

# *The efficacy of self-paced learning based on print media*

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## **Abstract**

This paper discusses the results of a study conducted at Southbank Institute, Queensland, that examined the efficacy of using self-paced program delivery based on printed material as an alternative to a traditional classroom mode of delivery. A framework based on social cognitive theory was adopted to consider the results of learning achieved by two groups of students in a computer-aided drafting module of a vocational education and training (VET) program. Students from one of the groups undertook their learning using a self-paced mode of delivery based on printed material. Students from the other group experienced their learning in traditional classroom mode. A comparative evaluation of the two different approaches to the delivery of learning was conducted, based on the grades achieved by students and the reported experiences of the learners regarding the particular mode of delivery to which they were exposed. The results of the study revealed significant differences in terms of the academic success achieved, dependent on the mode of delivery experienced. Students who undertook their learning in the traditional mode were more likely to have achieved success and enjoyed their learning experiences than were their counterparts exposed to the self-paced mode of delivery. The study also revealed that for students undertaking their learning in self-paced mode when the principal learning resources were print-based, the possession of good reading comprehension ability coupled with the use of appropriate self-regulating strategies was a significant factor in achieving success.

## **Introduction**

Economic imperatives to reduce costs provided the impetus for Southbank Institute, Queensland, to examine alternatives to challenge the predominant traditional classroom mode of delivery of learning. Potential savings on teaching costs prompted decisions to trial a self-paced mode of delivery based on printed resources to determine its efficacy as a viable alternative to the traditional approach. Distance education using self-paced delivery based on print media appeared to provide support for the notion that the mode had the potential to deliver quality-learning outcomes for some students at least. Whether it was an effective mode of delivery for a majority of students undertaking their learning at Southbank was not known. It might be, for example, that successful self-paced learning based on print media was dependent on specific characteristics of the learner.

The principal focus of the study was, therefore, to seek answers to two research questions: (i) are there differences in the outcomes of learning attributable to the use of a particular mode of delivery? and, (ii) do specific personal learner characteristics predispose students to achieve success when using a particular mode of delivery? Additional questions concerning enjoyment of the learning experiences offered by each of the two modes were also posed. The author's particular discipline area and the practitioner-based nature of this study determined that the focus of research would be on the introduction of self-paced learning in the introductory computer aided drafting (CAD) module of the Advanced Diploma of Engineering (Civil) program offered by Southbank's School of Civil Engineering.

## Literature review

The adoption of social cognitive theory (Bandura, 1986, 1997) was considered appropriate as a framework for a study involving environmental influences, personal factors and achievement outcomes. According to Bandura's theory, it could be anticipated that different outcomes of learning could eventuate as a result of influences attributable to different environmental settings wherein students might undertake much of their learning in isolation, or, alternatively, share their learning experiences with others in a traditional classroom setting. Social cognitive theory further suggests that the interdependency of the reciprocal, triadic relationship acting amongst behaviour, internal personal factors and environmental factors would empower individuals who possessed particular learner characteristics to overcome environmental factors that might otherwise hinder learning.

A review of the literature within a social cognitive framework indicated that differences in the outcomes of learning could indeed be attributable to the personal characteristics that individuals brought to the learning situation (Jegede, Taplin, Fan, Chan & Yum, 1999; Misko, 1994; Rotter, 1982; Zimmerman, 1994). Individuals with the ability to be academically self-regulating, for example, would, according to Zimmerman (1994), be better equipped to manage their learning in an environment where there is an absence of support from others. An alternative perspective (Jegede et al., 1999) suggested that the capacity of individual students to maximise learning opportunities with limited teaching support was influenced by each student's specific orientation to academic locus of control. A mode of delivery that requires students to undertake their learning with minimal teaching support was considered to be more appropriate for those with an internal rather than an external academic locus of control. A mode of delivery, furthermore, that requires students to undertake their learning in isolation through the medium of text was likely to prove troublesome for learners with poor reading comprehension (Hope, 1990).

