Research Outcomes

Barriers to Student Learning in Engineering: Annotated Bibliography
Acknowledgements

This work was funded by the Australian Learning and Teaching Council, ALTC, through the Fellowship program. The crucial contributions of Mrs. Hilary Beck (Project Officer) and Dr Lesley Jolly (Project Researcher) are greatly appreciated. I would like to also express my sincere thanks and appreciation to Ms Karen Whelan for many engaging and fruitful discussions, and for her instrumental work in preparing this annotated bibliography. My deep appreciation goes to my collaborators in this project; A/Prof Roger Hadgraft, and Dr Prue Howard, for their sincere cooperation and advice. Special thanks go to Prof Neil Page (Program Evaluator) and the Project’s Reference Group: Prof Tom Angelo, Prof Holger Maier, A/Prof Julie Mills, Dr Martin Murray, Prof Peter O’Shea, and Ms Jillian Rowe, for the valuable advice, insights and support they provided. Many thanks are due to the colleagues and students who participated in this study.
Introduction

The following annotated bibliography is one of three documents produced as part of an ALTC project. This part of the project focused on barriers to student learning in engineering education. The other two components are a literature review and an academic guide which provides practical strategies for engineering academics to overcome barriers to student learning.

Along with complete details of each reference provided, this annotated bibliography contains research notes on each reference addressing the following:

- An introduction or overview of the reference
- The scope of the reference
- Aims and research methods used in the research to inform the reference
- Usefulness and/or relevance to the overall ALTC project
- A short critique of the reference identifying any limitations/shortcomings or any areas of further research that are pointed to.

Where possible, the abstract of the reference is provided along with a URL for location. Keywords are included where they were provided for a journal article.

Organisation of the References

The references appear here in alphabetical order of author. However a schema has been developed to categorise the references depending on their usefulness to a particular audience. A series of coloured dots beside the reference title is used to identify those references that fall into the following categories:

- Those studies that are specifically about engineering education are marked ★, ★
- Those that are related to higher education more broadly or to other disciplines are marked ★
- Studies from the U.S.A. are marked ★
- Studies from Australia are marked ★, and
- Studies from the U.K. or Europe are marked ★★.

References

Annotated References

Reference Type: Web Page
Author: American Psychological Society
Title: Learner-Centered Psychological Principles ★ ★
Access Year: 2008
Access Date: 20 September
Research Notes: This document provides 14 psychological principles relating to the learner and learning process. They are broad but succinct and provide a framework for thinking about the design of curriculum, learning environments and learning activities. They are, by nature, based on theoretical concepts and therefore may appear to be not easily turned into practical strategies. They provide a broad summary of statements about learning theory as it is studied in psychology.
Abstract: In the engineering profession we need to reflect continually on the students we are training, their suitability and ability to become the next generation of engineers, facing an every-changing future. We need to face our responsibility in helping to develop the skills required for graduates of tomorrow and ensuring that we are not losing our best students to other professions. A survey has been conducted at Imperial College highlighting problem areas of students at risk from demotivation within engineering courses. Forty students who had not completed their course at the college were surveyed and 10 students were interviewed. The issues they raised have been analysed and intervention strategies have been identified which are presently being developed at the college as part of the ongoing quality improvement of courses. It is hoped that the approaches discussed can be disseminated further within Imperial College and to other universities.

Research Notes: The project that this article describes aimed at identifying the causes of dropping out of engineering for students who leave due to motivation problems rather than a lack of ability. The research methodology was to survey students who had left Imperial College, London without completing their degree. While 436 students were sent surveys only 40 usable returns resulted. 10 students also agreed to a face to face semi structured interview, which expanded on the survey responses. Most of the students who responded were capable of completing the degree based on their incoming academic results and their initial motivations. Although this paper does not explore it further, it is interesting to note that personal situation (financial or accommodation problems) was one factor that impacted on students lack of completion. The major factors identified by students as leading to non-completion were associated with course (degree) content or focus. Thus students had expectations of a more practical degree, with a lower workload and with a lower level of mathematical content. They also consider the degree “too highly pressurized and too academic”. Of further interest is that there were a few students who considered that the programme was not challenging enough. Two other areas leading to non-completion were the teaching approach (too much dry lecturing) and the staff/student interaction or peer interaction (compare this result with Vogt, 2008). A second set of questions asked of students what factors did motivate them in engineering. These reflect (not surprisingly) the opposite of those that de-motivate - practical work, active learning through problem-solving, design, and creative projects. The conclusion to this article presents a number of practical strategies that can be implemented to motivate students in their learning that address the factors identified in the survey. Even though the sample was quite small and the institution of a particular type (highly academic) the findings are not inconsistent with other studies both in engineering and beyond. The practical ways to address such issues that are outlined make this article of high relevance to the ALTC project.

Abstract: In spite of considerable research about the poor retention rate of undergraduate engineering students, we still have an inadequate understanding of the factors that affect students' decisions to remain in engineering programs and their ability to perform well enough to be retained. Although continued study is needed of external factors such as curricular requirements, admissions criteria, and test scores, we also need to know much more about the relationships between curricular experiences and students' learning styles, habits, and attitudes. The work presented in this paper was designed to enhance educators' understanding of the factors that underlie the concern about student retention in engineering. By observing 1,000 engineering students during their first three years in college, the research team generated a large database on the students' academic and non-academic characteristics as well as their successes and failures. The traits discovered not only support many findings from previous studies but also reveal some new relationships that could prove essential to designing an educational environment that will prepare engineers for success in the future. [PUBLICATION ABSTRACT]

Research Notes: This highly relevant article reports on a longitudinal study of around 1000 engineering students as they were tracked through their first three years of college. Students' Learning Styles were measured using the Learning Type Measure (which is based on Kolb) and the Learning and Study Skills Inventory. These results were then correlated with GPA and success in college (which was defined as matriculation into a specific engineering program at the end of the three years of study). The authors present a comprehensive review of the literature on factors that effect student performance in engineering and suggest that both external (educational environment, teaching style, etc) and internal factors (such as learning style) must be considered together so that "we can create an educational environment that considers students as partners with us in their learning and success, not simply as consumers of knowledge". The results confirm and extend previous studies - students with preferences for creativity, innovation, divergent thinking and subjective interpretations were much more likely to leave the program. The authors point out that the results of this study support other research that suggests that it is not enough to just focus on improving student performance but that we need to create an environment that supports students to engage in active and collaborative learning and take responsibility for their learning. This is a highly relevant article for the ALTC project although the limitations of some of the standard tests used are not discussed in any detail.

