

## CHANGES IN ENDORSEMENT OF AN INTEGRATED LEARNING SYSTEM OVER A PERIOD OF THREE YEARS

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*This paper extends previously reported research on the long-term use of an integrated learning system (SuccessMaker) that delivers mathematics activities randomly in the form of electronic worksheets and progresses students through various levels as success improves. Quantitative and qualitative changes were noted in the schools' endorsement of the ILS over a period of 3 years. However, most schools still endorsing the ILS in 2000 had predominantly transmission/absorption models of teaching and learning.*

An Integrated Learning System (ILS) is basically a collection of tasks, presented as electronic worksheets, divided into a range of *topics* (e.g., numeration, multiplication, fractions). The manufacturers of Integrated Learning Systems endorse their products as tools to “develop and maintain mathematical skills, and to develop problem-solving skills” (Computer Curriculum Corporation, 1996, p.1) and as tools to diagnose student difficulties. In order to achieve these goals, the ILS in this study (*SuccessMaker*) presents “a mix of dynamically distributed exercises appropriate to a student’s functional level, providing feedback and tutorial intervention when necessary and representing mathematical concepts through highly visual exercises” (Computer Curriculum Corporation, 1996, p.1). It delivers courses to each student individually, manages all student enrolment and performance data, and designates which tasks have to be completed. Its management system provides the means for teachers, laboratory managers, and administrators to organise the use of courses and to monitor student progress.

*SuccessMaker* is a closed system where curriculum content and learning sequences are not designed to be changed or added to by either the tutor or the learner (Underwood, Cavendish, Dowling, Fogelman, & Lawson, 1996). Each of the topics is sub-divided into collections of tasks that are sequenced in terms of performance at different *levels*. When students achieve high mastery at one level, the ILS automatically raises them to the next level. The random nature of the presentation ensures that task performance correctly represents level. The worksheets vary in quality, but many are generally attractive in their presentation and creative in the way they probe understanding, particularly with the use of 2-D representations of appropriate teaching materials in mathematics (e.g., Multi-base Arithmetic Blocks, Place Value Charts, fraction and decimal diagrams). *SuccessMaker* provides online student resources: *Help* (provides answers), *Tutorial* (directs how to do a task), *Toolbox* (calculators, rulers, tape measures, etc.), *Reference* (provides definitions), and *Audio* (reads text to students through earphones). The worksheets can be printed to provide off-computer activity.

The random nature of the worksheet presentation means that *SuccessMaker* does not provide sequences of activities that can address student misconceptions. There is also a tendency for questions to be closed and to base performance on speed (with time delays

resulting in the ILS defaulting to incorrect). The use of the Help and Tutorial icons automatically grades performance as incorrect. Because of their focus on rising through the levels as rapidly as possible, many students in this study tended to avoid using these aids.

The very nature of an ILS marginalises the teacher's role and removes students' initiative and autonomy (Bottino & Furinghetti, 1996). Furthermore, the one-student-at-a-time structure of the ILS discourages cooperative learning by groups of students. This is contrary to current views that learning with computers should be cooperative (Sivin-Kachala, Bialo, & Langford, 1997), particularly with respect to higher cognitive functioning (Carnine, 1993; Riel, 1994), investigations and the construction of links (Wiburg, 1995). There also appears to be insufficient task variety in *SuccessMaker* to prevent repetition; thus many students in this study tended to become bored. Some tasks have novel presentation and solution formats which many students found difficult to interpret. However, *SuccessMaker* does provide feedback to students on the correctness of their responses (desirable for effective learning according to Sivin-Kachala et al.).

**Learning and *SuccessMaker*.** In a re-analysis of studies into the effectiveness of *SuccessMaker*, Becker (1992) found very little evidence of this ILS improving student learning. He argued that the only significant improvements were found in studies supported by the manufacturers and that these had flaws. A more recent study by Underwood et al. (1996) found some statistically significant improvements from the use of the core mathematics course in primary and secondary classrooms, although the sample sizes from the primary classrooms were too low to meet Becker's criteria for significance.

