USING PROJECTS INSTEAD OF PRACS FOR HANDS ON LEARNING

Final Report for the
Graduate Certificate in
Education, 2000.

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Abstract

Prior to 2000, practicals in the power electronics subject have been isolated two hour sessions with only nominal assessment. Students were not motivated to prepare for or subsequently review the results of these prac sessions. The time in the pracs was rushed, and student's actions were task oriented. Learning was shallow or did not occur at all.

The change introduced in 2000 was to create two projects which each spanned a four week period. The contact each week consisted of a two hour laboratory session, and a one hour tutorial for the discussion of the problem. The projects were larger, linked, real world problems, tackled by groups of three students. Assessment was via individual wookbooks kept during the project, a group demonstration of the working project by all members, and a subsequent report written either individually or as a group.

These projects were highly successful in motivating the students, and achieved the transfer of the theory presented in lectures into personal practical understanding of that material. These outcomes were judged by observations of the class, project and exam marks, and responses to a questionnaire given at the conclusion of the semester.

Improvements for 2001 include better defined marking criteria for the assessable components of the project, and more careful timing of the projects.

This intervention in the power electronics subject along with this report form part of an action learning project for the Graduate Certificate in Education. The action learning process is validated as a powerful teaching tool.

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Statement of the Problem and its Context

Introduction – Lectures, Tutes and Pracs in CSEE

The Electrical Engineering Department, now the School of Computer Science and Electrical Engineering, at the University of Queensland has traditionally used three forms of contact with students --- lectures, tutorials, and practicals (hereafter lectures, tutes and pracs).

Lectures are invariably the conventional presentation of material at the front of the class using blackboards / whiteboards, overhead projectors, and now PowerPoint data projection. Class participation varies from virtually none, to significant, and usually takes the form of student or lecturer initiated question answer interactions, or perhaps worked examples requiring student involvement. Lecture sizes vary from 20 to over 200.

Tutes are an opportunity for students to work through a number of problems with the lecturer or tutor present for help. As a motivator and to provide feedback, some of these problems may be handed in for marks. When a common problem appears, the lecturer or tutor may work a problem on the board for the benefit of the entire class. One tutor is assigned for every twenty-five students, and where possible, tutorial sessions are often located in smaller rooms.

Practicals in CSEE

The delivery and nature of pracs has changed over the last decade in our department. Originally, all pracs were done as part of a single prac subject, and a day a week was allocated for this subject for each year of the course. For example, the third year prac subject ran every Friday from 10am until 5pm, with a one hour lunch break at 1 pm. Pracs were either three hours or six hours long. Individual pracs were associated with specific teaching subjects, and each subject may have had between two and four associated pracs scheduled each semester.

The limited allocation of resources meant that the ordering and timing of these pracs during semester was often far from ideal. Tutors were responsible for tutoring a range of practicals, sometimes in fields which were not their own. The format, delivery and assessment of pracs was relatively uniform regardless of subject area.

With increasingly flexible subject offerings, centrally co-ordinating and scheduling pracs became quite difficult. The prac subject was removed, and each subject was responsible for the delivery and assessment style of its own pracs. Many lecturers took the opportunity to review the content of their pracs. Often shorter pracs were scheduled more often during the semester, for example six three-hour pracs instead of three six-hour pracs. The pracs were usually scheduled in a set order, and more closely aligned to the content being delivered in lectures. This did however place greater demands on resources, and pracs requiring specific pieces of test equipment had to be phased out.

There are a number of expected benefits of the new approach to prac delivery:

- Shorter pracs are less intimidating.
- Each short prac only delivers one or two key lessons.
- Regular pracs (each fortnight) can now be closely tied to material delivered in lectures.
- Pracs can be scheduled in a specific order, and have dependencies from one to the next.

The Problem with Pracs as Currently Implemented

Shorter pracs do carry some disadvantages. The set-up and tidy-up time in a prac environment is always significant. A two-hour prac does not allow any scope for faulty equipment, unfamiliarity with equipment, lack of preparation, lack of understanding, or disorganisation of any kind. When any of these interruptions do occur, the learning goals are usually lost.

A two-hour prac does not generally allow the scope for grasping more than one concept. A short session focused on conveying a single concept often becomes an

unmotivating “academic” experience. Longer pracs allow exploration further down a path to deeper understanding or more complex issues.

The problem with pracs in CSEE, and in particular in the subject I teach, is that these disadvantages seem to have overwhelmed the potential benefits. Pracs have become short, isolated, sessions in the laboratory. Poor preparation and accountability through assessment has additionally unmotivated students.

I plan to replace short pracs with longer projects for the laboratory component of one of my subjects. I will explain how this should rectify many of the problems presented. But first, a review of some relevant literature.

Literature Review

Student Centred Learning

An excellent paper which offers an introduction to the concept of student centred learning is "What the Student Does: teaching for enhanced learning" (Biggs 1999).

In this paper, John Biggs offers two examples of students at different ends of the learning scale. Susan spontaneously adopts a deep approach to learning, since she is bright and motivated. Robert adopts a shallow learning approach, desiring only to expend sufficient effort to pass. Biggs emphasizes that their respective approaches are choices they adopt, and not innate to who they are. Robert can be encouraged to change his style of learning to be closer to that of Susan by the use of different methods of teaching.

Traditional transmissive teaching techniques allow students like Robert to be passive, or unengaged, in their learning. Susan is active or engaged of her own choice, despite the teaching technique used. Using an active teaching method forces Robert to be involved or engaged in the subject matter.

Biggs argues that successful learning is a result of what the students do. The task of teaching is to organise student-learning activities that promote understanding of the material. Learning outcomes are measured not in terms of knowledge gained, but rather understanding demonstrated.

Aligned teaching is defined as the practice of ensuring that objectives, teaching and assessment are all in agreement. The curriculum should be stated as clear objectives of understanding required, rather than topics to be covered. Teaching and subsequently assessment should also focus on the practicing and then demonstration of the meeting of these objectives. This consistency of criterion-based statements of understanding motivates students to pursue deep learning.

Two examples given of alignment are problem based learning (PBL) and the learning portfolio. The objective is to solve problems that will be met in the student's subsequent professional career; the assessment is the success of their solution. By careful selection of problems, all the important material (content) as well as its application will have been covered.

This paper suggests the practical component of my subject should be reformatted to address real world problems. The technical content of the problem should align with material presented in lectures and tutorials. Assessment should be criteria based, focusing on demonstrated understanding of the material.

Problem Based Learning

The paper "Design, Assessment, and Evaluation of a Problem-based Learning Environment in Undergraduate Engineering" (Reeves and Laffey 1999) describes the design and evaluation of a new introductory engineering subject. The subject uses problem based learning to teach higher order engineering problem solving skills such as problem specification, communication techniques, creativity, and conceptualisation.

Some unique issues were encountered when applying these new ways of teaching and learning within a defence force academy. Collaboration between students was foreign and difficult because of the great emphasis placed on reporting any collusion between students. Assessment was also a critical element in the subject redesign, because the academy relies heavily on GPA (i.e. cumulative course marks) for student awards and privileges.

Assessment was the greatest single source of dissatisfaction for both students and academics. A traditional knowledge and process-based course with specific curricula can be assessed by an appropriate exam to generate a well-defined normal spread of marks, with fine granularity. Although these marks may not actually show any correlation to student understanding, everyone (staff and students) is comfortable.

The marks generated by criterion referenced assessment in a course with general rather than specific goals are better presented in the form of the occupancy of a band (strata)

of competence, and marks will usually be far less spread. While this approach will say more about the students' actual learning outcome and techniques used, to the outside observer, it may appear to require more effort and produce a less satisfying result – if the result desired is a nicely spread normal distribution.

The authors did gather a variety of evaluations of the course and its outcome, all of which suggested it was successful in meeting its aims. In particular, an independently administered Reflective Judgement Exercise (RJE) showed that only the graduates of this new subject had significantly improved in the key area of higher order problem solving. The RJE was taken before and after the subject by participants in both the new and old subject, and also by students in later years of the course.

This paper prompted me to consider a number of issues which I had not previously realised would be problematic when implementing a course with a problem solving component. I am expecting some negative reactions from students and other academics; this paper suggested “some” might be “significant”. I had not considered the challenges of assessment in this new pedagogy, and the importance of using a number of methods to assure quality. I also need to ensure that I measure not just the student's knowledge and ability, but also the performance of the intervention in this subject, using before and after tests.

The paper “Creating a Deep Learning Environment: Motivation, Pedagogy and Organisation” (Abernethy, Dalmau et al. 1995) also discusses the re-creation of a first level subject as a deep-learning environment using problem-based learning. Students are again noted to exit a university with only surface-learning strategies, hence poor problem solving abilities, and “an inability to reconcile theory and practice”.

The three broad interventions undertaken in overhauling this subject were

- A review of the objectives of the subject, and revising these objectives so they reflected praxis,

- Changing pedagogy practices to promote deep learning, and

- Establishing closer links between the department and professional practitioners.

Although this paper focused mostly on the second goal, I was challenged to consider the importance of the other goals to the success of the subject.

Deep learning was to be promoted in this subject by

- Restructuring lectures and tutorials.
- Using assessment which promoted deeper levels of learning.
- Giving questionnaires about learning before and after the subject.

According to Gibbs (1992a), deep learning is occurring (note active, present tense) when students can show their understanding of material by being able to verbally explain that material, generate questions and answers, and solve problems using that material. Deep learning requires the student to have intrinsic motivation, and use appropriate learning techniques. For this subject, the team identified three demands which when placed on a learner would precipitate deep learning:

- Integrate (bring together) and reflect upon knowledge, skills and experiences as they are brought to bear on an issue or problem.
- Use a variety of perspectives when viewing an issue or problem
- Effectively communicate their response to an issue or problem using a combination of spoken, written or physical actions.