Author: A.-K. Carstensen and J. Bernhard
Year: 2007

Title: Threshold Concepts and keys to the portal of understanding
Editor: R. Land, J. H. F. Meyer and J. Smith
Book Title: Threshold Concepts within the Disciplines
Publisher: Sense Publishers

Research Notes: This paper describes a process and approach for identifying what needs to be addressed to open up opportunities for students to learn "key" concepts (in this case key concepts are those that open up the 'portal' of understanding as described by threshold concepts). The authors research is based around the learning of bode plots. They used a video recording of students learning in a lab based situation and then used this to compare the students learning space and the desired outcome learning space. The model they have used to describe the learning space is to identify objects of learning, islands of concepts that when integrated together into a conceptual model represent the complex understanding of a key concept. Each of the objects of learning are classified as belonging to either the object/event world or the theory/model world. For example in considering bode plots, Laplace transforms are part of the theory/model world and a real circuit in a lab based session belongs to the object/event world. The challenge for teachers is to ensure that even though each of the learning objects may be encountered sequentially the more complex interactions between concepts are understood. The authors discuss the limitations and possibilities of the research approach they propose (using videos) compared to other means of study of threshold concepts (interviews with teachers and students and in particular phenomenographic research on variation). The approach and example of modeling learning are very relevant to the ALTC project as they point to ways of highlighting the gap between learner understanding and intended learning outcome and provide a suggestion for ways in which teachers might design learning experiences to close that gap.
URL: http://webstaff.itn.liu.se/~jonbe/fou/didaktik/papers/Carstensen_Bernhard_Threshold_draft.pdf

Reference Type: Journal Article
Author: H. L. Chen, L. R. Lattuca and E. R. Hamilton
Year: 2008

Title: Conceptualizing Engagement: Contributions of Faculty to Student Engagement in Engineering
Journal: Journal of Engineering Education
Volume: 97
Issue: 3
Pages: 339
ISSN: 10694730
Keywords: College students
Studies
Learning
Behavior
Polls & surveys

Abstract: The concept of student engagement, now prominent in the engineering education and higher education communities has a long intellectual history. Yet only recently has attention focused on the role that faculty play as designers of educational environments to support student engagement. Drawing from examples and data from the Engineering Change study (which evaluated the impact of the new EC2000 accreditation standards on engineering programs and student learning), the Academic Pathways Study of the Center for the Advancement of Engineering Education, and studies underway at the United States Air Force Academy, we explore the role of faculty, as the institutional agents who are most proximal to the student experience, in developing, facilitating, and sustaining high levels of student engagement. [PUBLICATION ABSTRACT]
Research Notes: In this paper, the authors use data from three large-scale research projects to contend that student engagement is dependant on faculty engagement. They begin by reviewing the historical development of student engagement and demonstrate that the evidence is now clear that student engagement has a positive impact on student learning. They define student engagement as quality of effort and note the environmental impacts on student engagement. Their area of focus for environmental impacts is faculty engagement that they suggest is evidenced by three areas of activity - active participation in programme design, review and improvement and professional development; quality interactions between faculty and students both inside and outside the classroom (including advising and mentoring); and finally teaching that "addresses students' cognitive and affective states of mind". The authors go on to show through three different research projects how the evidence is emerging that it is indeed the case that evidence of these three areas of activity impact student engagement and therefore student learning. The projects are a large-scale review of the impact of changes to the ABET accreditation criteria (the Engineering Change study), the Academic Pathways Study which developed the Academic Pathways of People Learning Engineering Survey (APPLES) and finally a research project looking at the impact of an in classroom intervention on students short term engagement (using tablet PCs and collaboration software to allow instructors to dynamically adjust their teaching based on seeing what students in large classes were doing, at the same time providing closed loop feedback to the students). In summary, the authors suggest that "Together, these research efforts suggest that good instruction is a multi-dimensional construct that encompasses: (a) what faculty do in class, (b) what faculty do with students, formally and informally outside the classroom; and (c) what faculty do individually and with their colleagues to improve engineering courses and programs." This article is highly relevant to the ALTC project as it presents a well argued and evidence case for those activities that faculty can do to actively engage students and to prevent dis-engagement.


Reference Type: Web Page
Author: A. W. Chickering and Z. F. Gamson
Year: 1987
Title: Seven Principles for Good Practice in Undergraduate Education
Access Year: 2008
Access Date: 20 September

Research Notes: These principles are widely reported and referred to in literature on good teaching in higher education. They provide a broad framework along with practical guidance on what research shows as good practice in undergraduate education. The authors suggest that the principles provide a focus for improvement and that while each may be addressed on its own, together they provide a powerful framework for enhancing learning outcomes for undergraduates. As with the APA principles, these provide a big picture framework grounded in research literature on learning in higher education. The principles apply not only to individual teachers in the classroom but also to institutions, departments and teams.

URL: http://www.uis.edu/liberalstudies/students/documents/sevenprinciples.pdf

Reference Type: Conference Paper
Year: 2007
Title: A Preliminary Analysis of Correlates of Engineering Persistence: Results from a Longitudinal Study
Conference Name: American Society for Engineering Education Annual Conference and Exposition
Conference Location: Honolulu, Hawaii
Date: June 24-27 2007
Abstract: This paper outlines the preliminary findings of a longitudinal survey-based study, the Persistence in Engineering (PIE) survey. This survey was designed to identify and characterize the fundamental factors that influence students' intentions to pursue an engineering degree over the course of their undergraduate career, and upon graduation, to pursue a career in an engineering-related field, including practicing engineering as a profession, teaching, or conducting research. In addition, it is also designed to broaden our understanding of how students navigate their education and begin to form identities as engineers.

In the fourth year of the study, 76% of the 141 students enrolled in the study as first-year students are still enrolled in engineering (persisters) and 24% are no longer majoring in engineering (nonpersisters). Preliminary analyses suggest that there are some interesting similarities and differences between the persisters and nonpersisters. For example, nonpersisters are more likely to be motivated to study engineering by family influences. They also report lower levels of confidence in their math and science skills as first-year and sophomore students, as well as lower levels of engagement in both engineering and liberal arts courses as compared to their persister counterparts. These results are preliminary; even so, they begin to illustrate the many ways that persisters and nonpersisters are similar and the potentially significant ways that they are different. A more comprehensive analysis of the date is in progress.

Research Notes: This conference paper reports on the preliminary results of a survey-based study on Persistence in Engineering (PIE) (see also Chen, Lattuca and Hamilton, 2008 which also refers to this study). A cohort of students from 4 US universities were followed over a four year period (six surveys from Fall 2003 to this report, the seventh was scheduled for Spring 2007). The initial analysis provides information about the difference between persisters (those that continued in engineering) and non-persisters (those that transferred to another major). This survey data was used to develop a refined survey instrument to be administered to a larger and more representative cohort across the US. The initial results show that nonpersisters are more likely to be motivated to study engineering by family members, are less confident in their abilities in maths and science and are less engaged in their studies than persisters. The link between engagement and retention is reinforced in this research. The paper provides a full listing of the survey constructs, items and internal consistency reliabilities. This paper along with others about this research study are highly relevant to the ALTC project in providing research evidence for what impacts on persistence and nonpersistence in engineering education.

Reference Type: Journal Article
Author: R. M. Felder
Year: 1995
Title: A Longitudinal Study of Engineering Student Performance and Retention. IV. Instructional Methods and Student Responses to Them
Journal: Journal of Engineering Education
Volume: 84
Issue: 4
Pages: 12
Start Page: 361
Abstract: As part of an ongoing longitudinal study, the author taught five chemical engineering courses in consecutive semesters to a cohort of students, using cooperative learning and other instructional methods designed to address a broad spectrum of learning styles. This paper outlines the policies and procedures, assignments, and classroom activities in the experimental course sequence and describes the students' performance and attitudes as they progressed through the sequence. The results suggest that active and cooperative learning methods facilitate both learning and a variety of interpersonal and thinking skills, and that while these methods may initially provoke student resistance, the resistance can be overcome if the methods are implemented with care.