In a study comparing *SuccessMaker* progress in 23 schools across 6 months with changes in mathematics knowledge as measured by a standardised test, McRobbie, Baturu and Cooper (2000) found no significant improvement as measured by the test even though the ILS reported significant gains. This finding was supported by case studies of students' progress where data from interviews indicated that children with rapid ILS improvement had acquired little mathematical knowledge. As Baturu, Cooper and McRobbie (1999) argued, the worksheet nature of the ILS makes it susceptible to the same pedagogical flaws as were found by Erlwanger (1975) in the Individually Prescribed Instructional (IPI) packages that proliferated in the US in the 70s. Nevertheless, *SuccessMaker* was reasonably popular in many schools in Queensland, Australia. Therefore, Baturu, Cooper, Kidman and McRobbie (2000) explored the factors that appear to influence teachers' endorsement of the ILS. This study found that *SuccessMaker* was endorsed in cases where there was strong supervision, follow-up of students' difficulties, integration with other teaching, external rewards and some novelty with respect to computers. The chance for endorsement appeared to diminish if teachers did not support it philosophically, if rosters were inflexible and if more exciting computer options were available. All of the teachers who endorsed *SuccessMaker* did so because they believed it had contributed to improved levels of mathematical and affective performance in their classrooms.

This paper reports on a follow up study to the Baturu et al. (2000) study in which we investigated:

1. whether the schools' levels of endorsement had changed over a period of three years; and
2. issues which influenced the schools' patterns of endorsement and use.

### **Method**

Data for this study came from two sources. The first set of data was from interviews conducted with administrators, computer coordinators, teachers, teacher aides and technical staff from the 23 low socioeconomic schools involved in the first year of the project (1997). These interviews focused on (1) logistics, management and use of the ILS, (2) teachers' beliefs about teaching and learning and the ILS's role in teaching and learning, (3) perceptions of students' likes, dislikes and preferences with respect to the ILS, and (4) the schools' levels of endorsement of the ILS (see Baturo et al., 2000). The second set of data came from a questionnaire that focused on the logistics, management, use and long term endorsement of the ILS. The questionnaire was sent in 2000 to each of the schools involved in the study; 9 primary and 8 secondary schools responded (1 school had closed and 5 schools did not respond to the questionnaire). In order to clarify their responses to the questionnaire, follow-up telephone interviews were conducted with some of the teachers at five of the schools.

Eleven of the 17 schools that responded had over 20 percent students from indigenous backgrounds. Within Australia, it has been noted that many students from indigenous backgrounds tend to experience significant difficulties in learning mathematics taught in schools (Zevenbergen, Atweh, Kanen, & Cooper, 1996). According to Kepert (1993), many indigenous students have cultural backgrounds that will not immediately allow them to access the mathematics taught in schools. This viewpoint has been supported by Frensh, Frensh, Matthews, Stephen, & Howard (1994) who claimed that too often mathematics is taught in ways that do not take into account the various learning styles of indigenous students.

The data from the interviews and the questionnaires were first tabulated in order to ascertain changes in levels of endorsement of *SuccessMaker*. Each school was classified in one of three categories: Full Endorsement, Partial Endorsement and Non Endorsement. If a school unconditionally endorsed *SuccessMaker*, it was classified in the Full Endorsement category. However, if its endorsement of *SuccessMaker* came with some reservations or conditions, then it was classified in the Partial Endorsement category. Those schools who did not endorse *SuccessMaker* were classified in the Non Endorsement category. After changes in levels of endorsement had been ascertained, the data were further analysed in order to identify factors that had impacted on the levels and the quality of the schools' endorsement of *SuccessMaker*.

### **Results**

During the three-year period in which *SuccessMaker* operated within the schools, levels of endorsement for the ILS decreased. Of the 6 schools that originally fully endorsed *SuccessMaker* in 1997, only 3 were fully endorsing it in 2000, 2 were only partially

endorsing it, whilst 1 of the schools no longer endorsed it. With respect to Partial Endorsement, of the 7 schools in this category in 1997, 2 had withdrawn their endorsement by 2000. The four schools who had not endorsed it in 1998 had not upgraded their level of endorsement.