The first two action points can be encouraged in my students when they undertake pracs by choosing a real world problem of significant size and depth or scope so as to be challenging and motivational rather than trivial. It will be important not to solve the problem for the students, but rather to leave the problem "open" for a number of

weeks. Enacting the third point will depend on a mixture of modes of assessment of the practicals backed up by descriptive criteria.

Student motivation to apply a deep learning strategy is also clearly important (Abernethy, Dalmau et al. 1995). The student's choice of learning strategy is driven by a number of factors, and can be changed. Three motivations targeted by the subject creators were an appeal to a conscious decision ("deep learning is very beneficial – you should adopt it"), contingency (assessment favours those who adopt a deep learning approach) and a longer term approach of giving the subject a reputation of excellence ("this subject is excellent – you'll enjoy every aspect of it – including the way it is taught and assessed").

The student acceptance of the deep learning approach in Abernethy's study was varied. Of those who regularly attended lectures, approximately equal numbers (about 40% each) supported and rejected the technique. A number of reasons are offered for both acceptance and rejection.

Experiential Learning

David Kolb's book "Experiential Learning" (Kolb 1984) has a wealth of material, and goes deeply into material beyond the scope of this study. The second chapter defines the process of experiential learning, based on the work of three famous researches in this area, Lewin, Dewey and Piaget.

Lewin introduced the experiential or action learning model, which consists of a cycle of four stages. Starting from some concrete experience, the learner observes and reflects on those observations, leading to the formulation of an abstract model, concept, or understanding. This new model is then tested in real world, completing the cycle. Dewey's model of experiential learning builds on Lewin's by suggesting that the very act of completing a learning cycle prompts the learner to initiate the next action learning cycle. Each cycle will probably be at a more advanced or more abstract level. Piaget also links the learners' worlds of abstract concepts and concrete experience. He explains learning as the continual, "mutual interaction between the process of

accommodation of concepts or schemas to experience in the world and the process of *assimilation* of events and experiences from the world into existing concepts and schemas" (Kolb 1984).

Kolb summarizes his perspective on experiential learning with the following three propositions that I quote verbatim:

- Learning is best conceived as a process, not in terms of outcomes.
- Learning is a continuous process grounded in experience.
- The process of learning requires the resolution of conflicts between dialectically opposed modes of adaptation to the world.

Our traditional modes of education can view the process of learning are merely transferring knowledge for later recall using for example lectures and examinations. This transmissive mode of teaching does not necessarily demand the involvement of students, which leads to shallow learning and a lack of true understanding. Even if the learner does seek to understand the material, this *process* of learning most realistically occurs during revision for the examination, and not at either the lecture or the examination. This opportunity for deep learning occurs under unfavourable conditions: the student is forced to seek comprehension in an abstract world of concepts, under stressful conditions, and often without the presence of lecturers or tutors, or other forms of feedback to measure their success.

The use of projects as conceived in this study seeks to address many of these problems. Learning should occur during several unstressed sessions in the guiding and challenging presence of mentors and peers. The problems are set in the physical world and should be naturally motivating. Each problem is set over a number of weeks, with opportunities for reflection, and more than one project will be used, allowing for at least one major "forced" reflective period.

Educational Intervention

Power Electronics Pracs in 1999

As explained the first chapter, the practical classes run as part of many subjects in the School had become ineffective. This was particularly true of the Power Electronics subject taught by the author.

The power electronics subject was an appealing choice for an educational intervention seeking to find an effective replacement for practicals.

- The class consisted of third and fourth year students, who generally have a mature attitude to their education, and a cooperative and friendly relationship with their lecturers.
- The subject is an elective, and could be expected to be a manageable size, between 30 and 60.
- It was lectured by the author.
- It had problems with its practical program, but needed to have a practical content.

In 1999, this subject included five self-contained two-hour pracs, one per fortnight. The class of approximately 45 was split into two groups due to limited resources, and these groups took the same pracs alternate weeks. The prac topics were taken in order, and were aligned to the material presented in the lectures for that fortnight. Students worked in pairs.

The pracs were focused on observing in practice the theory presented in lectures. The tasks were relatively specific. Assessment was qualitative rather than quantitative, with marks being assigned for "Attendance, Attitude and Ability". Most students found getting full marks (4 marks for 4 percent) for pracs easy. As the assessment scheme

relied on students "honour", many students showed very poor preparation, and limited enthusiasm.

Replacing Practicals with Projects

The educational intervention, designed to remove many of the problems of the current approach to pracs, was to base the practical component of the subject around projects. The contact time was still a two-hour session in the electronics laboratory. However, a number of these sessions were grouped together over a number of weeks to form a project.

This intervention was trialed in the second semester of 2000 in the fourth year subject 3e431, Power Electronics.

Project size

The first obvious question is what is the correct number and length of projects to run during the semester. Assuming the semester has twelve useful teaching weeks, the initial options appear to be 6 two-week projects, 4 three-week projects, 3 four-week projects, two six-week projects or one semester long project.

Because of the nature of projects, a minimum amount of time is required to allow them to function as hoped. At the beginning, time is required for specifying and defining the nature, scope and goals of the specific project topic. For pedagogical and practical reasons, these issues are discussed and negotiated with the class. There is also some initial teaching or tutoring by the lecturer at the outset to establish the connection of the project to the subject content. I also desired the students to undertake some research into their approach to the problem to allow creativity and ownership.

Time at the conclusion of the project for presentation and marking becomes a significant part of the project if the project is short. Further, if there are several such presentations and reports to prepare and mark then this becomes an unhelpful burden to both students and staff.

Two-week and even three-week projects were deemed to be too short.

Having one or two large and long projects also presents problems. Project topics which can cover the entire subject content, especially if the content is already partitioned into different sections, are difficult to create and become artificial in nature. The links between lecture content become hard to draw and maintain. Students can become overwhelmed with the magnitude of the task, and might be required to draw more heavily on project management skills that are not the focus of this subject. Assessment becomes a large task and is at the end of the semester. Students are likely to procrastinate without intermediate checkpoints, and don't receive the feedback these would provide. A better approach is to connect a number of shorter projects under a unifying theme.

Project format in 2000

In 2000, I planned three four-week projects instead of the existing isolated two-hour pracs. Each project consisted of four or five weekly two-hour laboratory sessions. Linking these was a weekly one-hour tutorial session specifically for the discussion of the lab work between students, and between the students and the lecturer and tutor. In the first week, the problem was outlined, along with a suggested course of investigation, and a number of expected learning outcomes. After this, as lecturer I attempted to minimise my interference in the solving of the problem by the groups.

As semester progressed, it became clear that I would not be able to run the third project, due to a very high student and staff workload at the end of semester. Specifically, the third year students had a semester long team project due in the second last week, and for the fourth years, their thesis write-up was due in the third last week, and demonstration in the last week. As a lecturer, two sick family members at this time compounded my already busy schedule.

The third project was made optional, and the weighting of the projects adjusted to be the "best two of three". Not surprisingly, no students undertook the third project.

The project topics

The three projects were linked together by a common, real world problem or task. Each project problem specification will be common to the entire class, although different groups may choose to solve the problem in different ways.

In 2000 for the Power Electronics subject 3e431, the three projects will all be based around fitting a bright headlight and electric motor to a scooter. The three projects were

- A mains powered battery charger.
- A power electronic converter to best match the battery to the headlight, and
- A power electronic converter to drive the motor that will be installed in the rear wheel of the scooter.

Each of these tasks is increasingly complex, and matches the progression of material presented in the lectures.

The complete project outlines are included in the Appendix.

Project teams

Students worked in self-assigned groups of three. Students are used to working in groups of two for single session practicals, and teams of four for large, semester long team projects. These projects were intermediate in length, size and complexity. Working as a group allows a distribution of the workload, a mixture of past experience and skills, and the opportunity to share ideas and work creatively and critically. Individual assessment components were used to force equal load sharing to some degree.

In the team project subjects, the students are assigned to groups by the subject coordinator. Working with students who are initially strangers forces the use of communication, interpersonal and management skills, fulfilling one of the aims of these subjects. In contrast to this, in this subject, students are allowed to self-select

their group of three. Working with friends enables the students to focus on the technical problems of the project.

Project Assessment

Assessment occurred in the final week of each project. Based on experiences with another team project subject, the assessment included both individual and group assessable components to help ensure even participation by group members.

The assessment also included three different modes of presentation:

- A physical artefact (the hopefully working project),
- An oral presentation (the project demonstration and defence).
- A written report (explaining the detailed design and evaluation of the project).

Additionally, each student's workbook was marked.

Assessing via a number of different modes of delivery should result in a greater likelihood of deep learning on the part of the learner, and better evaluation of depth of understanding by the assessor. The act of presenting in different ways should stimulate learners who learn using senses other than the written (visual) medium.

Assessing a significant body of work in detail once after a number of weeks rather than a superficial examination of a small amount each week was expected to allow a more accurate final picture of student success. It should also motivate the students to prepare, work hard, and take the assessment seriously, which had not the case in the previous year.

It was hoped the marking workload would remain unchanged. The opportunity for intermediate feedback may have been reduced. However, the discussion tutorials were intended to counter this problem.

Assessment was done using criteria agreed upon and available from the beginning of the semester. These criteria based mark sheets are included as used in the Appendix. Assessment of the project, the presentation and the workbook was performed face to face, with the agreement of a fair mark at the conclusion of the presentation of material for assessment.