Research Notes: This is the fourth in a series of papers about a longitudinal study of student performance and retention. In this paper, Felder describes, in some detail, the instructional methods that were used in the five chemical engineering courses taught to the sample student body. The description of the student responses to the interventions, while based on student ratings and behaviours, also includes anecdotal notes from the author with reflections on his perception of impact. While these may appear to not be as rigorous as more in-depth survey or
interview data, they are logically consistent and with the references to evidence-based research provide a compelling argument as to the efficacy of these approaches. This is of relevance to the ALTC project because it provides practical guidance along with evidence of impact.


Reference Type: Journal Article
Author: R. M. Felder, G. N. Felder and E. J. Dietz
Year: 2002
Title: The Effects of Personality Type on Engineering Student Performance and Attitudes
Journal: Journal of Engineering Education
Volume: 91
Issue: 1
Pages: 15
Start Page: 3

Abstract: The Myers-Briggs Type Indicator (MBTI) was administered to a group of 116 students taking the introductory chemical engineering course at North Carolina State University. That course and four subsequent chemical engineering courses were taught in a manner that emphasized active and cooperative learning and inductive presentation of course material. Type differences in various academic performance measures and attitudes were noted as the students progressed through the curriculum. The observations were generally consistent with the predictions of type theory, and the experimental instructional approach appeared to improve the performance of MBTI types (extraverts, sensors, and feelers) found in previous studies to be disadvantaged in the engineering curriculum. The conclusion is that the MBTI is a useful tool for helping engineering instructors and advisors to understand their students and to design instruction that can benefit students of all types.

Research Notes: This paper relates to a series of papers by Felder and others describing a long term study of implementing innovative teaching with a cohort of students over five courses. The focus in this article is on reviewing whether or not the active and cooperative instructional strategy implemented enhanced the learning for students in MBTI groupings who might be less catered for in traditional instructional modes. The study showed that active and cooperative strategies did in fact improve the performance of extroverts (this is a category of MBTI type) although the effects for some of the other type areas were less marked. It also showed that the MBTI could be effectively used to 'map' the range of student types and provide guidance for teachers on types of teaching styles that might meet the needs of particular cohorts of students. This is of interest to the ALTC project since the MBTI is one instrument that has been used to uncover learning styles and this study was linked to teaching styles.


Reference Type: Journal Article
Author: R. M. Felder, G. N. Felder and E. J. Dietz
Year: 1998
Title: A Longitudinal Study of Engineering Student Performance and Retention. V. Comparisons with Traditionally-taught Students
Journal: Journal of Engineering Education
Volume: 87
Issue: 4
Pages: 12
Start Page: 469
Abstract: In a longitudinal study at North Carolina State University, a cohort of students took five chemical engineering courses taught by the same instructor in five consecutive semesters. The course instruction made extensive use of active and cooperative learning and a variety of other techniques designed to address a broad spectrum of learning styles. Previous reports on the study summarized the instructional methods used in the experimental course sequence, described the performance of the cohort in the introductory chemical engineering course, and examined performance and attitude differences between students from rural and urban backgrounds and between male and female students. This paper compares outcomes for the experimental cohort with outcomes for students in a traditionally-taught comparison group. The experimental group outperformed the comparison group on a number of measures, including retention and graduation in chemical engineering, and many more of the graduates in this group chose to pursue advanced study in the field. Since experimental instructional model did not require small classes (the smallest of the experimental classes had 90 students) or specially equipped classrooms, it should be adaptable to any engineering curriculum at any institution.

Research Notes: This is the fifth in a series of articles about a longitudinal study of student performance and retention. In this paper, comparison is made between the students in the experimental study and students who undertook a more traditional classroom based experience. This series of articles provides a comprehensive picture of an educational intervention that is practical and achievable and through this final paper, is shown to have had a significant impact on a number of areas. In particular while 85% of the students in the experimental group were retained (and in fact had graduated five years after the start of the study), only 68% were retained from the comparison group. Along with extensive statistical data, this paper also includes meaningful observations from the author who taught the students over the five consecutive semesters (Felder). The entire series of articles provides a neat and succinct evidence based case for innovative teaching (using active and cooperative learning methodologies) to improve student retention and student enjoyment of learning and is therefore of high relevance to the ALTC project.

URL: http://www4.ncsu.edu/unity/lockers/users/f/felder/public/Papers/long5.html

Reference Type: Journal Article

Author: R. M. Felder, K. D. Forrest, L. Baker-Ward, E. J. Dietz and P. H. Mohr

Year: 1993

Title: A Longitudinal Study of Engineering Student Performance and Retention. I. Success and Failure in the Introductory Course

Journal: Journal of Engineering Education

Volume: 82

Issue: 1

Pages: 15-21

Abstract: A profile of 123 students enrolled in an introductory chemical engineering course has been assembled. The information collected includes data on family and educational backgrounds, profiles on the Myers-Briggs Type Indicator and the Learning and Study Strategies Inventory, and responses to a questionnaire regarding attitudes and expectations. Student performance in the introductory course was correlated with the assessment data. The results suggest several significant predictors of success or failure in the introductory course, and by extension, in the chemical engineering curriculum.

Research Notes: This is the first in a series of journal articles describing a longitudinal study following a cohort of chemical engineering students through five courses in their degree program. The study cohort were exposed to innovative teaching methods (cooperative learning as opposed to traditional lecture presentation) which are not the focus of this paper but are explained in others in the series. In this paper, the students were surveyed and tested across a range of variables and then correlations were determined between those variables and their result in the first course. Significant results include the fact that students were more likely to succeed if they were from an urban background (as compared to rural), their fathers' educational attainment included some college education, they devoted less than 10 hours per week to outside work and success was also related to responses to the MBTI and previous educational success in a range of freshman courses and high school study. While the cohort studied is quite small (123 students), the results provide guidance for ways in which students might be targeted for support in their academic study. This study and the papers reporting on it, are highly relevant to the ALTC project.

Reference Type: Journal Article
Author: G. Gibbs and C. Simpson
Year: 2004-05
Title: Conditions under which assessment supports students' learning
Journal: Learning and Teaching in Higher Education
Issue: 1
Pages: 29
Start Page: 3
Abstract: Much evaluation of teaching focuses on what teachers do in class. This article focuses on the evaluation of assessment arrangements and the way they affect student learning out of class. It is assumed that assessment has an overwhelming influence on what, how and how much students study. This article proposes a set of 'conditions under which assessment supports learning' and justifies these with reference to theory, empirical evidence and practical experience. These conditions are offered as a framework for teachers to review the effectiveness of their own assessment practice.

Research Notes: This article provides a usable and practical framework for testing assessment systems. It includes a comprehensive and enlightening literature review that reveals some things that are anecdotally known (that students are driven by assessment, that students will do what it takes to pass including leaving out learning of those elements of a course that they think won't be tested, that successful students seek out evidence of what will be tested while less successful students just try to learn it all) and some surprising evidence about assessment (that coursework assessment results in greater, better and more long term learning than examinations, that while feedback is vital to enhance student learning it can be missed by students when they are given marks alongside it). The 10 conditions listed relate to two areas of influence - "the influence of the design of assessment systems and assignments on how much students study, what they study and on the quality of their engagement, the influence of feedback on learning". In conclusion, the authors note that the 10 conditions may be used as a checklist to review and make changes to an assessment and feedback approach. This paper is relevant to the ALTC project, since it highlights the link between assessment and learning outcome (in terms of quality, quantity and retention of learning) and provides practical guidance as to how to enhance that.

