Integrated Information Skills Instruction: Does It Make a Difference?

SLMQ Volume 23, Number 2, Winter 1995

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Once again, this column asks whether there is research support for our efforts in a fundamental area of our profession. In the Summer 1994 column, Robert B. Kozma asked whether and how instructional media can influence learning; in this issue, Ross J. Todd asks whether integrated information skills instruction can have an effect on students' learning and on their attitudes toward school. By nudging us to examine our basic assumptions, both authors challenge us to deepen our understanding of major issues in our field and to use that knowledge to shape our future efforts.

Todd has conducted several studies of the effect of integrated information skills instruction on Australian high school students, and the work reported here is part of his ongoing research agenda in this area. Not surprisingly, he reports that such instruction has a positive impact on students' mastery both of subject-matter content and of information-seeking skills; even more intriguing are his insights into the details related to these results. Todd's studies lay the foundation for a basic argument that integrated information skills instruction should be provided for all students and that policies, strategic plans, and staffing arrangements must be developed to ensure the school library media specialist's leading role in this effort.

In the context of an emerging global information society, information literacy is increasingly presented as a key challenge to educators and to educational authorities. School library media specialists worldwide have responded energetically to this challenge. Today school library media programs are increasingly based on the assumptions that information skills instruction is a valuable and essential part of the school's educational program; that these skills emphasize general information problem solving and research processes rather than just skills of location and access to library resources; that these skills should be taught within the context of the school's curriculum; and that the teaching of these skills can be enhanced by the use of innovative instructional methods.(1)

This report documents ongoing research in Sydney, Australia, into the impact of information literacy programs on student learning. In this research, information literacy is defined as the ability to use information purposefully and effectively. Kirk, Poston-Anderson, and Yerbury present it as a holistic, interactive ability encompassing skills in six areas:

1. defining the tasks for which information is needed;
2. locating appropriate sources of information to meet needs;

3. selecting and recording relevant information from sources;
4. understanding and appreciating information from several sources and being able to combine and organize it effectively for best application;
5. presenting the information learned in an appropriate way; and
6. evaluating the outcomes in terms of task requirements and increases in knowledge.

In essence, information literacy is demonstrated when competence with this range of information skills is demonstrated.(2)

At present, understanding of the impact of integrated information skills instruction on student learning is largely based on intuitive recognition and anecdotal reporting rather than on systematic investigation. Some limited findings, however, provided the framework for structuring the research documented here. In a qualitative exploratory study undertaken with students in Year Nine at Marist Sisters' College, Sydney, in 1992, Sivanesarajah, McNicholas, and Todd(3) identified some trends that indicate that integrated information skills can add a positive dimension to learning.

For this work, a group of low achievers approximately fourteen years old undertook a science program based on an integrated information skills approach. Improved mastery of content was evident in the midyear and across-the-year exams, with 95 percent of the class scoring above 50 percent. As part of the same study, Todd, Lamb, and McNicholas collected data from the 1992 Year-Seven and Year-Eleven students (i.e., students aged eleven to twelve and sixteen, respectively) and found further evidence to suggest that an integrated information skills approach to teaching and learning can have a positive impact on learning outcomes: improved test scores, improved recall, increased concentration and focus on the task, and improved reflective thinking were identified as trends.(4)

In terms of the relationships of information skills and attitudes to other attitudes and abilities of students, the work reported here drew on the research of Hardesty and Wright,(5) Kuhlthau,(6) and Todd, Lamb, and McNicholas,(7) which found that the variables self-perception, self-esteem, control of learning, mastery of content, focus on tasks, and reduced confusion and frustration seem to be linked to information skills instruction.

Methodology

At a general level, this study sought to determine the impact of an information skills program integrated into a particular curriculum on learning and on student attitudes. It specifically tested the assumption that information skills instruction, integrated into the science curriculum for students in Year Seven (the first year of secondary school), contributes to student achievement in a specific subject area as well as to overall student attitudes and motivation. Instruction was defined as a formal process of implementing specific teaching-learning strategies and conditions in a classroom to foster the acquisition of competence. The following specific questions formed the focus of the research:

- Is there a difference between a conventional content approach and an integrated content-an information skills approach to Year Seven science education in terms of levels of mastery of science content and of information-handling skills?
- Is there an interaction among level of ability, exposure to information skills instruction, and mastery of science content and skills?
- Is there an impact of the integrated content-information skills approach on attitudes to schooling?