Each group of three is expected to demonstrate a working prototype of their solution to each of these problems. The group of three team members will present the oral presentation on one occasion, each member taking responsibility for explaining different aspects of the project. The examiner will ask questions of individuals and the team. Each member will receive a separate oral presentation mark.

A written report is submitted at the conclusion of each individual project. The report may be written by individuals, or by the team. If a team effort, the report is expected to be roughly twice as long, and much more thorough. A short section should be included outlining the contributions of each of the individuals.

Each student will also have his or her workbook assessed at the end of each project. The criteria used will place an emphasis on regular, thoughtful entries that demonstrate thinking and learning, rather than necessarily correct entries.

Additional Resources required for projects

Will the introduction of projects require additional resources?

Money should not be a problem, since the costs should not rise significantly to implement projects instead of pracs. Costs can be made predictable and containable if components used by students can be limited to a specified list of available components, or each team are forced to operate with a small fixed budget.

If students are offered the flexibility of choosing their own components, then ordering of components will need to be more flexible and speedy since orders will occur as project designs are decided upon during semester. An advantage of working with a

fixed list of available components is that all components can be ordered ahead of time, perhaps even before semester starts.

Scheduled contact time with the students is unchanged. Unscheduled contact time is expected to rise since the project continues between formal allocated laboratory hours. Additional time will be required to creating the projects, and setting the assessment criteria. This should not be any more difficult than the similar task of revising prac notes and assessment criteria.

Marking time, although only occurring three times, will see the most significant increase. In previous years, marking was performed during the practical, and was nominal consisting of only a couple of minutes per pair. Marking the project presentations will probably require from 15 to 30 minutes per group, and will most likely be concentrated over a couple of days. Marking several 10 - 20 page reports and each student's workbook will also be time consuming.

I expect both staff and students will be supportive of the intervention planned. Several senior academics in CSEE will be supportive since a number of them have already completed a GDEd. The University system also rewards and indeed requires innovation in teaching, so I will have the official support of the School. Finally, the students involved in the subject are fourth years, and are generally mature, and enthusiastic. I expect to have their cooperation.

Accompanying changes to the subject

Although the key intervention in 3e431 is the introduction of projects in place of pracs, there are other changes in the remainder of the course to both add support to and gain benefit from the inclusion of projects. There were also aspects of the course that were simply poor practice, and this was an opportunity to fix them.

Lecture content and delivery

To allow students to begin the first project from the beginning of the semester, the order of presentation of the content was rearranged from the previous year. The content was also reviewed and some minor changes made.

Changes to Assessment

In 1999, the examinations were open book, with an emphasis on problem solving and design. This was retained for the 2000 exams. However, there were also a small number of marks that were based purely on factual recall, and rewarded shallow learning rather than understanding. These questions were removed.

The problem solving questions were placed in the context of a real world problem. As well as requiring the correct selection and use of facts and formulae, the questions also required the interpretation of the results, and making some simple (constrained) design decisions.

The overall assessment of the Power Electronics subject in 2000 was as follows:

	Assessable item	**Each worth**	**Total**
2	Projects	15%	30%
3	Tutorials	6.7%	20%
	Mid Semester Exam		20%
	End of Semester Exam		30%

Methods of Data Collection

There were a number of ways that should provide feedback on the success of using projects to enhance student learning in Power Electronics.

Project Marks and Exam Marks

The projects are marked against criteria which value understanding. If the students truly display understanding of the material the projects are seeking to teach, then this should be evident in the marks they receive for the three different aspects of their project work.

Further, since the exams were written to primarily examine deep learning, the effectiveness of the projects in enhancing deep learning should also be visible in the exam marks.

Student Questionnaire and Feedback forms (TEVALs)

A second way of receiving feedback about the perceived value and success of the projects is via a student questionnaire. An email questionnaire with several open ended questions would seem to be the most easy to administer and easy for the students to respond to (students love email). Open-ended questions will allow the students to offer their own views, and not be too swayed by any bias that my questions may introduce. They may have insights I may not have foreseen, and qualifications and additional comments that cannot be captured by a yes/no or multiple-choice questionnaire. The disadvantage of an open-ended questionnaire is the greater effort required by both the respondents and the collator of the results.

Presentation and Discussion of the Data

Project Marks and Exam Marks

The complete spreadsheet of marks for power electronics including the project marks has been included as an appendix to this report. Student names have been retained as initials for easy reference, and to allow cross-referencing to comments if desired.

As a way of showing the class performance in project work, each student's individual component marks including those for the projects have been plotted against their final mark. It might be argued that a perfect outcome would be to have, for each student, all their component marks expressed as percentages exactly equal to their final percentage. Expressed another way, that every mark falls exactly on the plot diagonal. This would imply that every component of assessment is a perfect indicator of the student's final mark.

This is most unlikely to happen for several reasons:

- Students may find one form of assessment (eg tutorials) easier to excel in than another (eg examinations).
- Students may have more opportunity for seeking peer or marker assistance to improve their performance in some assessment modes (eg tutorials).
- The questions set in one round of assessment (eg a tutorial) may be easier or harder than those in another (eg an exam).
- The marker may mark otherwise similar questions in different rounds of assessment more rigorously or generously.
- Students may perform differently at different times of assessment (eg, more preparation or greater understanding for a final semester exam than a mid semester exam).

What is desired is that each form of assessment does accurately reflect the students' performance in that activity. This is a more fundamental issue, which is reliant on well

designed methods of assessment, asking the right questions, and an accurate marking scheme which reflects the assessment criteria for each activity.

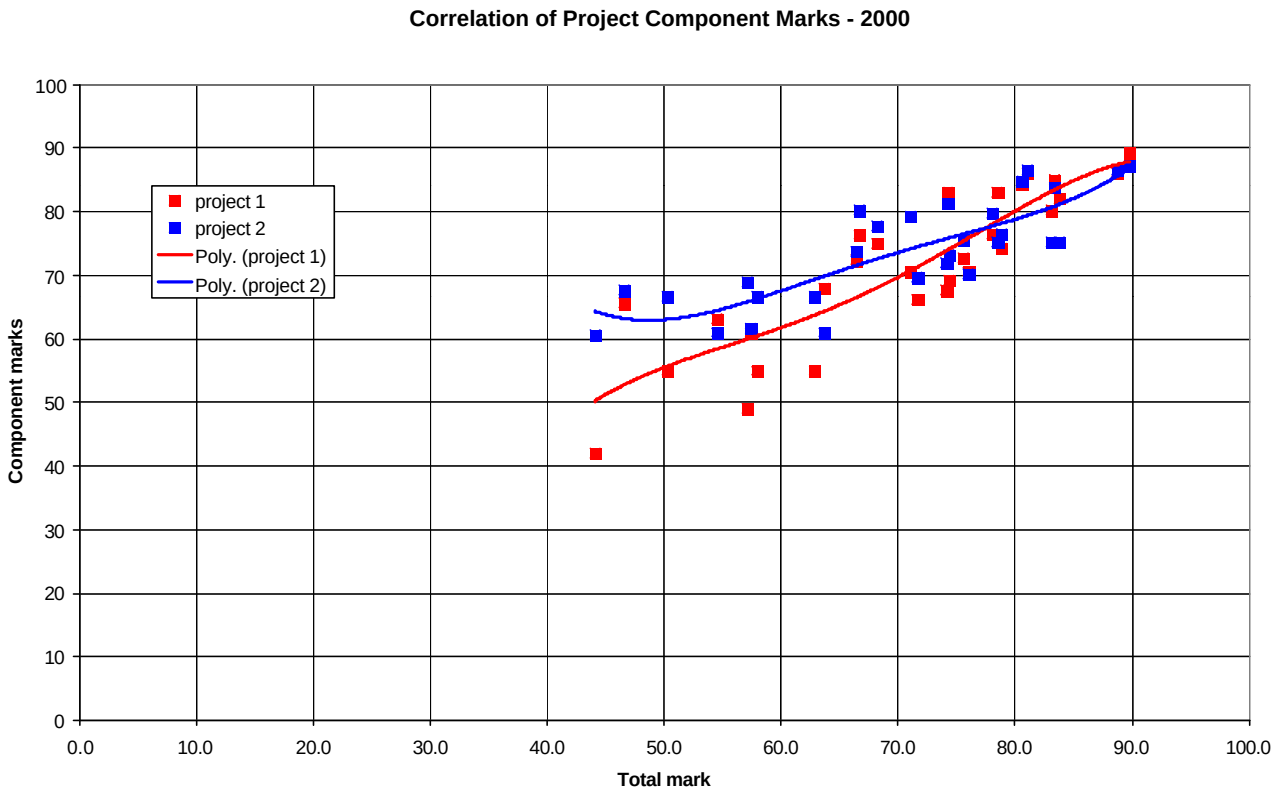
This was a failure of the 1999 prac marking scheme. Awarding marks based purely on attendance or attitude does not in any way separate excellent students from ordinary students. Yet, because these marks contributed 20% to the students' final mark, students who could not demonstrate an acceptable (passing) level of competence in an exam did indeed pass. I am pleased that this has been corrected in 2000.

Having noted it is unlikely for any individual mark to perfectly reflect students overall mark, the project marks do come very close. Qualitatively, as the marker of their project work, I can verify the trend seen in these marks. On the whole, the process of project work encouraged deep learning, which was displayed both in their project work, and their reports. Projects enabled students to accurately demonstrate their level of competence against the criteria, and generally, this level was above average.

It is proposed that the average students performed better in the second project because they have learnt what is expected of them and some of the skills they need, and because they make better use of their group.

