Looking for Kikan-Shido: Are elements of it detectable in tertiary engineering pedagogy?

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Abstract: Comparative studies of year eight mathematics and science classes in schools around the world have identified Kikan-Shido as a regularly practiced pedagogy. This paper contends that Kikan-Shido in these instances does not result from any identifiable and unique secondary school teaching philosophy and it is likely to be present for the successful delivery of problem-based teaching activities, particularly in mathematics and/or sciences based syllabi. In order to test this hypothesis for engineering education, four active computer-based revision tutorials in a subject that formed part of some undergraduate engineering courses at a tertiary institution were audio recorded and then storyboarded for later analysis. The possible occurrences of Kikan-Shido activities in such a common tertiary learning environment were investigated by analysing the teacher-student verbal communication and then comparing the identified practiced pedagogy with some of those defined for the earlier mentioned global study in secondary schools. A recommendation is made to extend any follow-up studies to include the tabulation of Kikan-Shido “activity patterns” which may be investigated for their suitability as a catalyst for the development of a metric for teaching quality.

Introduction

Comparative analysis of mathematics and science classroom pedagogy, that is practiced in a variety of countries and available from the data collected by the various Trends in International Mathematics and Science Study (TIMSS) video recordings (Gonzales et al., 2000), has concluded the existence of a “simple, common pattern” to teaching (Stigler & Hiebert, 1999), that is embodied in “lesson signatures” rather than “lesson patterns” (Hiebert et al., 2003). Further, the subsequent Learner’s Perspective Study (LPS), which is an international research consortium studying the practices in “well-taught” mathematics classrooms worldwide, has identified the following lesson events: “Beginning the Lesson, Learning Tasks, Student at the Front, Guided Development, Setting the Task, Walking Between Desks, and Summing Up” (Clarke, 2004). Each of these events has a form that enables its identification in the collected data from each of the countries that was studied. Clarke (2004) applied “Walking Between Desks” or Kikan-Shido “to establish the legitimacy of lesson events as one basis for international comparison of classroom practice”.

Kikan-Shido is a Japanese term which literally “means ‘between desks instruction’ where the teacher walks around the classroom, predominantly monitoring or guiding student activity, and may or may not speak or otherwise interact with the students” (O’Keefe, Xu, & Clarke, 2006). The principal functions within Kikan-Shido, namely monitoring student activity, guiding student activity, organisational and (sometimes) social talk, have been identified from the study of eighteen year-eight mathematics classrooms that were located in five countries around the world. In order to employ the enacted patterns of Kikan-Shido as the metric in their international comparative research, O’Keefe et al. (2006) expanded the four principal functions into 16 activity code definitions as shown in Table 1.

It is the contention of this researcher that students engaged in ‘learning-by-doing’ or ‘problem-based learning’ activities in tertiary institutions while being monitored and guided, typically in laboratory classes and/or tutorials, are participating in some Kikan-Shido activities - particularly in those that are characterised by verbal interaction between the academic and the student. For this pilot project the
desired outcome was simply to try to identify its presence, unlike Clarke (2004) who, as an integral part of the above mentioned global study, also analysed the percentage of time spent in performing each such activity.

Table 1: Kikan-Shido Activity Codes (O’Keefe, Xu, & Clarke, 2006).

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<th>Teaching and learning details</th>
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<th>Subject</th>
<th>HET210 – Electronics</th>
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<td>Details</td>
<td>is part of some of the engineering degree courses offered at Swinburne University of Technology. Approximately 50% of its contact hours are assigned to each of</td>
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the two major topics; namely analogue and digital electronics. In 2007, 21 students were enrolled in the subject with the same academic staff member timetabled to deliver all the lectures, tutorials and laboratory sessions. The use of an electronic circuit simulation software, *NI Multisim10* from *National Instruments*, was incorporated into all the components of this subject. Firstly, the simulator was used by the lecturer to illustrate the behaviour of both analogue and digital circuit elements during the appropriate lecture sessions. Subsequently, the students obtained hands-on experiences when, as part of their submission requirements, they were asked to include confirmation of their laboratory outcomes and their assignment results with file copies of appropriate simulations. Finally, throughout the semester the students were also encouraged to use the simulator to check their answers to textbook problems.

**The Procedure**

For the last two weeks of the semester the students were timetabled for four one-hour long troubleshooting sessions in an academic supervised computer laboratory, where the already mentioned simulator software was installed on each machine. The academic supervisor used Microsoft® PowerPoint® slideshows on a data projector screen to pace the students’ activities.

While a different topic was revisited in each session, the activity format in all cases was identical and consisted of: a quick topic review, a simulation by the students of the correctly operating circuit, an attempt by the students to predict the possible cause(s) of the faulty circuit behaviour and finally a check of the student’s own prediction(s) by a confirming simulation of the circuit with the predicted fault.

Although each student worked alone on a desktop computer, at the end of the second and fourth activities all the students’ results were communally discussed and with the aid of a data projector and a screen, representative simulation(s) was/were demonstrated to the class by the academic.