On this basis, the personal learning characteristics adopted as worthy of consideration for a study examining relationships between achievement and mode of delivery were:

- *Reading comprehension ability.* A measure of an individual's capability to achieve understanding by reading from text.
- *Academic locus of control (ALC).* The extent to which academic achievement is attributed by individuals (internals) to their own efforts or abilities, or, to forces such as luck, or powerful others over which individuals (externals) have no sway (Jegede et al., 1999; Lefcourt, 1982; Weiner, 1992).
- *Self-regulated learning.* The capacity for individuals to manage their own learning; to set realistic goals and to accept personal responsibility with regard to when, how, and for how long they apply themselves to learning (Zimmerman, 1994).

Thus, according to the literature, students with good reading comprehension ability, an internal academic locus of control, and the ability to self-regulate their learning may be expected to fare better in an environment where they will be required to learn through the medium of print with limited external support. Without such personal characteristics, learners may be better suited to a mode of delivery that provides more structured learning and offers greater opportunities for support. For those students capable of achieving successful academic outcomes regardless of the mode of study and

independently of the learner characteristics considered important in this study, then the freedom offered by the capacity of self-paced learning to overcome such situational barriers as shift work, family responsibilities or distance from the provider (Anwyl, Powles, & Patrick, 1987) might be considered to constitute a highly attractive option.

## **Research method**

A mixed-method approach to research was adopted for the study. Quantitative measures were complemented by qualitative data obtained from interviews.

*Participants.* Data was gathered from 68 students enrolled in the CAD 1 module of the Advanced Diploma of Engineering (Civil), CN940 program. Data was not available from all participants for each of the instruments used in the study. Participant numbers for whole group quantitative analyses varied, therefore, between 64 and 68 participants. Although the sample size was not large it more than satisfied criteria recommended by Gay (1992) for minimum numbers in an experimental study. Participant numbers also satisfied requirements for multiple regression (Tabachnik & Fidell, 1996). Participants were randomly assigned to one or other of the groups by means of a table of random numbers. This ensured that all participants had an equal and independent chance of being selected in either of the groups, and allowed the research data to be used to make generalisations to a larger population within statistically acceptable margins of error (Borg and Gall, 1984).

The majority (85%) of participants had recently completed their secondary schooling and were accessing vocational training directly from high school. Entry requirements into the program based on Year 12 results indicated only modest academic achievement for the majority of participants. Ages of students in the course ranged from 17 to 58, with a mean age of 23 and a mode of 18. Sixteen of the participants (23%) spoke English as a second language, but all students had demonstrated a level of English proficiency that satisfied program entry requirements. All participants had completed an introductory computer class in the first trimester, but had no specific prior knowledge of computer aided drafting.

*Instrumentation.* Data for this study were collected by two phases of instruments. Phase 1 instruments administered prior to the delivery of learning were designed to measure characteristics of the learner -- the reading comprehension ability test (Australian Council for Educational Research, 1989), the self-regulated learning strategies survey, (Purdie, 1997), and the academic locus of control scale (Trice, 1985); -- Phase 2 instruments consisting of questionnaires and interviews designed to measure students' perceptions of their learning experience were administered during, and at the conclusion of the study. Phase 2 instruments also included an assessment instrument to measure whether differences existed between the learning outcomes achieved by each of the two groups at the conclusion of study.

Interviews were conducted involving a representative sample of students from the study. The interviews generally took between 15 and 20 minutes and were semi-structured in nature to maintain the principal focus of the interview on issues concerning the mode of delivery, whilst still encouraging the free flow of information that an interview can so richly provide (Gay, 1992). Guides listing topics to be raised during the interviews were prepared in accordance with a format proposed by Lincoln and Guba (1989). The topics included categories corresponding with those used for

the Phase 2 questionnaires. The interviews facilitated the collection of information of a richer texture than could be captured by questionnaires alone (Gay, 1992) providing the capacity to probe more deeply into perceptions of the quality of learning applicable to each mode of delivery. Students all agreed to their interviews being tape-recorded. Analysis of the taped interviews based on standardised observational protocols determined the extent to which the data complemented, triangulated, expanded or enriched material collected by other means (Burns, 1997). In all, 28 interviews were conducted. Anonymity was maintained by use of a coding system.