A problem of similar difficulty posed in a tutorial will always be handled better by all students because of the time frame to research and generate an answer, and scope for assistance from the text, the lecturer, tutors and peers. The student may be able to acceptably express another's ideas in writing and receive good marks without having deep understanding of those ideas. This is much harder to do for projects because the assessment is via oral communication and physical demonstration.

Finally exams are difficult because of the additional time pressures.


Correlation of Project Component Marks - 2000
project 1
project 2
Poly. (project 1)
Poly. (project 2)
Component marks
Total mark
0
10
20
30
40
50
60
70
80
90
100
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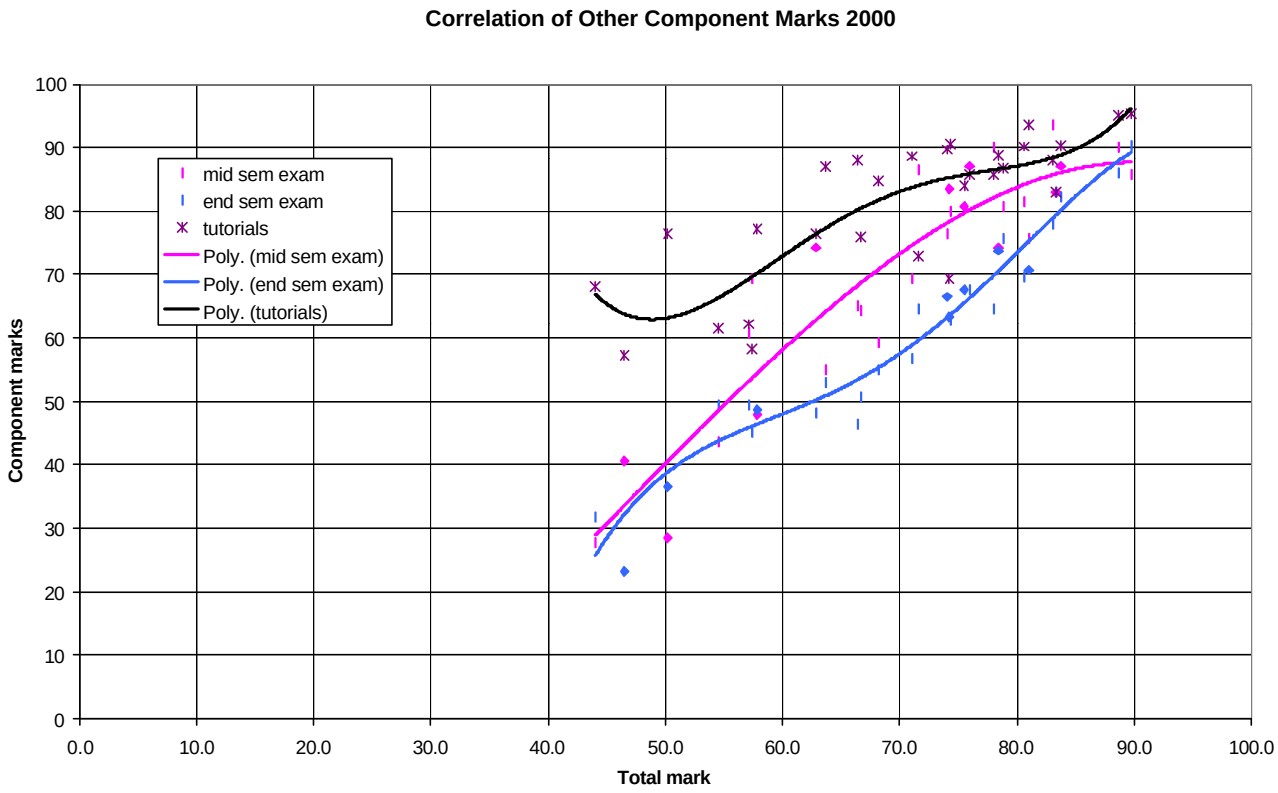
Correlation of Other Component Marks 2000
mid sem exam
end sem exam
tutorials
Poly. (mid sem exam)
Poly. (end sem exam)
Poly. (tutorials)
Component marks
Total mark
0
10
20
30
40
50
60
70
80
90
100
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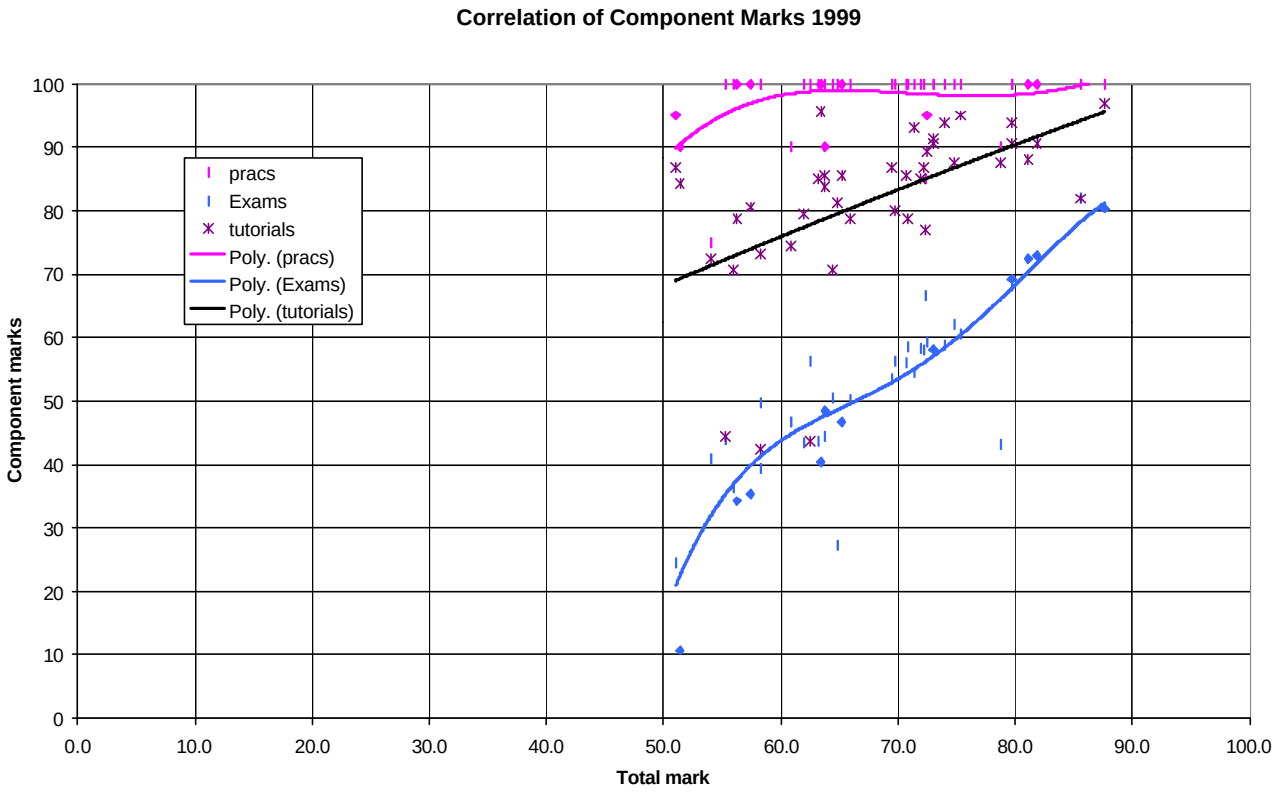
90.0
100.0


Correlation of Component Marks 1999
Component marks
Total mark
pracs
Exams
tutorials
Poly. (pracs)
Poly. (Exams)
Poly. (tutorials)
0
10
20
30
40
50
60
70
80
90
100
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0

Student Questionnaire

An email questionnaire with several open-ended questions was emailed to the whole class directly following the final exam in the subject. Despite the lateness of this questionnaire, the response was excellent. Slightly over half the class (16 from 29) replied. All clearly had taken the questionnaire seriously, investing both time and thought in their replies. I was delighted with the maturity and insight of their responses, which I had not counted on.

A copy of the email questionnaire is included in Appendix A, along with all the student replies, collated by question, but otherwise unedited. Students are identified by their initials to effectively make them anonymous, and yet still allow tracking and matching to marks. Because of the high quality and insightfulness of the responses, the reader is encouraged to browse this lengthy appendix – it is quite compulsive reading.

I have attempted to summarise the key findings of the questionnaire under subheadings that reflect the questions asked.

Overall response – are Projects better than Pracs?

The first question asked *"Do you prefer the use of projects to pracs? Why / Why not?"*

Most students responded with a clear yes, with a couple offering an enthusiastic *"Definitely!"* and *"Absolutely."* Generally each student offered a number of reasons, and often a common reason was given by a number of students. It is exciting that these reasons invariably align with the pedagogical goals that were fundamental to initiating the intervention. Equally exciting is that often the students had the maturity to consciously recognise these underlying pedagogical drivers and also had the correct attitudes and motivation and so supported them.

In summary, students reported that …

- Project work caused thinking, and students were compelled to understand to complete the task.
- Projects helped them see the interconnectedness of knowledge

- Projects turn theory into practice, and they gained personal practical knowledge (PPK).
- Larger problems (such as projects) better reflect real-life situations they will encounter.

- They had been given the goal, but not the process. They were in part responsible for the process of achieving the goal, that is, the problem was a design activity.
- The problem was not neatly specified. There were many possible solutions, and this encouraged creativity and self-expression.

- Projects were fun, interesting, and involving.
- They were time consuming, but this time commitment was more flexible.
- There was a compulsion to get it to work, both intrinsic and extrinsic.

