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

George P Banky
Swinburne University of Technology, Melbourne, Australia
Email: gbanky@swin.edu.au

***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.

Monitoring	M1	**Selecting Work** Students are chosen to share their work, methods or thinking with the whole class. This may occur immediately or later in the lesson.
Monitoring	M2	**Monitoring Progress** Teacher walks around the classroom observing student progress of on-task activity.
Monitoring	M3	**Questioning Student** An expression of inquiry that invites or calls for a reply from a student that may or may not be related to the current on-task activity.
Monitoring	M4	**Monitoring Homework Completion** While students are engaged in on-task activity, the teacher observes the completion of homework and may note student achievement or understanding of subject matter.
Guiding	G1	**Encouraging Student** Activity pursued by the teacher intended to motivate, provide support and feedback to individuals or groups of students.
Guiding	G2	**Giving Instruction / Advice at Desk** Teacher scaffolds the development of students' understanding by providing information, instruction or advice, focusing on the development of a concept that addresses meaning, reasoning, relationships and connections among ideas or representations, or the demonstration of a procedure.
Guiding	G3	**Guiding Through Questioning** A series of specific teacher questions intended to scaffold the development of student understanding of a procedure or concept during the on-task activity.
Guiding	G4	**Re-directing Student** Activities pursued by the teacher to regulate the behaviour of student(s) who are perceived not to be paying attention to the current activity, and to support students' on-going engagement during the lesson.
Guiding	G5	**Answering a Question** Information given by the teacher when requested by a student.
Guiding	G6	**Giving Advice at Board** Instruction or advice given while an individual or group of students work at the board. The instruction or advice may be intended for those students working at the board or may be intended for the whole class.
Guiding	G7	**Guiding Whole Class** Teacher walks around the classroom and provides information, instruction or advice intended for the whole class.
Organisational	O1	**Handout Materials** Teacher walks around the classroom distributing materials related to on-task activity.
Organisational	O2	**Collect Materials** Teacher walks around the classroom and collects materials from students.
Organisational	O3	**Arranging Room** Teacher repositions furniture to enable independent, paired, group or board work.
Social	S1	**School Related** Teacher engages in conversation related to school activities or curriculum.
Social	S2	**Non-School Related** Teacher engages in conversations of a social nature not related to the subject matter or on-task activity.

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

Teaching and learning details

The subject *HET210 – Electronics* 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 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).