The data collection process utilised a three-layered interpretive model for media-rich research into social interaction that has been attributed to Wortham and Derry (2006). Their proposal is underpinned by the ‘event matrix’ and consists of: the ‘raw data layer’, the ‘observed events layer’ and the ‘analysis layer’. For this investigation, the verbal interaction that occurred during these revision classes (the ‘event matrix’) was recorded on a portable audio recorder (the ‘raw data layer’) by clipping a lapel-microphone to the academic. As shown in Figure 1, after each event the recording, with the aid of a voice-to-text conversion software, *Dragon Naturally Speaking* from *Nuance*, was transcribed into a “storyboard” with the subsequent addition of time stamps and the corresponding images from the slide shows (the ‘observed events layer’). Once completed, the storyboard for each session was analysed for any audible Kikan-Shido activities by correlating sections of the recorded events with the activity descriptors listed in Table 1 (the ‘analysis layer’). As recommended by Miles and Huberman (1994) the first few pages of each storyboard were coded on at least two occasions, several days apart. A comparison of the resultant coding for each session was used to confirm internal code-recode reliability, which was found to be above 95% in each case.

The storyboarding process, which was developed at the Walt Disney Studios in Hollywood, in the early 1930s, quickly became a widely used tool during the planning stages of both animated and live-action movies. The most recent adoption of storyboarding is for the outlining of websites and other interactive multimedia projects during their respective design phases. In this case storyboarding was used to affordably create an adequate paper-based record of live-action events, such as the on-going audible interaction between participants in a tutor led computer laboratory.

For this initial investigation the above described procedure was chosen rather than the more costly multi-camera recording technique and the ensuing specialist software-based data storing, sorting and analysing that was used by O’Keefe, Xu and Clarke (2006). Since the researcher was also conducting these sessions, the alternative of self-observations was dismissed on the grounds of impracticality and bias. Further, the use of an outside observer was also rejected since it is virtually impossible to subsequently scrutinise and verify the collected data with any degree of confidence (Polgar & Thomas, 1995). In general, observers often fail to notice activities that may have had a critical influence on the results. However, audio recordings of the sessions, that are then transcribed into storyboards result in
permanent records that permit the researcher, expert(s) and/or other interested parties “to repeatedly view the behavior (sic) of an individual or a group and then decide how to code it at a later, usually more … convenient time” (Fraenkel & Wallen, 2006).

Digitised recordings are replayed on one computer.

A transcription is created by dictation on another computer.

Figure 1: The process used to create the “storyboard”

The Results

Table 2 summarises the obtained results. Since, in this case, the desired research outcome was only to detect the possible presence of some elements of Kikan-Shido, this tabulation only shows if an activity was recognised during the analysis of the session storyboards. While the number of occurrences and/or the time period for each activity are certainly available from the data records, these have not been used for this study.

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Table 2: List of detected Kikan-Shido pedagogical elements on a per session basis.
Conclusion

It is apparent from the results of this qualitative research that most Kikan-Shido activities were clearly audible, hence deemed to be identifiably present in the observed problem-based revision tutorials at a tertiary institution. The fact that students are exposed to elements of Bloom’s Taxonomy during both mathematical exercises (Covington & Tiballi, 1982) and the troubleshooting exercises (Banky & Wong, 2007), the latter forming an integral part of this research, leads one to the logical expectation that elements of Kikan-Shido should be detectable whenever students are participating in these types of academic pursuits.

The importance of having this form of pedagogy, at tertiary and post-tertiary learning and teaching institutions, has been recognised by a variety of researchers. Since Kikan-Shido, which supports one-to-one tutoring, inherently facilitates close interaction and collaboration, it is very likely to be a technique that encourages deep learning by the students (Gibbs, 1992; Palloff & Pratt, 2005). Further, both Biggs (1999) and Laurillard (2002) have confirmed that while collaborative activities do lead to deeper understanding they also necessitate more active student involvement in the learning process (Centra, 1993). All such outcomes are exceptionally desirable tertiary learning goals.

It is highly recommended that in addition to expanding the search for Kikan-Shido within a much larger number of subjects and activities in our tertiary institutions, the analysis of the percentage of the total time spent doing each “activity code” and the resultant “activity patterns” are investigated for their suitability as “teaching signatures” with their ultimate use as a possible indicator of teaching quality within and/or between institutions.

Before progressing too far, the storyboard data recording “tool” (described earlier in this paper) must be validated against the more conventional multi-camera video alternative (used by O’Keefe et al. (2006)), in order to establish the suitability of the former in lieu of the latter for documenting audible participant-interactions in a learning environment.

Finally, in any meaningful expansion of this study the issue of intra- and intercoder reliability must be addressed, with the ultimate aim of ensuring that it stays consistently greater than 90%. Additionally, extra care must be taken not to exacerbate the bias that is easily introduced when the research data is multimedia recorded and the investigation is focused on the “meanings (emics) rather than the structural features of social interaction (etics)” (Wortham & Derry, 2006).

References


Banky, G.P., Looking for Kikan-Shido: Are elements of it detectable in tertiary engineering pedagogy?