- The use of projects enhanced lecture material, and allowed students to interact better with the lecturer. In short, it was a better learning environment

One student stated *"I have no preferences otherwise it would be no"*. This student indicated that the project approach was a bit too daunting for him and he felt out of his depth.

Two other students also offered some negative reactions to the projects:

- Projects were too unstructured, and students had to work out the learning goals for themselves.
- They were more time consuming than pracs.
- Assessment was not well defined.

When asked to rate the use of projects on a scale of 1-7, most student gave them a 6, with some 5's and 7's. The most critical respondent gave 4.5, *"mainly due to the projects being too open ended, and the assessment […] not being tightly defined. The concept is very good, though."*

Project length, complexity and design freedom.

The majority of respondents were happy with the number and length of the projects (three projects, each four weeks long). Five students felt that two longer projects would have been better, but one student warned that *"Projects that drag on too long result in reduced interest from participants"*. Two students also noted that more time should be allocated for later projects as their complexity increases.

Students again realised that the complexity of the projects was a vital key in making them useful learning tools – *"I think they certainly help in understanding the lectures better"*, *"[The difficulty of the projects]…made me realise I have to certainly understand the theory before you can make something work"*, *"It is what would be expected in the real world"*.

The best student suggested *"If three projects were to be completed, they would definitely need to be a bit easier, which would ultimately make them less satisfying. I'd go for two projects and make them a bit harder instead"*.

Only one student found the projects were too complex. Most students felt the complexity was about right, but many did suggest more guidance or direction early in the project would help.

When asked, *"Should I have constrained you more? Or did you like doing the research required and making the design decisions required for a more open design specification?"* most students clearly indicated a preference for an open design specification and the minimal constraints imposed. The key reasons offered were the opportunity it offered to demonstrate creativity and individuality, and to make decisions as would be required in a real engineering environment.

Carrying out the required research was variously reported as time consuming, enjoyable, slow moving, or even daunting. More guidance in the forms of hints, pointers or boundaries was suggested.

Project Assessment

Most students had no problem with the method of assessment using workbooks, a demonstration, and a final report.

There was some disagreement about the value of assessing the workbook. Two students could not see the point of the workbook when the material was assessed by a demo and report anyway. Equally two others felt that if workbooks were assessed, the report should be dropped, or much reduced in both size and weighting. I feel this indicates that I should more clearly explain the different purposes of these documents, both verbally and in the marking criteria.

Initially the weighting for workbooks, demonstration and report was 20%, 40% and 40% respectively, but then was later changed to 20%, 20% and 60%. I suggested the change, which was accepted by the class, when I observed that students were investing far more time into the reports than the demos, and I wished to reflect that in the marking weighting. In the questionnaire, generally students were either happy with the weighting, or suggested that the marking scheme move marks away from the report as per the original weighting, or even further.

The contribution of the project marks to the overall subject mark of 30% was judged about right by most students. A couple actually suggested weighting them even more heavily since this better reflected the time invested in them. This is an encouraging result as it demonstrates the students believe the projects are worthwhile, and the project mark is a genuine reflection of their ability.

One student correctly stated that the marking criteria and assessment weighting was not clear enough. If these are clear, students know exactly what is expected of them, and how much time and effort to allocate to achieving the goals.

Working with others

Two of my questions asked about interacting with others in the project tutorials, and working together to write joint reports.

I misleadingly asked why so few had chosen to do joint reports. In fact, not quite half the class submitted joint reports, but once divided by three members, this becomes only three or four joint reports compared to 15 or more individual reports.

Students offered valid preferences and objections for both joint and individual reports. The most commonly cited problem of joint reports is the extra time and effort required to work with each other and co-ordinate the writing. Some indicated that they learnt more by doing the entire report themselves, while others indicated that working (writing) with the group helped them learn more. This was usually a reflection of peoples' personalities. Everyone agreed that having the choice was a great option.

Some of the reasons offered for a lack of participation in the project tutorials were

- Fear of criticism from lecturer and other students.
- Fear of being copied, or loosing a competitive edge.
- Laziness. As one student said *"we were waiting for you to tell us what to do"*.
- Self confidence.
- Lack of time.

The suggestions given to improve the lack of sharing included making the project tutorial sessions compulsory, setting questions which had to be answered on the board, and organising compulsory sharing which rotated from group to group.

Conclusions Drawn and Actions for 2001

The replacement of pracs with projects in the power electronics subject appears to have achieved its goals. Most students readily accepted, benefited from, and enjoyed the new approach to practical learning. One student's concluding questionnaire comment was "*Can you convince all lecturers to do the switch?*".

The use of projects will be retained in the power electronics subject in 2001, and may be introduced into other subjects as appropriate. A few details require fine tuning, and some aspects simply require better preparation. Specifically

- Plan the number and duration (scope) of projects with greater recognition of the external pressures on both the staff and students at various points in the second semester. The timing of mid-semester exams, mid semester holidays, and major project and thesis deadlines should be considered.

- More detailed marking criteria should be created. These should clearly explain what is required for each type of assessment (workbook, demonstration, or report), and what standard should be demonstrated to achieve a given grade. It is also important to explain the motivation and goals behind the use of that mode of assessment, as this motivates the students, and helps them achieve better overall outcomes.

- Plan better (perhaps more formal) modes of demonstration presentation to
    - Generate more motivation,
    - allow students to benefit from one another's work,
    - allow better feedback from students as well as staff,
    - achieve greater transparency and accountability in the marking process.

- Plan more deliberate use of contact time, especially the project tutorials, to help facilitate the sharing of information and creation of ideas.

Commentary on the Action Learning Experience

The Graduate Certificate in Education (GCEd) operates on the principles of action learning. The place where the real learning occurs is not in the classroom where theory might be presented, but back in the learner's own world where that theory is put into action as it is applied to a real life problem.

Action learning requires a continual cycle of planning, action, evaluation and reflection:

- Based on theory and the evaluation of past performances, plan a strategy to solve a real problem in the workplace.
- Put the strategy or intervention into action in the workplace.
- Evaluate the effect of that strategy – gather data from the workplace.
- Reflect on the outcomes of the intervention.

A full cycle of these four steps is required to achieve the goal of learning. Without gathering data, evaluating the results and reflecting on the outcomes, the success of the project will remain an assumption, and the reasons for success or failure will never be considered.

It was assumed that many short frequent cycles of this action learning loop would achieve the best outcomes, and the fastest progress. In practice, only one cycle, albeit a big one, was completed over the space of a semester long project. The gathering of the data and reflection has occurred as part of the completion of this report. Many valuable confirmations of success and suggestions for improvement have been generated from this process, and these will be used to plan for 2001.

The action learning process has proved to be a powerful tool for learning, and the integration of that learning into personal practice. The rewards would be so much greater if time was made for frequent analysis and reflection of the progress of a project, or indeed any facet of life. Unfortunately the pace of our society sweeps us along, and the art of reflection is a skill which requires discipline if it is to become a habit.

The three most rewarding aspects of the GCEd have been:

- The satisfying success of the action-learning project, as outlined above, both for the proof of the soundness of the action learning method, and the worthwhile outcomes of the specific project undertaken.

- The exploration of a new field and the numerous revelations experienced as preconceived ideas have been challenged and replaced with better, more informed ones.

- The shared journey with other participants – now friends – in this course.

Appendix A: Email questionnaire and responses

Hello all.

I've been doing a course part time this year to help me be a better teacher. Its called the Graduate Certificate in Education, GCEd. Its based around a whole lot of theory presented in the first semester. During this time, you also formulate (based on what you have learnt so far) a way to put this theory into practice in one of the subjects you teach. You apply that change, and then evaluate the results.

I saw that pracs as they were currently implemented in power electronics were not really helping students to learn. I decided to try and use projects instead of pracs. I think it has been successful -- I think you have definitely learnt more than had you just done pracs. But there are a number of mistakes I made too. I tried to cram to much in and I wasn't organised enough. I hope to fix these things up next year.

Both for my evaluation for the GCEd, and also for 3e431 in subsequent years, I'd really like your honest comment on the projects. I've tried to ask some specific questions to help you give specific answers, and not just vague ones. However, you are free to answer as much or little as you like. I'll be pulling out common themes for my report, and agreed problems / improvements for 3e431 next year.

If you want your comments to be confidential, save this email. Edit in your answers, print it out, and hand it in at the office for me. If you don't mind, then just email it back to me or to the newsgroup.

OK, after all that, I'll put the questions in the next email.

Thanks,
Geoff.
--
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Hi all.

With respect to the project component of the power electronics subject 3e431,

Did you prefer the use of projects to pracs? Why / why not?

Were the projects the right length? (4 weeks). (complexity aside, see the next question). Would you suggest three projects of 4 weeks duration for 2001?

Do you think the complexity of the projects was appropriate for their length? Do you think that they should be simplified?

Should I have constrained you more? Or did you like doing the research required and making the design decisions required for a more open design specification?

I need to make the availability / ordering of parts better (do you agree?). What other resource issues did you have? eg components, pcbs, lab access, lab equipment, web access, access to tutors / lecturer, access to experts or extra info.

Did you like the style of assessment?

Workbook?

Demonstration?

Report?

What do you think the weightings should be for each of these components?

(eg 20,20,60%?)

What do you think the weighting for the projects total should be?

(eg 10% per project, by 3 projects = 30% towards total 3e431 mark).

Why did so few of you put in joint reports? Did you like this as an option?

Most did not get very interactive. eg did not use the project tute session very interactively. Nor did I see groups sharing information much. Why not? How can I encourage this? Should I encourage this?