URL: http://www.open.ac.uk/fast/pdfs/Gibbs%20and%20Simpson%202004-05.pdf

Reference Type: Journal Article
Author: W. Hall, S. Palmer, C. Ferguson and J. T. Jones
Year: 2007
Title: Delivery and assessment strategies to improve on- and off-campus student performance in structural mechanics
Journal: International Journal of Mechanical Engineering Education
Volume: 35
Issue: 4
Pages: 272
ISSN: 03064190
Keywords: College students
Stress analysis
Methods
Learning
Laboratories
 Colleges & universities

**Abstract:** This paper considers the delivery and assessment strategies used in two structural mechanics units at Deakin University, a leader in distance education in Australia. The two units have had unacceptably high rates of student failure. Student perceptions of the delivery method were analysed and an investigation was carried out of the performance of 329 (173 on- and 156 off-campus) students enrolled in the two units. An analysis of the assignment, laboratory and examination marks is presented. Consideration is also given to the total marks. The results show that on-campus students performed better in structural mechanics than their off-campus counterparts. Plots of the distributions of student performance for the three assessment methods are provided (for each unit) and high failure rates are linked to low examination marks. Students tended to perform best in assignments and worst in examinations. Parametric statistical tests show a correlation between the marks obtained in continuous assessment and in examinations, and it is therefore proposed that, in order to improve performance, the students must be encouraged to participate fully in all aspects of the course. Many students were unenthusiastic about laboratory practical sessions and did not think they aided their understanding of the theoretical material. Motivation to participate is often dependent on the perceived relevance of a given task and its contribution to the total mark and, thus, to help motivate students to participate fully in the continuous assessment tasks, the authors propose several changes to the delivery methods, as well as to assessment criteria and marking schemes. [PUBLICATION ABSTRACT]

**Research Notes:** The authors reviewed two linked structural mechanics units that are offered both on and off campus. Via a student survey and an analysis of student results they postulate that the high failure rate is due to the lack of value that students currently place on the laboratory components of assessment (this compounds differences between on and off campus cohorts as the off campus students face many more challenges to get on campus to complete the laboratories and at a time that is relevant to their theoretical learning). The authors propose to address the issues raised by modifying the teaching team approach (using one or two academics to facilitate four hours of combined theory and problem solving rather than having separated lectures and then tutorials taken by less experienced teachers) and by changing the emphasis on assessment. The reasons for modifying laboratory and assignment assessment approaches is their contention that students who diligently undertake labs and assignments also improve their exam results through a greater understanding of theoretical concepts. The paper is somewhat relevant to the ALTC project as it describes an evidenced based approach to teaching innovation although the links between failure in the exam and results in the ongoing assessment are not substantiated.

**URL:**

---

**Reference Type:** Report

**Author:** R. James, E. Bexley, M. Devlin and S. Marginson

**Year:** 2007

**Title:** Australian University Student Finances 2006: Final report of a national survey of students in public universities

**Institution:** Universities Australia

**Research Notes:** This report is of the latest survey of Australian university student finances. The survey was conducted in 2006 and aimed to gather quantitative data regarding the overall financial situation of undergraduate and postgraduate domestic students. There was a further stratification of results to highlight the situation for Indigenous students as compared to non-Indigenous students. Short fact sheets are also available that highlight the key findings. For undergraduates, students are worse off in financial terms than they were at the time of the last such survey in 2000. In particular, there is a trend towards students working longer hours and many report the adverse effects that this has on their ability to study and attend classes. This report is relevant to the ALTC project in the context of other research evidence that suggests that student engagement is related to student retention and the impacts of paid work on engagement.


**Access Date:** 19 September 2008
**Reference Type:** Report

**Author:** S. Kift, H. Goss, A. Mylonas, M. Kelly and L. Stedman

**Year:** 2002

**Title:** QUT First Year Experience (FYE) Program Issues Paper 1: Engaging Learning Experiences

**City:** Brisbane

**Institution:** QUT

**Research Notes:** This is an internal position paper prepared at QUT to provide guidance to the First Year Experience Program in the area of Engaging Learning Experiences. Two other position papers on practical and timely support services and a sense of belonging complete the series. The paper provides a short review of the current literature and guidance for teachers, for the learning environment and learning design and highlight areas for attention. The paper is short and practical and many of the suggestions are of relevance across the curriculum even though it is aimed primarily at first year. Because it was designed as an internal QUT document, it is specific to that institution but the literature review and guidance are of relevance to most Australian institutions.


---

**Reference Type:** Report

**Author:** R. King

**Year:** 2008

**Title:** Addressing the Supply and Quality of Engineering Graduates for the New Century

**Institution:** Carrick Institute for Learning and Teaching and the Australian Council of Engineering Deans

**Research Notes:** This is a comprehensive report that both reviews the state of Australian engineering education and makes recommendations for the future. It provides an Australian context to the experience of students and staff in engineering education and guidance for future directions. It provides a snapshot of the current state of engineering education including a profile of current students, staff, research activity and accredited programs. Throughout each section examples from various institutions serve to highlight current practice. The recommendations are wide ranging and explicit. This report is of relevance to the ALTC project in providing a big picture context to the direction of engineering education in the future.


---

**Reference Type:** Report

**Author:** K.-L. Krause, R. Hartley, R. James and C. McInnis

**Year:** 2005

**Title:** The First Year Experience in Australian Universities: Findings from a Decade of National Studies

**Institution:** Centre for the Study of Higher Education, University of Melbourne

**Department/Division:** Department of Education, Science and Training, Funded by Higher Education Innovation Programme

**Research Notes:** This large scale report provides information about changes over a 10 year period in the attitudes and experiences of first year students in Australian universities. A number of findings are relevant to the ALTC project including the high rate of interest and job-related reasons for enrolling in university study, the increase in the number of hours of paid work and a corresponding decrease in the number of hours spent on campus and the
perception by large numbers of students about the lack of accessibility of staff and the lack of staff interest in progress and provision of feedback. Students enrolled in engineering are reported to:

- be more likely to find the work standard at university to be higher than they expected
- feel most pressured by their parents' financial commitment to send them to university
- prefer a general first year at university more than others
- most commonly agree that university clearly builds on school study
- work with peers on course problems areas and discuss their subjects with peers more than any other discipline group
- be the most regular users of online course material.

URL: http://www.dest.gov.au/sectors/higher_education/policy_issues_reviews/key_issues/assuring_quality_in_higher_education/first_year_experience_aust_uni.htm

Access Date: 20 September, 2008

Reference Type: Journal Article
Author: S. Lee, M. Harrison, G. Pell and C. Robinson
Year: 2008
Title: Predicting performance of first year engineering students and the importance of assessment tools therein

Journal: Engineering Education
Volume: 3
Issue: 1
Pages: 44-51
Start Page: 44

Abstract: In recent years, the increase in the number of people entering university has contributed to a greater variability in the background of those beginning programmes. Consequently, it has become even more important to understand a student’s prior knowledge of a given subject. Two main reasons for this are to produce a suitable first year curriculum and to ascertain whether a student would benefit from additional support. Therefore, in order that any necessary steps can be taken to improve a student’s performance, the ultimate goal would be the ability to predict future performance.