The participants in the study were Year-Seven students from Marist Sisters' College, a nongovernment, mixed-ability high school in Sydney that enrolls 750 girls in Years Seven through Twelve. The majority of students are Catholic; the school population is multicultural, with 55 percent of the students coming from homes in which English is not the first language.

A posttest-only comparison group experimental design was used to measure the effect of the "method of instruction" variable on two groups of randomly assigned students: two science classes of twenty each in the treatment group and two classes of twenty each in the control group. Three Year-Seven science teachers were assigned to the study classes, one to both treatment groups and one to each of the control groups. Each teacher had at least five years of science teaching experience and was judged by the school executive to be an effective teacher. The treatment group teacher was also an experienced information skills teacher. Instruction took place over three terms, commencing midway through term one and ending in the middle of term four.

The two classes in the treatment group received science instruction using teaching-learning strategies that included instruction in the steps and skills of the information-seeking process. The program was based on Information Skills in the School,(8) a document that presents a practical framework based on a conceptualization of the information process for the development of information skills across the curriculum in both primary and secondary schools in New South Wales. Learning activities were explicitly designed from this framework, and formal instruction in information skills was integrated into subject content and facilitated by cooperative teaching by the school's library media specialist and the science teacher with expertise in teaching information skills. During the study, the integrated information skills instruction program explicitly aimed at the development of information skills as a basis for the meaningful learning of science. The program placed emphasis on processes rather than sources and was built around the six stages of the information process-defining, locating, selecting, organizing, presenting, and assessing information-in order to provide students with a structured framework for making sense of the information surrounding them.

The two classes in the control group received the state-prescribed science content without any integration of information skills instruction. Teachers assigned to these classes had not participated in the development of curriculum programs involving cooperative program planning, and they taught independently rather than in collaboration with the school library media specialist.

Several measures were used to assess the impact of the method of instruction on learning. Students' mastery of science content and skills was measured by the annual science score, which

was based on marks of the midyear and end-of-year science exams. These tests were devised collectively by the science teachers and approved by the science coordinator in the school. Individual teachers were assigned sections of the exams to mark for the entire Year-Seven group to ensure consistency and equity in grading.

An extensive search of educational measurement manuals failed to identify any suitable test for assessing students' mastery of information skills: existing library skills tests did not encompass the range of skills embraced by the concept "information literacy." Accordingly, a simple information skills test was developed by the research team; students were then pretested to establish benchmarks of skills levels and posttested on variations of the test to measure the impact of information skills instruction. The measure centered on the following problem: "A teacher gives you homework. You are to hand in some information on 'rubric.' Write down all the steps you would take to finish your homework. Give as much detail as you can." A similar problem was presented at the end of the instructional period, this time using the term "gorse." These terms were not likely to be familiar to the students, who would thus have wide scope to respond without preconceptions of content and with freedom to explore and present optional strategies in their responses. Students had thirty minutes to write their responses, which were subjected to content analyses undertaken independently by the researcher and the school library media specialist. Students scored a point for each instance of written evidence of application of one of the six stages of the information skills process as documented in Information Skills in Schools. A high level of correlation between the two markers established inter-judge reliability for the instrument; disputed scores were jointly resolved.

The class groups were pretested to establish their academic ability levels to provide a basis for determining whether there was an interaction across level of academic ability, information skills instruction, and mastery of science content. The Australian Council of Educational Research (ACER) Intermediate Test F-a group test designed to assess the general reasoning ability of students between the ages of ten and fifteen years independent of specific learning in specific school subjects-was used for this purpose. The test has an alternative-forms reliability coefficient of .91 and an internal consistency coefficient of .96. Students' raw scores were transformed into a normalized grade score for Year-Seven students, using the specified table for conversion.(9)

Two standard attitudes tests were administered at the end of the research period to measure students' attitudes and perceptions about schooling. These tests were used to establish benchmarks and to identify trends that might be worthy of more detailed investigation during a later phase of the research, a longitudinal study that is currently under way. The forty-item ACER School Life Questionnaire assesses students' satisfaction, achievement, opportunity, identity, and perceptions of their teachers. It has a reliability coefficient of .93, with reliabilities for individual subscales ranging from .74 to .87 for different grade levels. The Comprehensive Assessment Program: School Attitude Measure (CAP:SAM), Level I/J, provides information on five attitudinal scales: motivation for schooling, academic self-concept (performance-based), academic self-concept (reference-based), sense of control over performance, and instructional mastery. Some changes in terminology were made to statements in this U.S. test to reflect Australian language patterns, but these changes did not alter the specific attitudes evaluated.(12)

Results and Discussion

Academic Ability

In the following statistical summaries, Class 1 and Class 2 designate the treatment group, while Class 3 and Class 4 designate the control group. At the outset of the teaching program, the groups did not show statistically significant variations in academic ability. Table 1 shows the mean scores and standard deviations for the academic ability measure for each class, based on the determination of normalized grades scores of the ACER Intermediate Test F. A one-way analysis of variance of this data indicated at a 95 percent confidence level that the classes did not have significantly different means for academic ability scores. A small number of high scores in Class 1 accounts for the higher average presented.