Any other comments?

Overall rate the use of Projects in 3e431 on a scale 1 -- 7.

1. very unimpressed, wasted my time and didn't teach me anything...
4. didn't bother me either way ...
7. very satisfying. wish other subjects did it this way.

If you can think of any questions / aspects I've missed, please contact me.

Many, many thanks.
Geoff.

Did you prefer the use of projects to pracs? Why / why not?

[BKN] Definetely! In Pracs there's often a large element of: "I think I understand, but I don't quite have the time to make sure". In the project you had to understand what you were doing to get anywhere.

Further, It is greatly sattisfying to utilize theory to create something that actually works. this is rarely possible in pracs.

[KLN] Yes. At least it's not dull. Unlike when having pracs, sometimes i don even know what's the pracs is all about.

[AS] I have no preferences otherwise it would be no.

The pracs focus on theory into practical more closely, eg. The graphs and waveforms. Projects on the other hand is too wide and has no direction guided, we create our own intention and this is causing a bit heavy stuff in our mind.

[RBK] Yes, pracs are rushed and are completed in 2-3hrs. Not only that, you have to follow instructions like a computer, taking all the fun out of doing the exercise (every is different I guess). With projects we can all attempt a solution as we wish with limited boundarys, however we can still express ourselvs. I guess it also forces us to think rather than compute.

[SRH] I liked the projects, although time consuming, they required thinking rather then just following a prac sheet. Also provided room for a little individuality

[DJZ] Yes.There is something to aim for at the end, and having to get a project actually working at the end is a lot easier to work towards than when the big hand and the little hand....

[MSG] Absolutely. Projects are a much more interesting way of gaining practical knowledge. It's much easier to bludge through a 3hr prac than a formally assessed project.

[GSR] I prefer projects. It gives me something to aim toward and it makes the lecture material more worthwhile to learn. Also, I think you sitting down with us and making sure we understand everything is very important, no other subject offers this to my knowledge.

[LL] I prefer use of projects rather than pracs. Projects gives me ample time to work out the best solution for the particular job.

[JJJ] I think projects are better than pracs as it allows us to see how everything is combined together and gives us a better opportunity to learn from they.

[EB] I prefered to have projects rather than pracs, however I think they where more time consuming I learned more doing the research and the decision all my myself (together with my groupmembers)

[AC] Well.. i prefer project more than prac.. as it is flexible (for contacting time) and it have some kind of "force" that drive you to do it with relevant knowledge... that meant you can't just any how do it...

[MW] Projects. It got more involved and interested in the practical work.

[AZ] Yes. Pracs can be too structured. I think the projects guidelines were a bit too loose, so a middle ground would be ideal. Also, the assessment for the pracs was not very well defined: we were unsure of what we had to receive a particular grade.

[CP] Projects as you had the time to get something to work, albeit not always to the extent that you wanted. The projects were also more interesting than pracs as being a larger excercise more interesting problems could be tackled, especially as they could have been used in a real-life situation. Pracs did not inspire that much interest, for me they were something that had to be done to pass a subject.

[JB] Yes, the projects were better as it gave us a chance to design, rather than plug and play.

Were the projects the right length? (4 weeks). (complexity aside, see the next question). Would you suggest three projects of 4 weeks duration for 2001?

[BKN] I think the most optimal solution would be to make two longer projects, as some time is needed in the beginning of a project to "feel" your way into the problem.

[KLN] I think that 2 project per semester is just fine.

[AS] Yes

[RBK] thats fine.

[SRH] The length was fine. Thesis made time management cricial however it is quite possible to finish each project within four weeks

[DJZ] Yes Although relatively small, four weeks is enough time to produce a fairly substantial working product.

[MSG] 3-4 projects is about right. Projects that drag on too long result in reduced interest from participants.

[GSR] I think so.

[LL] The time frame is fine. I guess 2 projects instead of 3 would be a better idea because of unforseen problems such as availability of components, etc...

[JJJ] The projects were about the right length, maybe more time is needed for the last two compared to the first project.

[EB] I think 4 weeks is a really short time to complete all the research, especially when you are not around to answer us questions. It was a good idea to make the last project optional.

[AC] Regarging this question i personnaly think it is okay.. but if it happen to be run along with some other project that might have some probelm... not enough time....(may be that's only my excuse...)

[MW] No I would make the projects slightly longer and only have two of them.

[AZ] Yes to both.

[CP] Considering we had a PSPICE guru in our group, the 4 weeks was ample time, though the latter project could have been given more time. Maybe 3 weeks for the first project, and longer for the subsequent ones as the complexity increases. Although, this would be determined on the PSPICE skills of the students. We seemed to run out of time, but I think that was also because of thesis commitments.

[JB] They are the right length, but the research dragged it out.

Do you think the complexity of the projects was appropriate for their length?
Do you think that they should be simplified?

[BKN] If three projects were to be completed, they would definetely need to be a bit easier, which would ultimately make them less sattisfying. I'd go for two projects and make them a bit harder instead. Maybe you could drop the battery charger (it required us to learn a lot about batteries, which, as I see it, is not really essential for the subject) and just go for the power supply and the motor drive (which sounded really exciting)

[KLN] So long as they are in conjunction with the current topics being taught in the lecture. Because i think they certainly helps in understanding the lectures better.

[AS] No. The projects do look a bit complex but useful.

I have already resolved to simplify my design so that I would cover more on the theory than to build with something else not mentioned in Power Electronics. Yes, it should be simplified.

[RBK] I think they were fine,.

[SRH] I don't believe the projects were too hard although made me realise I have to certainly understand the theory before you can make something work

[DJZ] Yes. They were already as simple as we wanted to make them. If those people who added microcontrollers to their projects start whingeing about the complexity of the projects, tell them to wake up.

[MSG] Perhaps not too complex if more direction is provided early in the project. We spent a lot of the project time just working out what we had to do and hoe to do it. Not enough time was spent on testing and further development.

[GSR] Yes, I think it should be expected that we have the ability to generate projects of this complexity, it is what would be expected in the real world.

[LL] The complexity is fine for 4 weeks per project.

[JJJ] The complexity was appropriate, but I think we could have done with a little more guidance at the beginning of each project to point us in the right direction.

[EB] The complexity was appropriate...

[AC] Like i said before you need to prepare youself for the prac instaed of waiing for the instruction... that is the force to drive you to leran more... but some hint and direction will be appreciated...

[MW] The complexity was just about right.

[AZ] Yes

There needs to be more guidance throughout the project, which in effect simplifies the project. See next question.

[CP] The first was fine, the second one needed to have the "fall-back" option of using the frequency generator in lieu of control cct specified earlier and then more people would have concentrated on the converter more before trying to use a control cct (which was added complexity).

[JB] They were good, except a clear guideline was not given as to how we would be marked. In the case of the switchmode converter, it was not clear if designing for a light and CDplayer would give a higher mark. Specify levels exactly in the marking criteria.

Should I have constrained you more? Or did you like doing the research required and making the design decisions required for a more open design specification?

[BKN] The large degree of freedom was the best thing about the projects. It teaches you to what will actually be required in real engineering work. I definetely felt more secure about how to go about solving the problem in the second project.

[KLN] Doing reasearch takes time. Due to the time constraints, i don think we have much time for reasearch. I would prefer to design the project according specs. Provided that the specs given are not too difficult to meet.

[AS] No, I do not want to be constrained in my possible designs. I prefer an open design.

[RBK] Yes I believe it was a more opened design spec, however I did learn quite a number of ways to solve the problem and hence selected the best.

[SRH] Liked the open design approach, more individuality

[DJZ] No. We are all big enough to do that stuff ourselves, although I was assuming that the data sheets of parts that you put on the web were your way of giving hints. Perhaps you could "compare and contrast" a selection of parts that could be used to perform a task (eg PWM chips), but give the students the option to research and select their own parts)

[MSG] Open spec is good, however a rough example solution might be provided to give a better idea of expectations.

[GSR] I thought the first prac was carried out well. There was good guidelines on how to complete the project and there was room to research and generate a different design. However, for the other two, there did not seem to be much research (just studying data sheets) and design to them.

[LL] The open design concept is perfect as it allows us to make decisions for the project.

[JJJ] I don't think that you should constrain us more, but in saying this it would be benifical to know what and where to look to save time on research to give more time on the actual project.

[EB] I think it's good to have an open discussion and restate some specifications if necessary.

[AC] Depend on the duration and the relevant info... for instance, if you are constrained to certain area than you might find the solution is just a straight way (only one solution, may be or not much)

[MW] I preferred the open design. It took us some time to start designing instead of trial and error but it was a valuable experience.

[AZ] There needs to be more guidance with choice of components, and direction of the design. A good approach would be to put together a short list of components which would be suitable for the given project (maybe 3-4), then let us design from there. There are hundred of chips available, and since we are not experienced in this area, it is unlikely that we will make good component choices (eg. take our example from project 2: using the Lm78s40 was a big mistake for my group, after which we switched to using discrete blocks, which was also not that good.) I think team projects and thesis already give us exposure to open ended designs: here we don't have the time, and would learn more if there was more guidance throughout the project.

[CP] I think this is team-determined. Some would like more free-reign, others more guidelines. I think the choice of eg. which converter to use should be up to the teams, but other specifications given more constraints. The links to datasheets was really good!

[JB] The research was good, except that it took a while to find and read. If it was all there as links or pages from the beginning it might have saved a few days. Limit the constraints to the available equipment that we can get.

I need to make the availability / ordering of parts better (do you agree?).
What other resource issues did you have? eg components, pcbs, lab access, lab equipment, web access, access to tutors / lecturer, access to experts or extra info.