A continuing change in students’ prior mathematics (and mechanics) knowledge is being seen in engineering, a subject that requires a significant amount of mathematics knowledge. This paper describes statistical regression models used for predicting students’ first year performance. Results from these models highlight that a mathematics diagnostic test is not only useful for gaining information on a student’s prior knowledge but is also one of the best predictors of future performance. In the models, it was also found that students’ marks could be improved by seeking help in the university’s mathematics learning support centre. Tools and methodologies (e.g. surveys and diagnostic tests) suitable for obtaining data used in the regression models are also discussed

Research Notes: The primary research questions addressed by this article relate to determining what factors may be used to predict the performance of first year students (both overall performance and performance in a mechanics course). Data on students was collected from a number of sources (both self-reporting, from diagnostic testing and from university academic records) and included demographic data, previous academic results (school based), current enrolment profile and diagnostic test results. The students were studying mechanical engineering at Loughborough University in the UK. A simple linear regression model was applied to the data using a stepwise method on the original 14 variables and subsequently removing those variables that were shown not to be significant. Three variables remained as being significant predictors of success - mathematics diagnostic test result, number of statistics modules studied (at A-level, i.e. high school) and whether or not the student had visited the Maths Learning Support Centre. The extent of the statistical modelling used to arrive at the final statements is somewhat limited. The authors also acknowledge that the sample size is quite small and this model is not
generalisable to other contexts. However, they do point out that collecting similar information at other institutions would be possible. The aim of the study was not to produce a generalisable result but rather to provide some recommendations for what could be done in a particular context. To that extent, it provides an interesting case of what academics can do within their own institutions to help their own students to be successful and hence, is of relevance to the ALTC project in providing practical guidance to engineering academics.

URL: http://www.engsc.ac.uk/journal/index.php/ee/article/view/75/115

Reference Type: Report
Author: G. N. Marks
Year: 2007
Title: Completing University: Characteristics and Outcomes of Completing and Non-completing Students
Series Title: Longitudinal Surveys of Australian Youth
City: Camberwell, Victoria
Institution: Australian Government Department of Education, Science and Training (DEST)
Volume: 51
Publisher: The Australian Council for Educational Research Ltd

Research Notes: This report is part of the series of Longitudinal Surveys of Australian Youth. The survey sample is a group of young people who were in Year 9 in 1995 and as such provides information only on school leavers who entered university (see also McMillan, 2005 which is a part of the same series). The report examined the overall course completion rate and looked for how this changed with socio-demographic factors and educational factors. It also went on to look at labour market outcomes for completers and non-completers. It was found that students’ regional and socioeconomic background had little influence on their likelihood of completing university although Indigenous students were much less likely to complete (although the survey sample of Indigenous students was quite small). Student high school background was strongly correlated with expected course completion - in particular about 94% of students with ENTER scores above 90 were expected to complete compared to 73% of students with scores between 60 and 69. Field of study had an impact on completion rate. Expected completion rate for Engineering and Related Technologies was 83.2% as compared with 96.7% for Medicine, Dentistry, Vet Science and Law and 70.2% for Information Technology. This report is of relevance to the ALTC project as a broad background to the impact of high school academic achievement on expected course completion.

URL: http://www.acer.edu.au/lsay/research.html

Reference Type: Journal Article
Author: G. S. May and D. E. Chubin
Year: 2003
Title: A Retrospective on Undergraduate Engineering Success for Underrepresented Minority Students
Journal: Journal of Engineering Education
Volume: 92
Issue: 1
Pages: 13
Start Page: 27
Date: Jan 2003
Abstract: This paper examines the various factors that contribute to the success of minority students in engineering programs by exploring past and current paradigms promoting success and analyzing models for advancing the participation of members of these populations. Included is a literature review of articles, government
reports, Web sites, and archives published since 1980. Student success is correlated to several indicators, including pre-college preparation, recruitment programs, admissions policies, financial assistance, academic intervention programs, and graduate school preparation and admission. This review suggests that the problem of minority underrepresentation and success in engineering is solvable given the appropriate resources and collective national "will" to propagate effective approaches.

**Research Notes:** This paper provides a literature review on programs and outcomes to support minority students in engineering. Since it was undertaken by the US National Action Council for Minorities in Engineering Inc, its focus is primarily on US minority students and in particular African American, Hispanic and Asian students although it does also report on women and students with a disability. If defines engineering success as "Satisfactory preparation for, recruitment and admission into, and completion of a baccalaureate engineering degree for members of underrepresented minority populations". It reviews success as correlated with pre-college preparation, recruitment programs, admissions policies, financial assistance, academic intervention programs, and graduate school preparation and admission. Of particular interest to the ALTC project is the intervention programs described. These are introduced in the context of Astin's student involvement theory and the metrics proposed by it to measure student involvement: amount of energy devoted to studying, amount of time spent on campus, amount of participation in student organizations, amount of interaction with faculty; and amount of interaction with other students. The successful models described address some of these issues and in particular for minority students amount of interaction with faculty is one of the most significant factors affecting retention.

**Reference Type:** Report
**Author:** J. McMillan
**Year:** 2005
**Title:** Course Change and Attrition from Higher Education
**Series Title:** Longitudinal Surveys of Australian Youth
**City:** Camberwell, Victoria
**Institution:** Australian Government Department of Education, Science and Technology (DEST)
**Volume:** 39
**Pages:** 43
**Publisher:** The Australian Council for Educational Research Ltd

**Research Notes:** This report is part of the series of Longitudinal Surveys of Australian Youth. The survey sample is a group of young people who were in Year 9 in 1995 and as such provides information only on school leavers who entered university (see also Marks, 2007 which is a part of the same series). It considers two areas of interest to the ALTC project - course change and attrition. Findings of interest include the higher likelihood of course change for students for whom their initial course was not their first preference, for students who spent over 15 hours a week in paid work and for students in engineering and related technologies (although engineering students were less likely to change than those in natural and physical sciences, medicine/dentistry/vet science/law, they are more likely to change compared to students in education, health, management and commerce, information technology and creative arts, course change rate was 13%). Attrition results suggest that one of the main reasons for students leaving was interest and course preferences (that is their first course turned out not to be what they wanted). By contrast academic difficulties did not figure as highly. Engineering attrition was reported to be around 11%. This report provides useful broad figures about course change and attrition and provides some recommendations for higher education institutions to address these issues. It is of some relevance to the ALTC project in providing broad quantitative data and limited qualitative data.


---

**Reference Type:** Book
**Author:** P. Race
**Year:** 2005
**Title**: Making Learning Happen: A Guide for Post-Compulsory Education

**City**: London

**Publisher**: SAGE Publications

**Call Number**: 370.1523 306

**Research Notes**: This is an easy to read, practical book about organising teaching-learning environments that "make learning happen". Of particular interest to the ALTC project is the section on slow learning and the need to consider the time factor in curriculum design to cement understanding of complex concepts.

---

**Reference Type**: Book

**Author**: P. Ramsden

**Year**: 2003

**Title**: Learning to Teach in Higher Education

**City**: London and New York

**Publisher**: RoutledgeFalmer

**Number of Pages**: 272

**Edition**: 2

**Research Notes**: A thorough and practical guide, grounded in research, to teaching in higher education. It provides a comprehensive overview of research in learning and teaching in higher education and in particular to the approaches to learning field (phenomenography). It discusses both what teachers can do to improve student learning from a classroom teaching perspective but also how the design of curriculum and assessment impacts on student learning outcomes. Finally it provides guidance on evaluating and improving teaching and is a handy starting point for those looking at applying a scholarly approach to teaching improvement. Sections that are relevant to the ALTC project include the model of student learning in context which summarises the relationship between the context of learning (teaching, curriculum and assessment), student approaches to learning and learning outcomes.