Table 1
Normalized Grade Scores: Academic Ability Mean Scores and Standard Deviations

	Class 1	**Class 2**	**Class 3**	**Class 4**
Academic ability	97.75	95.15	94.95	93.15
Standard deviation	12.89	11.58	11.15	10.20

ANOVA: df = 3, 76; F = 0.54; p = 0.654. Treatment group mean of 96.45, standard deviation of 12.17, control group mean of 94.05, standard deviation of 10.59.

Mastery of Science Content and Skills

Mastery of science content and skills was assessed through students' grades on the midyear and end-of-year science exams. The mean final scores for each of these classes, displayed in table 2, show no within-group differences but substantial differences between classes in the control and treatment groups. Both treatment classes recorded higher annual science scores than the control classes, approximately seven points of a possible one hundred. An analysis of variance of these mean scores showed that the differences between each of the classes of the treatment group (mean 71.35) and each of the classes of the control group (mean 62.2) are statistically significant.

Table 2
Final Science Scores: Mean Scores and Standard Deviations

	Class 1	**Class 2**	**Class 3**	**Class 4**
Science score	72.75	69.95	61.90	62.50
Standard deviation	14.39	11.90	11.23	12.17

ANOVA: df = 3, 76; F = 3.76; p = 0.014. Treatment group mean of 71.35, standard deviation of 13.11, control group mean of 62.2, standard deviation of 11.56.

It would thus appear that the “method of instruction” variable yielded a significant impact on students’ mastery of science content and skills. This finding raises the issue of equity in educational opportunity: if research evidence continues to demonstrate that integrated information skills instruction has a positive impact on students’ learning, then it might be argued that students not receiving such instruction are not being given equal educational opportunity.

It might be suggested that the personalities and teaching styles of the individual teachers could account for differences between groups. Because the treatment group classes were taught by the same experienced information skills teacher and the same library media specialist, it might be expected that the treatment classes would achieve similar scores. The scores of the treatment group classes appear to confirm this. The two control classes were taught by different teachers, however, and no controls were placed on their individual teaching styles. Nevertheless, there is only a small variation in the mean scores of the classes of the control group.

Entry Information Skills Scores

Table 3 shows the mean scores and standard deviations for the entry information skills scores. The analysis of variance of this data showed no significant difference at the 95 percent confidence level in the scores of the control and treatment groups.

Table 3
Entry Information Skills Scores: Mean Scores and Standard Deviations

	Class 1	**Class 2**	**Class 3**	**Class 4**
Information skills score (out of 6)	2.70	2.25	2.50	2.35
Standard deviation	1.53	1.33	1.19	1.69

ANOVA: df = 3, 76; F = 0.37; p = 0.778;. Treatment group mean of 2.48, standard deviation of 1.43, control group mean of 2.43, standard deviation of 1.45. Overall mean: 2.55 stages.

Identifications by students of the six stages of the information-seeking process formed the basis for a detailed analysis of their abilities in this area, and table 4 shows the distribution of the number of stages identified by the students at the beginning of the study. Table 5 displays the content analysis summary of the students’ identification of the specific stages.

Table 4
Entry Information Skills Scores: Percentage of Students Who Identified Stages

No. of Stages	**% of Students**
0	10
1	20

2	17.5
3	25
4	23.75
5	2.5
6	1.25

Table 5
Entry Information Skills Scores: Percentage Distribution of Identified Stages

Stages	**% of Students**
Defining	49
Locating	69
Selecting	36
Organizing	19
Presenting	40
Assessing	4

Locating and defining skills were identified by at least half the students, with smaller percentages identifying the selecting and presenting skills. In terms of “defining,” the most common feature in students’ responses was the specification of dictionaries as the preferred resource. In terms of “locating,” the students commonly identified the school library media center as the source of information and the use of catalogs and other finding aids as the primary strategies. Only a few students identified people as part of the process; in these cases, people were cited not as a potential source of information but as a means of confirming aspects of presentation, such as correct spelling of words. Only two students identified the library media specialist as a source of information. In terms of “selecting,” half the students who scored here mentioned writing ideas in their own words; the other half expressed selection as copying or photocopying information. In most cases, the focus with “presenting” information was on coloring photocopied pictures, decorating the page, writing neatly, establishing the width of margins, and choosing to present information in plastic sleeves.