[BKN] True, the part ordering seemed a bit un-organised. In the future you should probably set a sharp deadline for groups who want to order "special" parts. However, as many groups won't meet this deadline you should probably stock some standard parts, which the slow groups would then have to build their project around. Lab access was okay, as we had access to a thesis lab. Relying on this kind of self arranged access is, however, not the best way to do the projects. The extra lab (the one across from your office) was a great idea, but should have been

made available earlier. In this kind of do-it-yourself work one lab day a week is definetely not enough.

[KLN] I am quite unsure too. But if everygroup is using the same component, maybe this might make things easier.

[AS] Yes, I do agree with you. My reason is that we don't want to be always the 3E431 culpit to cause the technician or tutor or lecturer to hunt for component or the hassel to rush and wait for component to arrive.

Lab accessibility was a mild problem as it was fixed up with the help of the Lab Manager and Lab Supervisor. But the main problem is the frequent Pspice errors - no Pspice template.

[RBK] Defenetly the ordering of parts. The lack of parts was the hinderence of our projects.

[SRH] Didn't have that much of a problem, The electronics workshop came in handy though

[DJZ] I for one didn't even enter the electronics workshop in hawken looking for parts. If we really wanted them, they were around somewhere.

full time lab acces would have been better, but again, fifth level was available when I really needed it

aren't you the expert?

[MSG] Perhaps make the component ordering web based? Use a web page that sends a form to Helen/Tutor for processing? More lab access time would be useful. The resources in peter allen's lab would be better for project work.

[GSR]

[LL] No comments.

[JJJ] The problem with ordering parts was there wasn't a set procedure to follow given early enough. With lab access, it was good to have a full day in the labs to do the projects.

[EB] Yes this would have been better. I would have prefered to have mor access to the labs, especially on the week ends and have a greater choice on components, faster order.

[AC] All the abovce seem to be needed... however, for the components we do need to write down what we want before the project or few days before we start building the circuit. i.e. have our paper design first.

[MW] A system similar to the projects would work. Just as long as everybody knows who to give orders to and when by.

The labs were excellent we just couldn't get into them enough. It was a lot easier when we got the lab (505) to our selves and we could leave equipment set up.

[AZ] Yes, I think the parts ordering system needs to be improved.

If you restrict the parts we can use (by using a short list), this will allow you to keep in stock all of these components, without having a big problem with outlay costs. Extra parts can then be re-ordered. If the parts are at uni, we won't have the problem of waiting for parts which we had in these projects.

In terms of other resources, I think access to the labs was a very big problem (only 1 day a week). Because of this, many groups used a lab that was easily accessible: a popular choice was the thesis lab on level 5 of the Axon building. Either there needs to be extended access, or a different lab chosen. One very important consideration is to have somewhere where we can leave our projects set up (due to their complexity, its preferable not to have to re-assemble the project every time). Our group used the red boxes with a breadboard from the second year projects for our circuits. Kits like these for all of the groups would be handy.

More time for assistance with projects would be helpful, or alternatively stagger the supervised times, for example have two 1 hour time slots, on different days.

[CP] Definitely, the biggest problem was the holidays (for 3 weeks) which slowed up the process on the second project considerably. Perhaps have two or more people able to vet the orders placed for faster ordering. The lab access could have been increased, especially in the holidays when people have more time (except those 4th years doing thesis). The tutor/lecturer combination was good for labs (ie. one not there, the other was) but the tutorials could have been better manned.

Access to experts or extra info (eg. other newsgroups) would have been good, too. Perhaps suggestions of a few good sites might be an advantage.

[JB] Lab access was the big issue, considering all our parts were in the lab along with the equipment, it made doing extra work a bit difficult.

Did you like the style of assessment?
Workbook?
Demonstration?
Report?

[BKN] The style of assessment was okay, but it should have been made clear, in a consistent way, what the weightings are, so that people don't waste too much time on things that don't count too much to the final grade. By the way, you claim to have changed the weighting to 6-2-2, but the official course web page still claims 4-4-2. This information should either not be posted at all, or it should definetely be updated to prevent confusion.

[KLN] If we are having a workbook, i don see there is a need for report.

[AS] Yes to all the above. For better benefit for 2001, the criteria for the report needed to be included in the student guideline.

[RBK] Yes I didn't have a problem with that.

[SRH] Yes that was good gave incentive to put effort into the project as a whole

[DJZ] Workbook, I couldn't see the point, this could have been covered in the demo and the report. Surely and explanation of method is better than numbers?

[MSG]

[GSR]

[LL] Everything is fine..

[JJJ] The style of assessment was good.

[EB] I still think the presentation should be worth more than the pracbook.

Workbook: Worth too much, consider there are just some notes, that will be discussed in the report in more detail.

Demonstration: Besides the weighting good.

Report: good.

[AC] Yeah, i like it very much. As it does assess everyone in the team and again you have to be "loaded" with relevant knowledge to perform each of those elements/events.

[MW] Yes to all.

[AZ] Reports take a very long time to write, mainly due to all the formating required, diagrams, pictures and equations. In my opinion, too long for the gains obtained. I think we should get more marks for the workbook and our presentation, and maybe write only write one report (ie. instead of one for each project). For the workbook, have particular sections to assess, eg. justification, component choice, but less formal than the report. I found that we were concentrating on the report at times more than the project. The other choice is to scrap the report altogether.

Demonstrations are fine.

[CP] These three sections were good to include, although more specific mark sheets (ie. specific to projects) should have been made available beforehand.

[JB] Yes these are the best way to gain an idea of what happened. Do not change.

What do you think the weightings should be for each of these components? (eg 20,20,60%?)

[BKN] See above + I still think that the initial 20%-40%-40% was better, as it made people focus on making a working product. Further, I found that preparing for the presentation forced us to understand the weird workings of the network (spikes etc.) that can easily be ignored in a report, if no explanation is at hand.

[KLN] I think the current weighting is alright

[NGC] I think the weighting depends a bit on the resource issues. Weighting the report 60% is good when it is hard to get a good product together for the demo. If the effectiveness of the demos is not as constrained by access to components etc, then it might be worthwhile returning to 20%, 40%, 40%. I'd probably suggest rating workbooks as simply "acceptable" or "not acceptable", rather than trying too hard to assess their "quality". (Hmm, did I ever get around to getting you to mark my workbook?)

[AS] I think of 10,20,80 because our workbook were a bit messy and that we could write better report.

[RBK] Fine

[SRH] I would have liked the actual demostration worth more marks. I personally put a lot of work into making it go and felt that it would have been nicer to have a little more reward for my efforts

[DJZ] (0,50,50)

[MSG] I agree with that. Maybe closer to 50/50 for the work put in. (ie. 25,25,50%)

[GSR]

[LL] The present weightings are okay.

[JJJ] The weightings for each section should probably be more for the demo and less for the report, say 20 for workbook, 30 demo and 50 report.

[EB] 10,30,60

[AC] well, this answer will be biased as i would like to have the demo and workbooks weight a little bit more... say 35%,35%,30% almost even... yet that only my thought. Geoff, you do point out the importance of the report... so... is up to you...

[MW] As it was this semester was good (the prac book and demo were easy marks) but for the amount of work put in they probably should have been 20,10,70%

[AZ] Excluding a one-off report, of the total percentage of the individual project:

60%: Presentation
40%: Workbook

[CP] The example breakdown is good as it is easier to write up a technical report than each have a go at explaining the demo, and the workbook should be kept regardless. Otherwise, give more equal weighting to the demo and report, to increase the communication skills of students, but ask that they each prepare a short segment about different aspects of the project (something we didn't altogether get the hand of!).

[JB] Yes, these are as fair as you can get.

What do you think the weighting for the projects total should be?
(eg 10% per project, by 3 projects = 30% towards total 3e431 mark).

[BKN] I think that a total of 30% on the projects is fine, as they constitute a significant protion of the workload in this subject.

[KLN] 15% per project is fine, considering the amount of work and time put it.

[NGC] With this year's specs, the individual projects are probably worth more than 10% each (they are certainly more work than 2 submitted tutorials). If the scope/complexity is reduced, they will probably become more appropriate for the number of marks.

Another option would be to weight the projects more heavily (even with reduced scope, this could be good):
Projects: 3x15%
Tutorials: 3x5%
Exams: 2x20%

Time-wise, this would probably work out better.

E.g (for a 13 week semester with a break after week 8).
Tutes due Fri Week 3, Fri Week 7, Fri Week 11
Projects due Week 5, Week 9, Week 13
Exams: Week 8 and in exam block.

[AS] I think this is just right as it is.

[RBK] not fussed

[SRH] The weigthing is ok projects are good learning experiences and the effort and knowledge reflects in the projects

[DJZ] yep

[MSG] I agree with that.

[GSR]

[LL] 2 project 15% each will be good.

[JJJ] I think the weighting for the projects was about right.

[EB] 30% is appropriate for all projects together.

[AC] It is okay i think. as the project do deserve that mark for the whole subject.

[MW]

[AZ] 10% per project is fine.

If there was a "one off" report which I have mentioned, have this count for an additional 5%.

[CP] 30% is a good proportion.

[JB] That's fine.

Why did so few of you put in joint reports? Did you like this as an option?

[BKN] My group did make joint reports, which I found was great, as it gives you two people to talk to about the validity of the explanations offered. However, as people seemed rather stressed about their thesis work, it would my guess that they chose the single reports due to the larger degree of freedom with respect to when you write it.

[KLN] Maybe they find it hard to meet together for discussion. Mine is a joint report.