---

**Reference Type**: Journal Article

**Author**: M. Scheja

**Year**: 2006

**Title**: Delayed understanding and staying in phase: Students' perceptions of their study situation

**Journal**: Higher Education

**Volume**: 52

**Pages**: 421-445

**Abstract**: Findings are presented from a study of undergraduate students’ experiences of understanding in first-year engineering. At the end of their first year of study 86 Swedish students of electrical engineering and computer science were asked to reflect in writing on their experiences of studying and learning. Fifteen of them also took part in interviews which explored in some detail their experiences of understanding in relation to perceived constraints of the teaching-learning environment. The analyses of the students' written accounts and the interview data focused on the students' experiences of studying and of understanding in relation to course work in engineering. The majority of the students reported problematic first-year experiences and testified to a sensation of 'falling out of phase' with their studies. This sensation was frequently coupled with a lag in coming to understand course material, which may be characterised in terms of delayed understanding. The notion of delayed understanding is discussed in relation to ideas about students’ perceptions of the learning environment and the impact that those perceptions might have on students' opportunities to reflect on learning material and develop a
solid understanding of course material in engineering education. In conclusion, it is suggested that the notion of delayed understanding captures the complications of a study situation in which a perceived lack of time to reflect on learning material obstructs students’ understanding of course material in engineering, and also points up a more general aspect of learning observing that time to reflect on previous experiences is an essential component of the process of coming to understand learning material in a particular educational setting.

**Research Notes:** This article reports on a qualitative research study looking at student reports of experiences of study and of understanding. It references the phenomenographic research on student learning and aims to provide analysis of individual experiences of study and understanding. The author reports that many students experience a feeling of "falling out of phase" in their studies associated with a heavy work load and high course requirements. Student quotes from a survey (n=86) and interviews (n=15) are used to illustrate these experiences. The students further report that the pressures of a full course schedule lead them to take "tactical steps" to stay in phase - that is to choose collaboration and sometimes copying of other's work as a means to submitting assessable tasks on time. Interestingly the students recognise that this path leads to completion rather than understanding but felt compelled to choose such methods to cope. Their perceptions of the teaching and learning environment that lead to such pressure relate to over demanding teaching and in particular the teaching pace, that is, lecturers who moved on to new topics assuming they were complete without time for students to actually understand - hence the term delayed understanding to describe the experiences of students. Delayed understanding related to two forms of expectation - delayed in relation to students' personal expectations and delayed in relation to external expectations as communicated by the structure of the teaching-learning environment. In his conclusion, the author notes that perhaps one of the challenges for engineering educators is that students believe that understanding is instantaneous, that is, attendance at a lecture or completion of a topic on the schedule means it is understood whereas the requirement for time and practice is inherent in all learning and should be communicated to students. This article is relevant to the ALTC project in that it provides an interesting insight into the approaches that students will adopt based on their perceptions of the requirements of the teaching-learning environment. It was clear from a number of student quotes that students started out with the aim of understanding and engaging with material but felt forced to develop an approach of "deliberate 'non-engagement'" to meet the requirements of their program.

---

**Reference Type:** Journal Article

**Author:** K. A. Smith, S. D. Sheppard, D. W. Johnson and R. T. Johnson

**Year:** 2005

**Title:** Pedagogies of Engagement: Classroom-Based Practices

**Journal:** Journal of Engineering Education

**Volume:** 94

**Issue:** 1

**Pages:** 87

**ISSN:** 10694730

**Keywords:** Cognitive style  
Social interaction  
Professional practice  
Student behavior

**Abstract:** Educators, researchers, and policy makers have advocated student involvement for some time as an essential aspect of meaningful learning. In the past twenty years engineering educators have implemented several means of better engaging their undergraduate students, including active and cooperative learning, learning communities, service learning, cooperative education, inquiry and problem-based learning, and team projects. This paper focuses on classroom-based pedagogies of engagement, particularly cooperative and problem-based learning. It includes a brief history, theoretical roots, research support, summary of practices, and suggestions for redesigning engineering classes and programs to include more student engagement. The paper also lays out the research ahead for advancing pedagogies aimed at more fully enhancing students’ involvement in their learning.

**Research Notes:** This paper provides a historical context for cooperative learning and problem based learning in engineering education, along with a comprehensive review of the current theoretical and research evidence in
support of the effectiveness of these modes of instruction. It shows the links between cooperative learning and academic success, quality of relationships among students and between students and faculty, psychological adjustment and positive attitudes toward college experience. The paper goes on to provide practical guidance as to how cooperative learning and problem based learning can be implemented into engineering education and finally concludes with a series of unanswered questions for future research. The paper provides an effective summary of the positive impact of cooperative learning and problem based learning on student engagement and the link between that engagement and student success. It is of relevance to the ALTC project because it provides both a well argued theoretical case and practical examples of implementation.

URL:

Reference Type: Journal Article
Author: L. Springer, M. E. Stanne and S. S. Donovan
Year: 1999
Title: Effects of Small-Group Learning on Undergraduates in Science, Mathematics, Engineering, and Technology: A Meta-Analysis
Journal: Review of Educational Research
Volume: 69
Issue: 1, Spring
Pages: 21-51
Abstract: Recent calls for instructional innovation in undergraduate science, mathematics, engineering, and technology (SMET) courses and programs highlight the need for a solid foundation of education research at the undergraduate level on which to base policy and practice. We report herein the results of a meta-analysis that integrates research on undergraduate SMET education since 1980. The meta-analysis demonstrates that various forms of small-group learning are effective in promoting greater academic achievement, more favorable attitudes toward learning, and increased persistence through SMET courses and programs. The magnitude of the effects reported in this study exceeds most findings in comparable reviews of research on educational innovations and supports more widespread implementation of small-group learning in undergraduate SMET.

Research Notes: This paper is an extremely comprehensive meta-analysis of a range of studies on small group learning. It includes a comprehensive and detailed statistical analysis of the results of studies on the impact of small group learning on academic achievement, persistence/retention and a broad range of attitudes including self-esteem, motivation to achieve and attitudes towards learning SMET (science, mathematics, engineering and technology) material. While the authors identified 383 reports related to small-group learning from 1980 or later, only 39 of those reports were used in the final analysis because of their stringent criteria for inclusion (including being in an accredited post-secondary institution, incorporating small group work inside or outside the classroom, in an actual classroom not a laboratory setting, published or reported after 1980, with sufficient statistical information to estimate effect sizes). The studies covered a wide range of small group learning approaches. The results indicate that "small-group learning has statistically significant and positive effects on undergraduates in SMET courses". This study is of high relevance to the ALTC project since it provides well researched and supported evidence for approaches that lead to improvements in student success (and thus the overcoming of barriers to learning).

Reference Type: Journal Article
Author: R. Suresh
Year: 2006-2007
Title: The Relationship between Barrier Courses and Persistence in Engineering
Attrition in engineering programs continues to be an important issue for universities across the country. This study examined the connection between student performance in barrier courses and persistence in engineering. Quantitative results showed that high school academic experience, student behaviors (including study habits, work habits, coping strategies), students' perceptions about faculty behavior (including teaching styles and the "weed-out" culture), the perceived culture of support in the engineering school, and motivation to succeed in engineering all impact students' performance in barrier courses. Qualitative results showed that motivation to succeed might be the reason why some students persist even when they "struggle" with barrier courses.