Final Information Skills Scores

Given that the major feature of the treatment group was deliberate information skills instruction integrated with science content, one might expect to see a significant improvement in the information skills that students used in their information problem-solving activities. The findings, presented in table 6, confirm this. Both treatment classes showed an increase in the number of stages identified in the information problem-solving task given to them, with a mean score for the treatment group of 3.75 stages identified, representing an average increase of 1.2 stages. In contrast, the control group, with a mean of 2.7, showed only a very small improvement

over entry scores, on the order of .275 stages. This small increase might be attributed to random error or to information skills gained serendipitously in the information-searching process that accompanies many school-based assessment tasks. The analysis of variance of these data, however, shows significant differences between the classes of the treatment group and the classes of the control group, and these differences are significant at the 95 percent confidence level. The data thus clearly suggest that integrated information skills instruction has a positive impact on students' abilities to identify information-handling strategies to solve their information needs in a particular curriculum content area.

Table 6
Final Information Skills Scores: Mean Scores and Standard Deviations

	Class 1	**Class 2**	**Class 3**	**Class 4**
Information skills score (out of 6)	3.70	3.80	2.80	2.60
Standard deviation	1.30	1.51	1.11	1.19

ANOVA: df = 3, 76; F = 4.56; p = 0.005;. Treatment group mean of 3.75, standard deviation of 1.39, control group mean of 2.7, standard deviation of 1.14.

Table 7 shows the comparative number of stages of the information-seeking process identified at the end of the study by both the control and the treatment groups, and table 8 shows the percentages of students who identified each of the stages. The scores of the treatment group show both an increase in the number of stages identified and a greater level of identification of those stages that involve the higher-order skills of analysis, synthesis, and evaluation of information.

Table 7
Final Information Skills Scores: Percentage Distribution of Identified Stages

No. of Stages	**% of Students (control)**	**% of Students (treatment)**	**% of Students (total)**
0	0	0	0
1	15.9	0	7.9
2	29.5	22.7	26.2
3	31.9	22.7	27.3
4	15.9	25.0	20.4
5	4.5	15.9	10.3
6	2.3	13.7	7.9

Table 8
Entry Information Skills Scores: Percentage Distribution of Identified Stages

Stages	% of Students Identifying (control)	% of Students Identifying (control)	% of Students Identifying (control)
Defining	71	87	79
Locating	70	84	77
Selecting	29	61	45
Organizing	32	47	39.5
Presenting	19	64	41.5
Assessing	2	37	19.5

These findings raise the question of the correlation of information skills mastery with academic ability. Traditionally, educators have asserted that a positive correlation exists between standardized tests of general academic ability and assessment scores across a range of curriculum areas. This appears to be the case for the control group under consideration. There is a moderately strong correlation (.739) between academic ability and final science score for the control group. This is not the case for the treatment group: the Pearson correlation between the treatment group's academic ability score and final science score (.42) is considerably lower. This finding suggests that the program of instruction used during the study might be more effective for one level of academic ability than for another. Table 9 shows mean science scores by academic ability and group type, arranged as a 2 x 4 factorial design. The students in both groups were ranked into four levels (above average; average-upper; average-lower; and below average) on the basis of the academic ability scores derived from the ACER Intermediate Test F using the recommended range of scores for each group.

Table 9 also shows that the effect of information skills instruction did not remain constant across the levels of ability. For this reason, some degree of interaction may be said to exist between level of academic ability and information skills instruction. The two-way analysis indicated that there was not a statistically significant interaction among the four levels of academic ability and the two types of instruction (GROUP TYPE * ABILITY: $F = 1.4$; $p = 0.250$). An analysis of the differentials showed that the below-average students did not appear to make any improvement in their science scores through integrated information skills instruction. These findings are not consistent with the Sivanesarajah, McNicholas, and Todd qualitative study of lesser-ability students in Year-Nine science in the same school,(13) who made considerable improvement in their final science scores after a year of information skills instruction integrated into their science curriculum. One possible explanation is that, unlike the Year-Seven students, the students in the earlier study were not in a mixed-ability class and received instruction in information skills through strategies tailored specifically to their learning problems.