Table 1

*Levels of endorsement for SuccessMaker (1997 and 2000)*

Initial (1997)	Endorsement		
	Final (2000)		
	<i>Full</i>	<i>Partial</i>	<i>None</i>
<i>Full</i>	3	2	1
<i>Partial</i>	0	5	2
<i>None</i>	0	0	4

The changes to the levels of endorsement were based on both pedagogical and logistical factors. For example, the school that changed from Full to Non Endorsement offered the following reasons: (1) extremely negative feedback about *SuccessMaker* from the students, (2) a realisation on the teachers' part that *SuccessMaker* was not an effective learning tool, and (3) the logistical problem of fitting sessions with *SuccessMaker* into the timetable. The two schools which changed from Partial to Non Endorsement indicated that their reasons for reducing their level of endorsement for *SuccessMaker* as being: (1) the transfer of the teacher who originally implemented *SuccessMaker* from the school; and (2) the feelings of other staff within the school that *SuccessMaker* was not an effective learning tool. The logistical problems of training staff, how to access reports and worksheets from *SuccessMaker*, and of timetabling the three regular 15 minute sessions per week (as recommended by the publishers of *SuccessMaker*) in the computer laboratories together with perceptions about the limited educational value of *SuccessMaker* were the reasons offered by the two schools that changed from Full to Partial Endorsement.

An analysis of the data revealed that all 10 schools which either partially or fully endorsed the use of *SuccessMaker* in 2000 made extensive use of external rewards to keep the students engaged on task. Data from the interview and follow-up telephone interviews seemed to indicate that the use of external rewards played a very important role in maintaining student activity on *SuccessMaker*. In contrast to this, the 7 schools who did not endorse *SuccessMaker* did not utilise external rewards.

When the data was subjected to more detailed analysis, it was noted that the reservations or conditions that underlay Partial Endorsement of *SuccessMaker* had undergone important qualitative changes during the three years. In 1997, partial endorsement was primarily based on price and logistical issues (such as timetabling computer time). By 2000, Partial Endorsement no longer was primarily based on these issues. Instead, it was based more on educational issues such as:

1. the limited roles *SuccessMaker* could play in a school's mathematic education curriculum program,
2. the limited set of clientele for which *SuccessMaker* activities were deemed appropriate, and
3. the need for supervision.

### **Limited roles for *Successmaker* in mathematics Curriculum program**

All of the schools that partially endorsed the use of *SuccessMaker* in 2000 clearly indicated that they did not perceive that it had general application across the whole mathematics curriculum program. This sentiment about *SuccessMaker* was probably best encapsulated by the comment from one of the high schools, namely, that *SuccessMaker* "can be a valuable component of a learning program".

These schools identified specific niches or roles for *SuccessMaker* within their mathematics curriculum program. For example, most of these schools felt that *SuccessMaker* provided good reinforcement learning activities and was excellent for "drilling the basics in...getting kids ready for high school". Some of the schools also felt that *SuccessMaker* provided effective individualised sets of learning activities for remedial mathematics students.

One of the primary school teachers indicated that she felt that *SuccessMaker* provided worthwhile learning activities in a few specific problematic topics such as division. She thus endorsed the use of the ILS for assisting in the teaching of these specific topics. She, however, felt that its learning activities in many topics were not pedagogically sound so she did not endorse the use of *SuccessMaker* in these latter topics.

### **Limited set of clientele**

The teachers from the schools partially endorsing *SuccessMaker* firmly believed that it is only suited for targeted groups of students such as those in need of remediation and/or those students "who have literacy and numeracy deficits". They were very negative about its suitability for use with the general student population. This notion that *SuccessMaker* should only be used for remediation and learning deficit students probably is best epitomised by a teacher from one of these schools. When she was asked during a follow-up telephone interview during 2000 whether she would endorse *SuccessMaker* for use with her own son, she quite unequivocally stated "no" because she felt that her son was a good learner and thus did not need *SuccessMaker*. However, she was most happy to endorse it, in her classroom, for those students who had learning difficulties.

