and S3 felt that, if they were not *entirely* sure themselves, they would not want to critique their peers' work. All three students agreed, though, that preserving their anonymity facilitated the process to some degree.

However, even if peer feedback was readily given, S2 and S3 would not really value it. S2 asserted that the BSA learning experience would be no poorer without peer review; S3 deemed it "less valid" without the feedback from experts (e.g. registrars) because she and her peers were "not quite so sure of the information". In fact, S3 even hoped for an opportunity for ongoing dialogue with staff reviewers. Nevertheless, during their interaction with the system, S1 did find S2's peer comments (identifying missing information) useful.

Over 100 students responded to the evaluation survey of BSA. From the respondents 77percent were attracted to participate due to the computer based nature of the programme. Of these students 61% percent registered for the site. Those who failed to register gave a variety of reasons for lack of participations with lack of time, partly due to examination pressure, and perception of lack of relevance being the most cited reasons. Of the different facets of BSA the students found writing the presentation to be of more value than reviewing a presentation. The staff reviews were also perceived to be a greater value than the peer reviews.

The interaction with the site indicated loss of interaction at key points. For writing a presentation 154 students selected a concept, of these 105 (68%) completed the MCQs pre-tests. Of this number 81 students (77%) went on to write a presentation but only 26 students (27%) actually submitted and proceeded to the post test. When asked in the evaluation survey why that student failed to submit a presentation the main reason was the perception of value was not worth the time input, at what was a busy end of year period. Other reasons given included students being "unsure" of what they were meant to be doing and system errors for example loss of saved data and the resultant disillusionment.

Discussion

This paper has briefly presented the Basic Science Alive (BSA) system, which aims to assist medical students in linking basic science concepts with clinical practice through peer review.

Our very early evaluation points to a sense of the challenges we might face in promoting peer review to medical students (volunteers). In view of these students' feedback, we emphasised the profile of staff reviewers within BSA (registrars and above) during the student briefing at the start of the pilot project. The comment relating to the valuing of feedback only from experts may highlight an interesting tension between the underpinning educational philosophies of the curriculum, where collaborative work is valued and peer review is compulsory in continuing practice, and the highly-hierarchical environment of the medical profession. The difficulties of inexperienced people reviewing work may identify the need not only to give clearer instruction to a reviewer but perhaps earlier opportunities for peer review in order to develop this confidence.

One interesting feature of our work, compared with much of the previous work on peer reviewing, is that we are using peer review in a purely formative way, and indeed, participation is optional. This has a number of implications for how peer reviewing is run, such as not having deadlines for presentations or for reviews, and needing to allocate reviews on the fly (in a balanced way) rather than all at once; as well as needing to build incentives into the process. Attempting to ensure consistent marks from different

reviews is not an issue for us. Indeed, the diversity of perspectives may be one of the learning benefits that this type of peer review affords.

References

Cho, K., Schunn, C.D., & Wilson, R.W. (2006). Validity and reliability of scaffolded peer assessment of writing from instructor and student perspectives, *Journal of Educational Psychology*, 98(4), 891-901. DOI 10.1037/0022-0663.98.4.891

Biggs, J.B. (2003). *Teaching for quality learning*. Buckingham. Open University Press/Society for Research in to higher education (2nd Edition).

Dochy, F., Segers, M., & Sluijsmans, D. (1999). The use of self-, peer and co-assessment in higher education: A review, *Studies in Higher Education*, 24(3), 331-350.

Boud, D. & Falchikov, N. (2006). Aligning assessment with long-term learning, *Assessment & Evaluation in Higher Education*, 31(4), 399-413. https://doi.org/10.1080/02602930600679050

Ilgen, D.R., Fisher, C.D., & Taylor M.S. (1979). Consequences of individual feedback on behaviour in organizations. *Journal of applied psychology*. 64(4): 349-371.

Lindblom-Ylänne, S., Pihlajamäki, H., & Kotkas, T. (2006). Self-, peer- and teacher-assessment of student essays, *Active Learning in Higher Education* 7(1), 51-62.

Medical Council of New Zealand. (2007). Continuing professional development and recertification. Wellington: Medical Council of New Zealand

Mulder, R.A. & Pearce, J.M. (2007). PRAZE: innovating teaching through online peer review. In *ICT: Providing choices for learners and learning. Proceedings ascilite Singapore 2007*. http://www.ascilite.org.au/conferences/singapore07/procs/mulder.pdf

Papert, S. (1991). Situating constructionism. In I. Harel & S. Papert (Eds.), Constructionism (pp. 1-14). Hillsdale, NJ: Lawrence Erlbaum Associates.

de Raadt, M., Toleman, M., & Watson, R. (2005). Electronic peer review: A large cohort teaching themselves? In *Balance, fidelity, mobility: Maintaining the momentum? Proceedings ASCILITE Brisbane 2005*. http://www.ascilite.org.au/conferences/brisbane05/blogs/proceedings/17_de%20Raadt.pdf

Rourke, A.J., Mendelssohn, J., Coleman K. & Allen, B. (2008). Did I mention it's anonymous? The triumphs and pitfalls of online peer review. In *Hello! Where are you in the landscape of educational technology? Proceedings ascilite Melbourne 2008*. http://www.ascilite.org.au/conferences/melbourne08/procs/rourke.pdf

Rudland, J.R. & Rennie S.C. (2003). The determination of the relevance of basic sciences learning objectives to clinical practice using a questionnaire survey. *Medical Education*. 37(11), 962-965. DOI: 10.1046/j.1365-2923.2003.01671.x

Smith B.L., & MacGregor J.T. (1992). What is collaborative learning? http://learningcommons.evergreen.edu/pdf/collab.pdf

Topping, K. (1998). Peer Assessment Between Students in Colleges and Universities, *Review of Educational Research*, 68(3), 249-276. https://doi.org/10.3102/00346543068003249

West M. (2002). How can good performance among doctors be maintained? BMJ, 325, 669-670. https://doi.org/10.1136/bmj.325.7366.669

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Please cite as: Joy R Rudland, Judith Swan, Phil Blyth, Jenny McDonald, Michael Winikoff, Swee Kin Loke, Richard Zeng, Ayelet Cohen (2009). Basic science alive: Linking science knowledge to clinical practice. In *Same places, different spaces. Proceedings ascilite Auckland 2009*. https://doi.org/10.14742/apubs.2009.2256