Table 9
Final Science Scores by Level of Academic Ability and Method of Instruction

Level of Ability (ACER F)	Information Skills	Conventional	Differential
Above average	84.5	69	15.50
Average-upper	75.13	65.67	9.46
Average-lower	71.42	59.5	11.92
Below average	62	62.55	0.55

Analysis of Attitudinal Data

The School Life Questionnaire summary statistics are presented in table 10. At a general level, given the positive scores in all categories, all the students in Year Seven seemed satisfied with their schooling, expressed a sense of confidence in their ability to be successful in their schoolwork, generally believed in the importance of schooling, related well together socially, and were satisfied about the adequacy of the interaction between teachers and students. In all categories except the social integration category, the treatment group had slightly higher mean scores than the control group. And while one cannot attribute those differences to information skills instruction on the basis of such limited data, it is important to note these benchmarks for understanding any patterns that might emerge during the longitudinal study of these students.

Table 10
School Life Questionnaire Mean Scores

My school is a place where. . .	T1	T2	C1	C2	T1+2	C1+2
General satisfaction items	2.45	2.47	2.49	2.32	2.46	2.41
Teachers items	2.95	2.94	3.07	2.79	2.95	2.93
Status items	2.51	2.59	2.54	2.48	2.55	2.51
Social integration items	2.82	2.99	3.18	2.99	2.91	2.87
Opportunity items	3.07	3.12	2.15	2.81	3.09	2.98
Achievement items	2.95	2.86	.95	2.79	2.91	2.87
Negative effect items	1.88	1.71	1.62	1.74	1.80	1.68

For example, the fact that the treatment group generally scored lower than the control group on the social integration items (although patterns are not consistent) suggests that the longitudinal study should pay particular attention to whether information skills instruction might have an

effect on the students' socialization process. Furthermore, a variation of the questionnaire tailored to a specific curriculum might shed further light on the impact of integrated information skills instruction. While several questionnaires are tailored to science instruction, these tend to focus on general attitudes toward science rather than on science instruction and science learning outcomes.

Table 11 presents a summary of the five categories of the second instrument used to assess student attitudes, the Comprehensive Assessment Program: School Attitude Measure. In terms of motivation for schooling, performance-based academic self-concept, and instructional mastery, the treatment group scored higher, although there are no significant differences between the groups overall. These findings seem consistent with the trends identified in the School Life Questionnaire. In terms of reference-based academic self-concept, in which students assessed how others view their school performance, the control group scored higher than the treatment group. The treatment group also scored less favorably in terms of their perceptions of their control over their learning. Thus, the impact of integrated information skills instruction on perceptions of control of learning and on students' development toward independent learning is important to watch during the longitudinal study.

Table 11
School Attitude Measure Mean Scores

	T1	**T2**	**C1**	**C2**	**T1+2**	**C1+2**
Motivation for schooling	2.63	2.73	2.64	2.47	2.68	2.56
Academic self-concept (performance-based)	2.49	2.52	2.59	2.41	2.59	2.50
Academic self concept (reference-based)	2.54	2.61	2.64	2.59	2.58	2.61
Sense of control over performance	1.85	1.91	1.86	2.01	1.88	1.84
Instructional mastery	2.65	2.78	2.76	2.59	2.72	2.68

Conclusions

Within the specific research context, and for the specific students involved, integrated information skills instruction appears to have had a significant positive impact on students' mastery of prescribed science content and on their ability to use a range of information skills to solve particular information problems. The study also points to the value of both a process approach and an integrated approach to information skills instruction. Given that research findings on the impact of integrated information skills instruction on secondary-school education are virtually nonexistent, and that available studies have tended to focus on the library skills of locating and selecting resources within the narrow context of the school library and often isolated from a specific curriculum context, there are real difficulties in making any generalizations

beyond the immediate research setting. Clearly, there is an urgent need to test the conclusions of the study in a range of school settings and to develop additional measures of students' ability to master and use a range of information skills to meet their needs. The findings of many studies of the impact of integrated skills instruction on aspects of teaching and learning are necessary to establish a knowledge base about information skills and to provide an empirical base for information practice in schools.

Acknowledgments

The author wishes to acknowledge the School of Information Studies in supporting this research through research funding; Leonie Clark, research assistant for the project; and Celeste McNicholas (teacher-librarian), Sr. Fidelis (principal), and Liz Lamb (assistant principal) for their vision for information literacy in the school and their support of all aspects of this research.

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