### **Need for supervision**

All of the 7 schools that partially endorsed the use of *SuccessMaker* in 2000 strongly emphasised the need for supervision. As one of the high schools noted, *SuccessMaker* could be a very effective learning tool:

*providing they (the teachers) are careful about how they use it. It is not to be used as a child minding device.*

An analysis of these 7 schools' responses to the questionnaire revealed that they perceived that three types of supervision were needed in order for *SuccessMaker* to operate effectively:

1. supervision of the operation of *SuccessMaker* system
2. supervision of the students' behaviour whilst interacting with *SuccessMaker*
3. supervision of the mathematical learning.

#### *Supervision of the operation of SuccessMaker*

All of these 7 schools had experienced on many occasions problems with the operation of *SuccessMaker*. For example, the ILS had a history of crashing, especially if some of the graphic capabilities of *SuccessMaker* were being used. Other types of operational problems that occurred included difficulties in extracting students' scores and in extracting hard copies of worksheets. Thus, as one school said, students could not be left to work on *SuccessMaker* without someone (a teacher or a teacher aide) being there "to drive the wheels".

#### *Supervision of student behaviour*

Although each of the 7 schools partially endorsing *SuccessMaker* in 2000 indicated that a teacher and/or a teacher aide was necessary in order to ensure that the ILS was functioning properly, their major reason for stressing the need for supervision of the ILS sessions by a teacher or a teacher's aide was to ensure that the students stayed focused on the task. As one of the primary schools stated:

*the program needs human resource to supervise students to see they are on task and not just random selection.*

#### *Supervision of mathematical learning*

Most of the schools partially endorsing *SuccessMaker* expressed skepticism about its publisher's claims that it provided necessary interventions when students were experiencing difficulties with the topics being covered. These schools indicated that they had found it necessary to act upon reports of problems immediately they were identified either by *SuccessMaker's* assessment mechanisms or by the teacher/teacher's aide. Their actions generally took the form of small group tutorials away from the computer where, if necessary, recourse was made to concrete teaching materials.

One teacher in fact created a very systematised mechanism for this process. She got each child to record his or her score on assessment tasks and to print out the worksheets they were having difficulty in completing. She used this information to plan specific mathematics lessons in order to meet the needs of these students. She thus effectively integrated *SuccessMaker* mathematical activities into her other mathematical learning activities.

## Discussion and conclusions

Over a period of three years, both quantitative and qualitative changes have been made to the schools' endorsement of *SuccessMaker*. In 1997, 13 out of the 17 schools fully or partially endorsed *SuccessMaker*. By 2000, this number had fallen to 10 schools. However, the most important changes educationally were the qualitative changes that had occurred to the nature of partial endorsement. Whereas in 1997, the reservations/conditions that underlay Partial Endorsement were primarily based on price or logistical issues, by 2000 the reservation/conditions were primarily based on educational issues such as *SuccessMaker's* curriculum limitations, the limited clientele for which *SuccessMaker* is appropriate, and the need for supervision.

However, it should be noted that the educational philosophy underlying the practices employed in those schools partially endorsing *SuccessMaker* in 2000 seemed to have been based on a deficit model of education. This is reflected in the schools' comments about *how* and *with whom* they believed that *SuccessMaker* could be successfully utilised. It is also reflected in the extensive use of external rewards utilised in these schools to keep students on task whilst using the ILS. The deficit model of education assumes that underachieving students lack essential skills or orientations which allegedly hinder their academic achievement and that the major task of education for these types of students is to "fill-in" these deficits. In recent years, serious doubts have been expressed about the limitations of the deficit model. Liedke (1995), Gonzales (1993) and Hamovitch (1994), for example, have found that educational interventions based on the deficit model are not successful because they are often insensitive to the societal and cultural backgrounds of many underachieving students (particularly those from indigenous backgrounds). Because of this, many educators are arguing for educational curriculum and teaching methods that promote and build on students' existing repertoires of knowledge and incorporate their home cultures and history. Thus, it could be argued that the use of *SuccessMaker* to overcome the deficits of underachieving students may not in the end result in significant, long term educational gains by students at these schools.