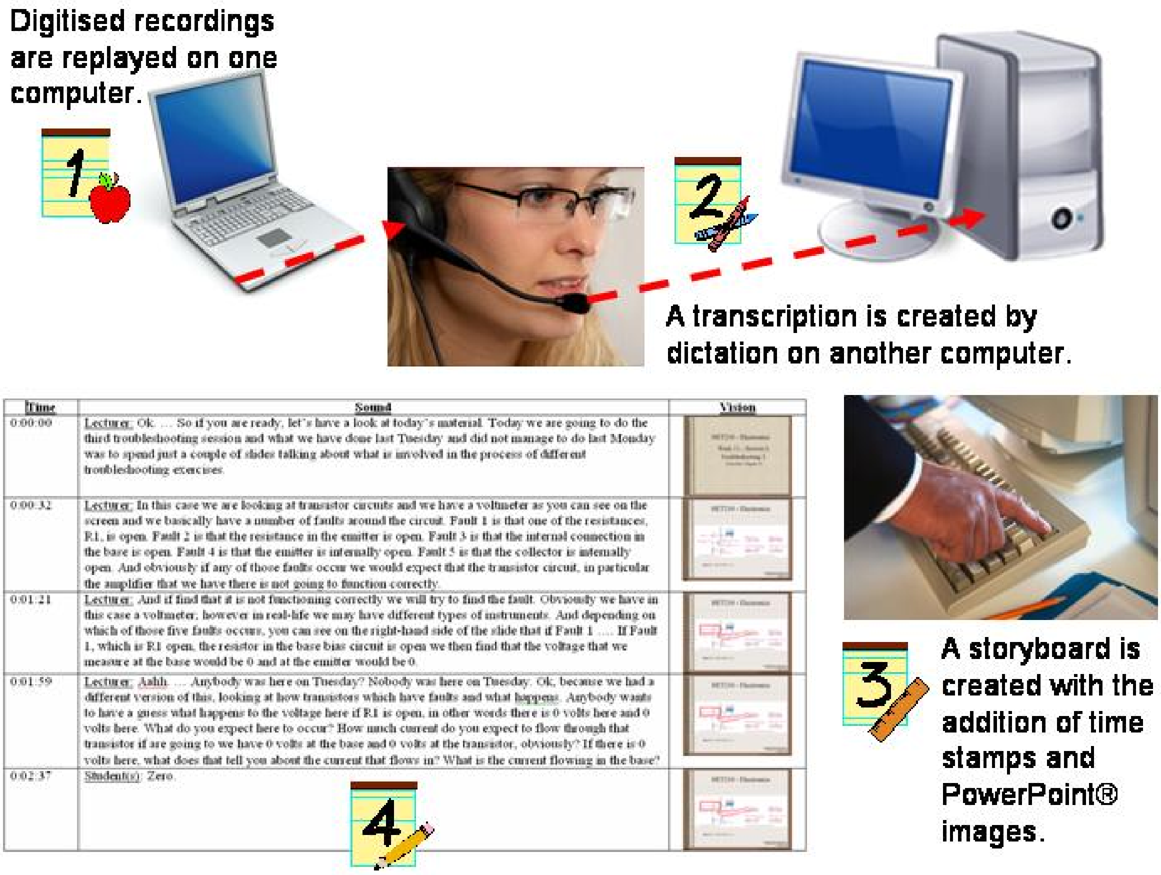

Figure 1: The process used to create the "storyboard"

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.

Session	M 1	M 2	M 3	M 4	G 1	G 2	G 3	G 4	G 5	G 6	G 7	O 1	O 2	O 3	S 1	S 2
#1		√	√		√	√	√	√	√		√	√	√		√	
#2	√	√	√		√	√	√		√	√	√	√		√	√	
#3		√	√		√	√	√		√		√	√		√	√	
#4	√	√	√		√	√	√		√	√	√	√			√	

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., & Wong, K. K. (2007, September 2 - 7, 2007). *Troubleshooting Exercises Using Circuit Simulator Software: Support for Deep Learning in the Study of Electronic Circuits.* Paper presented at the International Conference on Engineering Education, Coimbra, Portugal.

Biggs, J. B. (1999). *What the student does: Teaching for Quality Learning at University*. Buckingham: SRHE and Open University Press.

Centra, J. A. (1993). *Reflective Faculty Evaluation: Enhancing Teaching and Determining Faculty Effectiveness*. San Francisco: Jossey-Bass Publishers.

Clarke, D. J. (2004, April 12-16, 2004). Kikan-Shido - Between Desks Instruction. *Annual Meeting of the American Mathematical Research Association*, from http://extranet.edfac.unimelb.edu.au/DSME/lps/assets/Clarke_Kikan-shido.pdf

Covington, H. C., & Tiballi, T. (1982, April 3, 1982). *Using Bloom's Taxonomy for Precision Planning and Creative Teaching in the Developmental Math Classroom.* Paper presented at the Western College Reading Association Convention, San Diego, CA.

Fraenkel, J., & Wallen, N. (2006). *How to Design and Evaluate Research in Education* (6th. ed.). New York: McGraw-Hill.

Gibbs, G. (1992). *Improving the Quality of Student Learning*. Bristol: Technical and Educational Services Ltd.

Gonzales, P., Calsyn, C., Jocelyn, L., Mak, K., Kastberg, D., Arafeh, S., et al. (2000). Trends in International Mathematics and Science Study (TIMSS). Retrieved 11th June, 2007, from http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2001027

Hiebert, J., Gallimore, R., Garnier, H. E., Givvin, K. B., Hollingsworth, H., Jacobs, J., et al. (2003). *Teaching Mathematics in Seven Countries: Results from the TIMSS 1999 Video Study (NCES 2003-013 Revised).* Washington, DC: U.S. Department of Education, National Center for Education Statistics.

Laurillard, D. (2002). *Rethinking University Teaching - a conversational framework for the effective use of learning technology* (2nd ed.). London: RoutledgeFalmer.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: an expanded sourcebook*. Thousand Oaks, Ca: SAGE Publications, Inc.

O'Keefe, K., Xu, L. H., & Clarke, D. J. (2006). Chapter Four: Kikan-Shido: Between Desks Instruction. In D. J. Clarke, J. Emanuellson, E. Jablonka & I. A. C. Mok (Eds.), *Making Connections: Comparing Mathematics Classrooms Around the World*. Rotterdam, The Netherlands: Sense Publishers.

Palloff, R. M., & Pratt, K. (2005). *Collaborating Online: Learning Together in Community*. San Francisco, CA: Jossey-Bass.

Polgar, S., & Thomas, S. A. (1995). *Introduction to Research in the Health Sciences* (3rd ed.). South Melbourne: Churchill Livingstone.

Stigler, J. W., & Hiebert, J. (1999). *The Teaching Gap*. New York, N.Y.: Free Press.

Wortham, D. W., & Derry, S. J. (2006, June 27 - July 01, 2006). *Ways of Working: A Three-tiered Interpretive Model for Video Research.* Paper presented at the 7th International Conference on Learning Sciences Bloomington, In.