Research Notes: This study hypothesised that performance in barrier courses in engineering programs might be a predictor of student persistence. Barrier courses were defined as those that had the highest failure and/or withdrawal rate. The barrier courses were identified only anecdotally rather than through any systematic analysis of student results, although those identified align with other research literature on student attrition - calculus, physics and statics. This article contains a thorough review of the literature as background to this study and places it in the context of other research in both engineering and more generally in higher education. The cohort studied were students in the first 2 years of an engineering degree at a major research extensive university in the north east of the USA. The study was retrospective so therefore did not include surveys of non-persisters. Persisting students were classified into three groups - group I or "sailers" who had never failed a barrier course and achieved either an A or B grade, group II or "plodders" were those who achieved B and C grades and who may or may not have repeated a course and finally group III the "struggling persisters" who had C grades or lower and had repeated one or more courses. Both quantitative surveys (n=728) and personal interviews (n=15) were conducted. While there is extensive discussion in this paper, the extent of the statistical analysis seems quite limited (for example causation is not discussed). The article identified another study limitation in that the students were surveyed and interviewed well after they had completed the barrier courses and this may have impacted on their views. Some results of interest include the finding that students in group I were much more likely to be positive about faculty teaching styles and culture in the classroom than group III students. This raises the question of whether students who perform well view their classrooms positively or faculty tend to teach to those who perform well. Motivation to succeed in engineering was the common factor across all persisters and the author suggests that this may be the determining factor in student success (a necessary but not sufficient requirement). Finally his conclusions suggest changes only to student preparation (high school subject choice and careers information) and support programs (to help the struggling persisters with difficult courses) rather than making any recommendations to the engineering program itself or teaching. This article is of relevance to the ALTC project in exploring the range of student experience of courses.

Reference Type: Journal Article
Author: P. T. Terenzini, A. F. Cabrera, C. L. Colbeck, J. M. Parente and S. A. Bjorklund
Year: 2001
Title: Collaborative learning vs. lecture/discussion: Students' reported learning gains
Journal: Journal of Engineering Education
Volume: 90
Issue: 1
Pages: 123
ISSN: 10694730
Abstract: This study examined the extent to which undergraduate engineering courses taught using active and collaborative learning methods differ from traditional lecture and discussion courses in their ability to promote the development of students' engineering design, problem-solving, communication, and group participation skills. Evidence for the study comes from 480 students enrolled in 17 active or collaborative learning courses/sections and six traditional courses/sections at six engineering schools. Results indicate that active or collaborative methods produce both statistically significant and substantially greater gains in student learning than those
associated with more traditional instructional methods. These learning advantages remained even when differences in a variety of student pre-course characteristics were controlled.

**Research Notes:** This study looked to fill a gap in current empirical research about the relationship of students learning outcomes to instructional approaches. The method employed was to develop a "Classroom Activities and Outcomes Survey" that was administered to students. The survey gathered information in three areas: student demographics (personal and academic), student perception of the instructional characteristics of the course in which they were enrolled (by asking students how often they or their instructors engaged in certain instructional activities) and the extent to which students believed they had progressed in their skill development and learning as a result of being in that course. The discussion in this article of method and analysis is very thorough and includes discussion of limitations of the study (including addressing the issue of reliance on self-reporting of learning gains, which is addressed by referring to other research that suggests validity of this measure). The conclusions point to a clear enhancement in learning outcomes in the areas of design skills, communication skills and group skills for students involved in active/collaborative instructional settings. For the ALTC project, this study points to an increased use of active and collaborative instructional strategies to enhance learning outcomes.

**URL:**

---

**Reference Type:** Journal Article

**Author:** V. Tinto

**Year:** 1997

**Title:** Classrooms as communities

**Journal:** The Journal of Higher Education

**Volume:** 68

**Issue:** 6

**Pages:** 599

**ISSN:** 00221546

**Keywords:** Higher education  
College students  
Community colleges

**Abstract:** Tinto uses data from a study of a learning community program in an urban community college to explore the educational character of student persistence. Classroom activities influence student persistence by changing the way students and faculty interact within and beyond the classroom setting.

**Research Notes:** This article is by one of the leading researchers in the area of student persistence. It reports on a study in a single college in the U.S. that sought to understand what impact the introduction of learning communities and collaborative learning strategies in the classroom would have on student persistence and learning. The study sampled students in two different programs - a traditional curriculum and an innovative Coordinated Studies Program. As well as demographic data, students were surveyed about their level of engagement both in and out of the classroom using a modification of Pace's Quality of Student Effort Scales. Further qualitative analysis was undertaken through observation, interviews and document review. Observation was of classroom activity and of the campus and surrounding community. The quantitative survey data showed improved persistence amongst students who were in the Coordinated Studies Program. The qualitative data revealed three broad areas of difference: building supportive peer groups, shared learning-bridging the academic-social divide and gaining a voice in the construction of knowledge. Although this research data is from students in liberal arts courses it aligns with research in engineering that demonstrates that persistence is improved when students are engaged with fellow students and with their classroom experiences. For this reason, this article is of relevance to the ALTC project because it places the engineering specific research in the broader higher education context.
Reference Type: Conference Paper
Author: V. Tinto
Year: 2005
Title: Student Retention: What Next?
Conference Name: National Conference on Student Recruitment, Marketing, and Retention
Conference Location: Washington, D.C.
Date: July 27-30, 2005
Research Notes: A keynote presentation from one of the leading US researchers in student persistence or retention. It provides a short history of the focus of student retention research and action in higher education and points to the need for institutional shifts to achieve movements in student retention. In particular, Tinto notes that, while early work on retention focused on student support services, it is now widely known and accepted that the work of student retention has to take place in the classroom, with a change to classroom pedagogy to achieve student engagement. This paper is of some relevance to the ALTC project in providing a big picture context to thinking about student retention in higher education.
URL: http://faculty.soe.syr.edu/vtinto/Files/Student%20Retention-What%20Next_.pdf

Reference Type: Journal Article
Author: P. Tynjala, R. T. Salminen, T. Sutela, A. Nuutinen and S. Pitkanen
Year: 2005
Title: Factors related to study success in engineering education
Journal: European Journal of Engineering Education
Volume: 30
Issue: 2
Pages: 221
ISSN: 03043797
Keywords: Higher education
Engineering
College students
Academic achievement
Abstract: Recent studies on student learning in higher education have paid attention to the relationships between characteristics of the learning environment and students' study orientations and study success. The purpose of the present paper is to examine these relationships in university level engineering education. The data were collected from Lappeenranta University of Technology, Finland, by means of an Internet survey (n=394). Grade point average, credits per semester and students' qualitative evaluation of their learning outcomes were used as indicators of study success. The findings of the study indicate that students' perceptions of their learning environment were related to their study orientations which, in turn, were related to study success. Having a deep study strategy was the most important predictor of study success. Having a surface strategy, doubt about one's abilities and lack of regulation were factors negatively related to study success. Meaning-oriented and self-regulated students using a deep strategy showed the best success in their studies and externally regulated
students using a surface strategy the worst. The findings of the study suggest that the learning environments in Lappeenranta University of Technology encourage deep learning. [PUBLICATION ABSTRACT]

**Research Notes:** This article is a report on a Finnish study of engineering students at Lappeenranta University of Technology. It is based in the area of higher education research around Student Approaches to Learning that came from the research of Marton and Saljo, Entwistle and Biggs. Based on a model with the three components of background variables, learning process and learning outcome, it aimed to address the nature of the relationship between students' perceptions of their learning environment and their study orientations and between students’ general study orientations, more situational study approaches and study success. The process of sampling, in contrast to some of the other references in this review was quite thorough. An internet survey was used to gather data from students across the whole engineering program (spanning all years and disciplines). Students were clustered into groups and their study success compared on the basis of extensive statistical analysis of the survey results. Students in the "meaning-orientated self-regulated" category were the most successful and students in the "externally regulated surface learning" category were the lease successful. While emphasising that the impact of learning environment is via student perception or conception of that environment, the authors also conclude that recent changes to the engineering program to enhance pedagogical approaches have resulted in improvement in student learning outcome. This study is very relevant to the ALTC project as it points to the complex inter-relationships between the learning environment, students perceptions of it and their study success.