*Self-paced mode of delivery.* Self-paced learners used a learning package consisting of a study guide and a set of explanatory notes. Combined with work-tasks, this provided opportunities for students to develop the skills required of the module by working through a series of exercises. Examples of work exhibiting best practice were also made available so that students could model their own work on suitable exemplars. Importantly, the knowledge required to develop the skills and techniques needed by students to complete the assignments was fully covered by the material contained in the learning package and matched the extent of the content knowledge delivered to students in the traditional group. After an initial orientation providing advice on how to undertake their learning using this mode, there were no further scheduled classes. Access to computer laboratories was relatively freely available, but students were required to manage their own learning using the study guide and the explanatory notes. Those students who had a computer at home with the appropriate software were free to work entirely at home if they so wished. Most students, however, used the School's computer facilities. Some students chose to team up with their peers in an effort to progress their learning. For many students, however, learning CAD was an isolated experience.

*Traditional classroom mode of delivery.* Students learning through the traditional classroom mode of delivery were timetabled to attend two, three-hour classes per week in a computer laboratory at the Institute. Classroom sessions were structured so that teachers presented content material using strategies aimed at developing skills relevant to the learning outcomes. A variety of strategies were used, including lectures, demonstrations, modelling, and individual tutoring. Teachers directed and regulated the pace of the learning, introducing new content as considered necessary. Teachers also provided encouragement and attempted to motivate their students to succeed. When students found themselves struggling with aspects of the learning, the teacher was available to provide appropriate support. The support made available by a teacher is recognised as a major facet of traditional classroom delivery (Rowntree, 1992).

*Measuring Learning Outcomes.* A fundamental requirement of this study was to determine whether or not differences existed in the quality of learning outcomes that might be attributable to the mode of delivery by which the learning was experienced. A practical test was developed requiring students to produce two drawings using the CAD skills that they had learned. Students' drawings were saved on diskettes collected by the teacher at the end of the test. The use of a detailed common marking schedule and a moderation process promoted strong agreement amongst markers on the allocation of marks awarded to each of the students tested.

## Results

To confirm that the random allocation of participants between groups had indeed produced two groups equivalent in terms of their learning characteristics an initial comparison was conducted using one-way multivariate analyses of variance (MANOVA). The dependent variables comprised the students' initial reading comprehension ability, their self-regulated learning skills, and their academic locus of control. The self-regulation of learning characteristic includes a set of sub-categories for the strategies: goal setting, task orientation, motivation, and monitoring and evaluation. The aspect of self-regulated learning was explored both as a single entity and as four sub-categories. The independent variables consisted of the two participant groups differentiated by the mode of delivery adopted -- one group using the traditional classroom approach and the other employing a self-paced approach based on print media. The multivariate test of significance (using Wilk's lambda criterion) produced a non-significant result  $F(13, 54) = .90, p > .05$ . On the variables considered, therefore, the two groups could be considered equivalent.

*Between-group differences in learning outcomes.* Univariate  $F$  tests were conducted to examine between-group differences in terms of learning outcomes as measured by scores on the CAD competency test. The results of the univariate  $F$  tests showed that the two groups differed significantly,  $F(67,1) = 15.10, p < .001$ . The mean score for the traditional group ( $n = 34$ ) was 72.68 (Std.dev. = 24.92) whereas the mean score for the self-paced group ( $n = 35$ ) was 47.57 (Std.dev. = 28.56). The practical significance of the groups' mean scores difference is dramatically illustrated when an effect size measure ( $\eta^2$ ) is considered. In this instance a value of  $\eta^2 = .20$  was obtained. This should be interpreted in light of the accepted evaluation of  $\eta^2$  whereby .01 indicates a small difference, .06 a medium difference, and .14 a large difference.