It also should be noted that the schools who still endorsed *SuccessMaker* in 2000 had instrumentalist viewpoints about the nature and discourse of mathematics. That is, they viewed mathematics as a static corpus of isolated facts, rules and procedures which students needed to learn. Because *SuccessMaker's* random presentation of mathematical content, its structuring of mathematics closely matched that of the teachers in these schools.

Therefore, although there seemed to be a movement towards a focus on student learning amongst the teachers in the schools who partially endorsed *SuccessMaker* in 2000, methods of teaching and ways of utilising the ILS still were very transmission/absorption in nature (just as they were in 1997). Their methods of teaching mathematics were not being modified to focus on collaborative, socioconstructivist principles such as those being promoted by most current mathematics education curricula and reform documents.

## References

- Baturo, A. R., Cooper, T. J., Kidman, G., & McRobbie, C. J. (2000). Factors influencing teachers' endorsement of the core mathematics course of an integrated learning system. In T. Nakahara & M. Koyama (Eds.), *Proceedings of the 24th conference of the International Group for the Psychology of Mathematics Education* (Vol. 2, pp. 65-72). Hiroshima, Japan: PME.
- Baturo, A.R., Cooper, T.J., & McRobbie, C.J. (1999). Karen and Benny: Déjà vu in research. *International Group for the Psychology of Mathematics Education*, 23(2), 73-80.
- Becker, H. J. (1992). Computer-based integrated learning systems in the elementary and middle grades: A critical review and synthesis of evaluation reports. *Journal of Educational Computing Research*, 8(1), 1-41.
- Bottino, R. M., & Furinghetti, F. (1996). Teachers' behaviours in teaching with computers. *International Group for the Psychology of Mathematics Education*, 20(2), 129-136.
- Carnine, D.W. (1993). Effective teaching for higher cognitive functioning. *Educational Technology*, 33(10), 29-33.
- Computer Curriculum Corporation. (1996). *Getting started with SuccessMaker*. Sunnyvale, CAL: Computer Curriculum Corporation.
- Erlwanger, S. H. (1975). Case studies of children's conceptions of mathematics. *Journal of Children's Mathematical Behaviour*, 1(3), 157-283.
- Frensh, D., Frensh, T., Matthews, S., Stephen, V., & Howard, P. (1994). Issues related to the learning of mathematics by Indigenous people. *Square one*, 4(2), 10-17.
- Gonzales, R. D. (1993, November). *National Standards and culturally/linguistically diverse students: A question of equity*. Paper presented at the Annual Meeting of the National council of teachers of English, Pittsburgh, PA.
- Hamovitch, B. A. (1994, April). *The State as equalizer: Who is helping whom?* Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, LA.
- Leidke, W. W. (1995). Changing the focus of intervention settings for mathematics. *British Columbia Journal of Special Education*, 19(1), 28-34.
- McRobbie, C., Baturo, A., & Cooper, T. (2000). Low achieving mathematics students' attitudinal and achievement changes as a result of using an integrated learning system. In J. Bana & A. Chapman (Eds.), *Mathematics education beyond 2000* (Proceedings of the 23rd annual conference of the Mathematics Education Research Group of Australasia, Vol. 2, pp. 424-431). Fremantle, WA: MERGA.
- Riel, M. (1994). Educational change in a technology-rich environment. *Journal of Research on Computing in Education*, 26(4), 452-473.
- Sivin-Kachala, J., Bialo, E.R., & Langford, J. (1997). *Report on the effectiveness of technology in schools: 1990-1997*. Washington, DC: Software Publishers Association.
- Underwood, J., Cavendish, S., Dowling, S., Fogelman, K., & Lawson, T. (1996). Are integrated learning systems effective learning support tools? *Computers in Education*, 26(1), 33-40.
- Wiburg, K. (1995). Becoming critical users of multimedia. *The Computing Teacher*, 22(7), 59-61.
- Zevenbergen, R., Atweh, B., Kanes, C., & Cooper, T. (1996). Social and cultural contexts in mathematics education. In P. Sullivan, K. Owens, & B. Atweh (Eds.) *Research in mathematics Education in Australasia 1992-1995* (pp. 11-40). Campbelltown: Mathematics Education Research Group of Australasia.