**URL:**

---

**Reference Type:** Journal Article

**Author:** J. D. Vermunt and N. Verloop

**Year:** 1999

**Title:** Congruence and friction between learning and teaching

**Journal:** Learning and Instruction

**Volume:** 9

**Pages:** 257-280

**Start Page:** 257

**Abstract:** Theories of learning and theories of teaching often originate and operate independently from one another. This article attempts to contribute to the integration of the two types of theories. First, the cognitive, affective and regulative activities students use to learn are analyzed. Next, different ways in which teachers can regulate the learning and thinking activities of students are discussed, as well as the teaching strategies they can use for that aim. The third part focuses on different ways in which student-regulation and teacher-regulation of learning act upon one another. Congruence and friction between these modes of control are discussed. From this interplay implications are derived for process-oriented teaching, aimed at promoting congruence and constructive friction, avoiding destructive friction and reducing the gap between learning and teaching.

**Research Notes:** This article provides a neat theoretical model to think about learning and teaching and the relationship between the two. It suggests that the learning activities that students are involved in fall into three categories: cognitive activities, affective activities and regulative activities. The activities that students actually engage in are dependant on both their learning styles, strategies conceptions and orientations and the teacher’s regulation strategies. High quality learning requires a range and balance of learning functions across the learning activity range. The paper suggests that teacher regulation falls within a spectrum that can be characterised by three points: strong teacher control, loose teacher control and shared control (between teacher and students) of learning functions. Teaching style may be seen as the combination of teacher regulation (strong, loose or shared) across the range of learning functions in a particular teaching instance. Finally the model suggests that the combination of the degree of student-regulation (the capability of students to undertake learning activities) and the degree of teacher-regulation leads to learning situations where there is either congruence, constructive friction (where students are challenged to improve their self-regulation) or destructive regulation (where in extreme cases there can be learning degradation). To maximise congruence and constructive friction, the authors suggest the use of process-orientated teaching and postulate a different role of the teacher from traditional knowledge transmission. Six guidelines are provided for teachers: teacher as diagnostician, teacher as challenger, teacher as model learner, teacher as activator, teacher as monitor, teacher as evaluator. For each, examples are provided. This paper is of
relevance to the ALTC project as it provides a link between thinking about learning styles and teaching styles. It provides a useful model that would allow teachers to map themselves, their students and the tasks and learning activities of the curriculum to check for congruence or friction.

Reference Type: Journal Article
Author: C. M. Vogt
Year: 2008
Title: Faculty as a Critical Juncture in Student Retention and Performance in Engineering Programs
Journal: Journal of Engineering Education
Volume: 97
Issue: 1
Pages: 27
ISSN: 10694730
Keywords: Academic achievement
Higher education
Studies
College students
Learning
Engineering
College faculty
Student retention

Abstract: Large numbers of students depart from engineering programs before graduation. For example, in fields such as engineering and computer science, students have commented on the inaccessible or unapproachable nature of faculty. To evaluate this problem, this study gathered data across four research universities. Using structural equation modelling, it measured environmental effects, i.e., academic integration or faculty distance on (a) self-efficacy, (b) academic confidence and (c) self-regulated learning behaviors effort, critical thinking, help-seeking and peer learning, and (d) GPA. Results showed that faculty distance lowered self-efficacy, academic confidence and GPA. Conversely, academic integration had a positive effect on self-efficacy, which in turn had strong positive effects on effort and critical thinking. Consequently, ongoing educational reform efforts must encourage engineering faculty to understand the significance of their student/professor relationships and seriously undertake measures to become personally available to students. [PUBLICATION ABSTRACT]

Research Notes: This article addressed a number of research questions about the influence of environmental effects such as academic integration and faculty distance on students’ self-efficacy, academic confidence, self-regulated learning behaviours and GPA. It uses a conceptual framework based on Bandura’s social cognitive model which links environment, behaviour and self. Students were surveyed from a range of branches of engineering and across all year levels (from freshman to senior) although the majority (69%) came from the first two years. The students were drawn from four institutions, all west coast (USA) research intensive institutions. The student sample was identified using engineering campus organisations such as IEEE and the Society for Women in Engineering (hence a non-typical gender breakdown) as well as through surveying in large core physics classes. The survey was designed to test perception or self reports on a number of variables, many of which had a number of sub-scales. The variables were Discrimination, Academic Integration, Academic self-confidence, Self-efficacy, Effort, Critical thinking, Help seeking and Peer learning. Results were analysed using a number of statistical models (exploratory factor analysis to validate subscale items, structural equation modelling for multivariate analysis incorporating confirmatory factor analysis to validate the measurement model and path analysis to fit the structural model) and packages (SPSS and EQS). There is thorough discussion of this process confirming the validity of the approach but also outlining limitations. The general structural equation model proposed shows that faculty distance has a negative impact on academic confidence and self-efficacy and that in turn these two influences GPA. Academic integration was also shown to influence self-efficacy. There is some confusion about the separation between the variables of faculty distance and academic integration but the final
conclusion is clear that efforts by faculty to provide "a classroom environment wherein students feel safe asking questions or at least not intimidated to approach professors and/or peers for further clarification of course materials" can and do result in improvements in student outcomes. Limitations identified in the article itself include the non-random student sample and the inability to deduce a causal order for variable interactions given that the survey was only administered at a single point in time and the study was not longitudinal. This article is highly relevant to the ALTC project because it directly answers questions about what faculty (academic staff) can do to enhance student learning outcomes and remove barriers to success.


Reference Type: Journal Article
Author: M. Zinatelli and M. A. Dube
Year: 1999
Title: "Engineering" student success: How does it happen and who is responsible? ★ ★
Journal: Journal of Engineering Education
Volume: 88
Issue: 2
Pages: 149
ISSN: 10694730
Abstract: Despite increasing interest in strategies for enhancing academic performance, several factors limit the ability of engineering students and professors to collaborate in improving the way students approach learning. Evidence indicates that it is worthwhile overcoming these limitations in order to facilitate change. There is a great deal of valuable information available about study skills training as well as evidence that this training results in better academic performance. Moreover, research on motivation suggests that professors can play a key role in helping students make improvements in their study behavior. This paper provides recommendations for helping students recognize the benefits of changing the way they study and for motivating them to participate in study skills training.

Research Notes: This is a short paper which suggests that faculty should take a greater role in promoting study skills training to students and provides some simple ideas that can be implemented. Although it refers to research and evidence the link is to broad psychological research on motivation rather than more specific details of implementation in engineering specific contexts. It is of some relevance to the ALTC project because it points to some simple strategies that could be incorporated into engineering courses but lacks any research depth.


Other Useful References