*Relationships between learner characteristics and learning outcomes.* Participants were considered first as a single entity without the differentiation afforded by allocation into their respective groups. A correlation was conducted to explore the relationship between students' learner characteristics and the learning outcomes quantified using the results of the CAD competency test. As expected, there was a correlation between academic locus of control and self-regulated learning considered as a single entity. This shows as a negative correlation (-.42) because Trice's academic locus of control (ALC) scale records external responses as positive scores. Thus, low scoring on the ALC scale, indicating an internal academic locus of control, would be expected to correlate with good self-regulated learning skills. Negative correlations were also evident between academic locus of control and each of the sub-categories of self-regulated learning. There was, on the other hand, no indication of any relationship between learning outcomes and individuals' orientation to academic locus of control when all participants were considered as a whole and not differentiated by group. Nor, when considering all participants as a non-differentiated whole, did there appear to be any indication of a relationship between the achievement of successful learning outcomes and the ability of individuals to self regulate their learning. There was, however, a small, but significant correlation (.28), between the CAD competency test results and reading comprehension ability.

*Relationships amongst outcomes, mode of delivery, and characteristics.* When participants were differentiated into their two groups based on mode of delivery, interesting differences emerged. The correlation between learning outcomes and

reading comprehension ability for the traditional group was relatively small (.26) and was not significant ( $p = .15$ ). For the self-paced group, however, the correlation was much stronger (.38) and was significant ( $p = .03$ ). Thus, it could be inferred that reading comprehension ability is a significantly more important factor in the achievement of successful learning outcomes for those required to manage their own learning using textual resources, than for those whose learning is regulated by a teacher using a traditional classroom approach to the delivery of learning.

A correlation was found to exist between the self-regulated learning sub-category of monitoring and evaluation strategies and the outcomes of learning for those in the self-paced group. No such relationship was evident between self-regulated learning and achievement outcomes for those in the traditional group. This suggests that students in self-paced mode were likely to perform more successfully if they self-regulated their learning using monitoring and evaluation strategies. For students in the traditional classroom, learning outcomes did not appear to be affected by the possession of self-regulating skills. In addition, the correlation between academic locus of control and successful learning outcomes (-.32) approached significance ( $p = .06$ ) for the self-paced group. In contrast, there was no correlation on the same factor for the traditional group (-.09). Although falling outside the usually acceptable  $p < .05$  parameter for statistical significance, these results for academic locus of control are, nonetheless, noteworthy.

*Predicting Success.* Stepwise regression was employed to ascertain whether characteristics of the learner could be used to predict learning outcomes for students, depending on the mode of delivery experienced. The results of the CAD competency test were adopted as the dependent variable for the regression analysis. Results of data regarding learner characteristics as determined from the ACER reading comprehension ability test, together with appropriately modified versions of Trice's academic locus of control scale and Purdie's self-regulated learning strategies survey were adopted as independent variables. It had been anticipated that one, or more, of these three measures of specific characteristics of the learner could play a predictive role in determining the suitability of individual students engaging in a particular mode of delivery. The size of the sample, although satisfying minimum statistical criteria (Gay, 1992; Tabachnik & Fidell, 1996), was sufficiently small to warrant the adoption of a strategy that involved performing several stepwise multiple regressions using various combinations of the independent variable. The results suggested that none of these independent variables was a predictor of test results for the traditional group. However, marked differences were apparent between the two groups. The results indicated that high levels of reading comprehension ability and well-developed self-regulated learning skills appeared to be useful predictors of academic success for self-paced students learning from text. Academic locus of control did not appear in the equation as a significant predictor of achievement for self-paced students.

Reading comprehension ability accounted for 14% of the variance indicated in the regression with self-regulated learning accounting for a further 11%. When separate regressions were performed using each of the sub-categories of self-regulated learning in concert with the reading comprehension ability and academic locus of control variables, goal-setting appeared as the most useful, accounting for a further 13% of the variance in addition to the 14% accounted for by reading comprehension ability.

*Students' perceptions of their learning experiences.* Univariate  $F$  tests conducted on data gathered by the mode evaluation questionnaires indicated that significant differences existed between the two groups in terms of students' perceptions of aspects of their learning pertaining to (a) effectiveness, (b) enjoyment, (c) value of teacher support, and (d) the desire for an ordered routine and structured learning. On the other hand, no significant between-group differences were apparent for the remaining two aspects of learning -- value of student support or, need for external motivation

Univariate test results with regard to the value that students ascribed to the effectiveness of learning depending on the mode of delivery experienced, indicated significant between-group differences,  $F(1,62) = 7.86, p = .01, \eta^2 = .11$ . The mean score for the traditional group ( $n = 31$ ) was higher ( $M = 3.50, SD = .88$ ) than for the self-paced group ( $n = 33, M = 2.78, SD = 1.15$ ). That is, students in the traditional group were somewhat more positive in their support for the effectiveness of learning in the traditional classroom setting than were their peers in the self-paced group.

The results for value ascribed to the enjoyment of the particular mode of delivery by which CAD 1 was undertaken also showed significant differences between the two groups.  $F(1,62) = 76.28, p < .01, \eta^2 = .55$ . The mean score for the traditional group ( $n=31, M = 5.24, SD = .78$ ) was extremely high in comparison to the mean score for their peers in the self-paced group ( $n = 33, M = 2.75, SD = 1.40$ ) indicating a significant difference in favour of the traditional classroom as far as students' enjoyment of their learning experiences was concerned.

A significant difference was revealed between the groups with regard to the value of teacher support,  $F(1,62) = 9.61, p < .01, \eta^2 = .13$ . The mean score for the traditional group ( $n = 31, M = 4.79, SD = .78$ ) suggested that regard for the value of teaching was somewhat higher amongst students in the traditional group than it was amongst students of the self-paced group ( $n = 33, M = 4.23, SD = .66$ ). Although differences between the groups with regard to the value of teaching were statistically significant, the results suggest that teaching is held in high esteem amongst students from both groups.

Univariate results on the desire for an ordered routine and structured learning indicated a significant difference between the groups,  $F(1,62) = 16.18, p < .01, \eta^2 = .21$ . The mean score for the traditional group ( $n = 31, M = 4.79, SD = 1.16$ ) compares with the much lower mean figure for the self-paced group ( $n = 33, M = 3.09, SD = 1.51$ ). Students from the traditional classroom group afforded greater support for the notion of increased order and structure in their learning than did those in the self-paced group.

No significant differences between the groups were evident with regard to students' perceptions of the value of student support,  $F(1,62) = .00, p = .98, \eta^2 < .01$ , nor for the need for external motivation,  $F(1,62) = 2.14, p = .15, \eta^2 = .03$ . Univariate results indicated little to suggest that student support was perceived by students to be an essential element in the learning process. Mean scores for the traditional group ( $n = 31, M = 3.39, SD = 1.35$ ) were markedly similar to the results obtained for the self-paced group ( $n = 33, M = 3.35, SD = 1.38$ ). Both groups appeared to adopt a quite neutral position regarding the value of student support. The position of both groups with regard to the need to be externally motivated was somewhat negative. The mean scores for the traditional group ( $n = 31, M = 2.66, SD = 1.01$ ) and the self-paced group ( $n = 33, M = 3.12, SD = 1.47$ ) were low enough to suggest that, regardless of group affiliation,

participants generally did not feel a particularly strong need to be externally motivated to achieve success in their studies.

*Interviews.* Students' perceptions of their experiences as revealed in the analysis of the questionnaire data was strongly reinforced by the information gathered during the interviews. Almost all of the students interviewed suggested a preference for the learning experiences offered by the traditional classroom approach in comparison to the self-paced option provided in this study. There was general agreement on the greater effectiveness and enjoyment offered by the traditional classroom approach. The value of teaching support was highly regarded by almost all students irrespective of group affiliation. Somewhat surprisingly, in view of the many negative evaluations of the self-paced mode adopted in this study, the interviews indicated a willingness on the part of many students to consider a similar self-paced approach in other, less complex areas of study, or at a time in the program when they had assembled a more complete knowledge base in the discipline. Teaching support was suggested by most students as a necessary adjunct to learning in self-paced mode.

## **Findings and discussion**

*Effectiveness of learning.* The results of this study suggest that students who undertake their learning by means of a traditional classroom mode of delivery are likely to perform significantly better than their counterparts using a self-paced mode of delivery relying on text. Students who undertook their learning in self-paced mode appeared more likely to be successful provided they had good reading comprehension ability and self-regulating skills. Marked differences in learning outcomes between the two groups with regard to the relative effects of learner characteristics, accentuated the importance of self-regulated learning skills, particularly those involving monitoring and evaluation. A clear indication was provided that self-regulated learning skills were likely to be beneficial to learners in self-paced mode, but did not appear to advantage traditional classroom learners. Interestingly, effective student learning in the traditional classroom setting was not dependent on the personal characteristics considered in this study. It can be argued that the highly controlled learning environment typical of the TAFE traditional classroom setting used in this study, mediated against the need for students to be self-regulating. Students in the traditional classroom who were required to adhere to the program and the deadlines set by the teacher were, effectively, having their learning externally regulated. There appears to be little advantage in being a self-regulated learner when the teacher regulates the entire learning process.

The findings indicate that academic locus of control (ALC) had no statistically significant effect on the outcomes of learning for any of the learners in either of the settings in this study. It had been hypothesised that internals would cope more satisfactorily than would externals using a mode of delivery that required a greater level of intrinsic motivation. Correlation data was tantalisingly close to providing support for this notion, but fell marginally outside the traditional parameters accepted for significance. The strong correlation between academic locus of control and the use of self-regulating strategies added weight to the suggestion that further research might be warranted on the importance of an internal ALC for students using a self-paced mode of delivery.

*Enjoyment of learning.* The differences between the two groups in terms of perceptions of the level of enjoyment experienced whilst undergoing their learning was one of the

more interesting outcomes of this study. It seems likely that the lack of enjoyment expressed by students engaged in the self-paced mode of delivery was related to the mode's perceived lack of effectiveness. The dissatisfaction expressed by students with regard to self-paced learning based on print media may well be related to a lack of self-regulated learning skills displayed by most participants. Many students were unable or unwilling to use appropriate self-regulating learning strategies regarded by Purdie (1997) as so important. The inability to self-regulate their learning made the achievement of success less likely for those in self-paced mode compared to their counterparts in the traditional group where the need for self-regulation was ameliorated by the provision of direction from the teacher.

Many of the students interviewed suggested that despite their misgivings about a self-paced approach to learning they felt it could be successful under certain circumstances. Students suggested that the difficulties encountered with self-paced learning in this study were related to the complexity of learning required to master the subject matter. There was general agreement that difficult content areas involving complex learning required a teacher to properly explain the material and demonstrate the requisite skills. There was further agreement amongst many students that the need for learning support from a teacher was of most value in the early stages of learning.

*Predicting success.* The potential to predict academic success for learners contemplating a self-paced approach to learning based on print media would be of great value. Success for students translates into improved completion rates, which, in turn, equate with better utilisation of resources for Southbank Institute. For individual students, the availability of advice that forewarns against a potentially wasteful enrolment likely to produce unsatisfactory outcomes would be highly beneficial. Based on the results of this study, it would be possible to design a mode predictor instrument that would alert students to the danger of encountering significant learning difficulties should they choose to undertake their learning using a self-paced mode of delivery based on print media.

*Limitations of the study.* The nature of this study involved the experiences of students in a real-life learning situation rather than in conditions applicable to a laboratory experiment. As a consequence of the reduced level of control applicable to non-laboratory conditions, there are a number of limitations to the study. It is not possible in a paper of this length to consider these limitations fully, but it is worth bringing the matter to the attention of readers before any generalisations are made.

## **Conclusions**

This study has shown that different modes of delivery can produce differences in learning outcomes depending on the particular personal learner characteristics of individual students. Self-paced learners relying on the use of printed resources appear less likely to achieve the same quality of learning outcomes as their counterparts using a traditional classroom approach to learning unless they possess specific learner characteristics. The specific learner characteristics that were shown to affect the outcomes of learning most significantly in this study were reading comprehension ability and self-regulated learning skills. It was also apparent that the majority of VET students who participated in this study did not enjoy the experience of learning without appropriate support. It seems that, contrary to expectations, many

VET learners feel the need for a teacher to direct and support their learning, particularly in the initial stages of an educational program.

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