[NGC] We did a joint report. Maybe people expected you to be tougher on the joint reports?

[AS] Yes, optional. Some people just don't attend your lectures nor the tute and absent frequently in pracs but yet got away with it by relying on others for their report though their workbook looked very decorative. Well, the class number was small and it was very obvious to see who was around and who wasn't.

[RBK] I did like this as an option.

[SRH] Joint reports were fine, working with people with different writing styles is a good learning experience

[DJZ] I did. Good option

[MSG] It's a good option, however in a somewhat rushed situation most people would rather submit their own work than rely on somone else.

[GSR]

[LL] I guess difficulty in putting them together. More time required to produce more pages (20pages) for combine report. Comparing to individual report of 10 pages... I think 10 pages will be a better deal..

[JJJ] I didn't do any joint reports as it is easier to just do one by yourself where you can do it in your own time and the marks you get are for your work, not someone elses. It was alright for an option, but I wouldn't do it.

[EB] No idea, I liked to discuss first my group members about what we are going to write.

[AC] well i do like this ideas... yet i more prefer to do the whole report as that will help me to learn much more instaed of as be in one of the corner of the whole project...

[MW] Didn't have the time. I get better understanding from doing the report by my self.

[AZ] Discrepancy between group members on who wanted to do the report individually or in a group. In a group, there can be problem getting coherency in the report, which partly has to do with the standard of each person in the group.

I think the option is good, though.

[CP] We put in a joint report as we all felt it would take less time and we all contributed and had faith in our report-writing abilities.

[JB] Don't ask me!

Most did not get very interactive. eg. did not use the project tute session very interactively. Nor did I see groups sharing information much. Why not? How can I encourage this? Should I encourage this?

[BKN] We didn't get too interactive because we were waiting for you to tell us what to do ;). I guess that is actually true to some degree. However, in the days leading up to the due dates, it was my experience that the groups got more and more interactive in the labs. I don't know how to promote interactivity in the tute.

[KLN] Make tut compulsory. Spilt the class into their respective groups for disscussion purposes. Make use of this period for paper design so that time will not be wasted during projects period.

[NGC] Personal reason? I'm lazy and overly self-confident - it meant I usually didn't have to go to Uni at all on Thursdays.

It's not easy with such a small class. The subjects where I have seen that sort of thing happen (team projects, digital design and hardware programming) have been ones which have involved almost the whole year level working in the same labs. This meant that not only would you and your team members be around, but so would other teams. *shrug* Making sure everyone is working on the same design problem might be a good way to start.

[AS] I agree with that. I have asked around for some ideas in design outside classroom hours but got no output from whom I asked.

I could only give the reason that students like myself tends to be creative but tends to copy. I have stopped myself from doing that. We know by facts that we will lose lots of marks if we copy or let our work being copied by someone who did not put in enough work.

We tends to work more closely with our group member(s). But sometimes, I felt that someone was sharing away the group ideas and yet I got nothing from others.

(Q: How can I encourage this? Should I encourage this?)
I think the step would be to highlight each team work and offer improvement no matter how bad our designs were. We should not criticise others. We know that we are to be proactive in our work. But the fact that other students copy our work and declare as others has caused us to stop saying anything. Yes, we, "real worker", should be encouraged to interact to help each other to start off in design as in a company. The manager always do the first step.

[RBK] That I believe is up to each individual. As me and my group wanted to have a good mark, but didn't particularly feel it necessary to spread the answers to our hard work so others could benifit from it and as a result effect our grades.

[SRH] I don't think the old university competion between students has left our university yet. I do not believe that people naturally like sharing ideas unless it benefits them. Selfish I know but I guess that is what many people are like.

[DJZ] when I get there 10 minutes late and you are not there, I go home. Perhaps have a "this is what we've done" session at the prac tute, similar to team project would see more sharing of information. Stress that the subject is not a competition at the start.

Encourage the sharing of information.

[MSG] This comes down to competition between groups. Those who had done the work did not want to make life easier for those who had not. I don't think you should force groups to share what they've learned. Maybe these sessions could be turned into checkpoint meetings such that groups could see how they are progressing compared to everyone else.

[GSR]

[LL] Maybe, you can pose questions during the tute for students to show their results on the board. Make it compulsory and rotate questions for an organised group of 4 students. Assign questions for group every tutes....

[JJJ] Most didn't get very interactive probably we were afraid of being wrong when we didn't know much about the material being used. I don't think you could have done any more than you did to encourage this, but it is a good idea.

[EB] I thought we were sharing informations between groups. Some times it was hard to be up to date, because of other assesments, so I think we didn't have too much to discuss at some times. But it's good to know that there is a possibility to come and discuss problems.

[AC] Not thing special and we always choose the different configuration with others so... nothing much can be done... The ideas seem to be alright, as through that practice we might be able to learn more from others ... . well i can comment on "how can you encourage this idea" but i do hope it work and may be the problem arise from the time constrain in the prac session (i mean the thrusday morning tute session)and some other possibilities....???

[MW] Yes you should encourage it however I find it much easier to explain my problems if I can demonstrate them. In my opinion it may have been better to hold the tutes in the labs.

[AZ] I'm not quite sure "interactivity" works. I think many people treat university competitively (which is natural), since people want to do better than everyone else. That's what I found in this subject, and also in 3e312/3e412 (Control systems), taken by Gordon Wyeth. There was also a similar problem in the team projects: the lecturers would have liked to see us share information between groups, but this did not happen for competitive reasons I've already mentioned.

If any information gets shared, its happens between people who we are friends with, and even then not very often.

If sharing is encouraged, then some people will ride on other people's backs, which I've seen happen. In summary, I don't think that it should be encouraged.

[CP] It was good to hear at the end how others had done their projects, perhaps the demo could be to the group? Otherwise, I guess sharing info was only useful when you were doing similar solutions, not everyone had the same design. The Thursday mornings were good for me, but not everyone thought so and the turn-out was not always high. I think those mornings should be encouraged.

[JB] They are good as an introduction to the projects, but near the end most of the info is small things that we ask each other. Since alot of designs are different, then there is only minimal info sharing. Maybe an informal (5 min) progress talk each project time with a representative from each group.

Any other comments?

[BKN] Great subject!...
...But, it was very intimidating in the very first prac. I hadn't done much electronic stuff for some time (I've been more into EM, antennas, radars, remote sensing etc.), and I had absolutely no clue as to how I could characterise that @*&-*>#@ transformer. If Justin hadn't been in the group, I might still have been sitting there. Anyway, it takes a while to get the mind in gear, and a soft start of some kind on the first prac would be a nice thing.

[KLN] The above are just my comments. Maybe they are rubbish. But I hope they can help. But lecterer and tutor certainly have to motivate the students.

[NGC] (none)

[AS] This projects are good in that it has exposed me into design work and applying the theory. It has help me to throw every ideas that I could think of with relate to Power Electronics. It also initiated me to purchase components and done my PCB (half-complete though).

[RBK] no

[SRH] thanks for your help the subject was pretty good

[DJZ]

[MSG]

[GSR]

[LL]

[JJJ]
[EB] I really enjoyed my semester in brisbane, even if it wasn't like a holiday at all (as I hoped :-))

[AC]

[MW] Can you convince all lectures to do the switch?

[AZ] None.

[CP]

[JB] At my job interview they specifically asked if the projects were actual design or just experimenting.

Overall rate the use of Projects in 3e431 on a scale 1 -- 7.

[BKN] Hmmm...I think I'll give it a 6.

[KLN] My ratings are 6. Overall I find the projects very useful. Thanks.

[NGC] Probably a 5. It's a good idea, but you still need to work the kinks out of it.

[AS] I give 6 for very satisfying. But not to other subjects please, I am not that gifted when thinking of power system, digital, software and communication.

[RBK] very well, prob.- 6, could give a 7 if we had parts to work with.

[SRH] 6 went pretty well

[DJZ] 6

[MSG] 6. This subject has rated highly in terms of practical knowledge gained.

[GSR]

[LL] Overall rating : 6 for projects

[JJJ] Overall Rating: 5-6

[EB] 7

[AC] well i will give 5~6....

[MW] 6

[AZ] 4.5, mainly due to the projects being too open ended, and the assessment (what was required for each project) not being tightly defined. The concept is very good, though.

[CP] 7

[JB] 7, satisfying because of the design component

Appendix B: Student marks spreadsheet 2000.

3e431 Power Electronics marks, 2000

	Tutorials			**20%**	**Project 1**			**15%**	**Project 2**			**15%**	**Exam 1**	**Exam 2**	**Total**	**Grade**
Initials	tute 1	tute 2	tute 3	total	demo	WB	rep.	total	demo	WB	rep.	total	(mid)	(end)		
	6.7%	6.7%	6.7%		3%	3%	9%		3%	3%	9%		**20%**	**30%**	**100%**	
BKN	92	98	96	95.3	90	95	87	89.2	90	88	86	87.2	85.7	90.2	89.7	7
JTB	98	96	91	95.0	90	80	87	86.2	90	85	86	86.6	90.0	86.0	88.7	7
PJM	91	90	90	90.3	83	78	83	82.0	83	83	70	75.2	87.1	82.3	83.8	6
GDB	83	99	67	83.0	80	90	85	85.0	82	82	85	83.8	82.9	82.9	83.4	6
SDH	90	84	90	88.0	83	93	75	80.2	83	83	70	75.2	93.6	78.0	83.0	6
EB	92	96	93	93.7	90	80	87	86.2	90	85	86	86.6	75.7	70.7	81.0	6
AZ	93	98	79.5	90.2	80	87	85	84.4	82	87	85	84.8	81.4	69.5	80.6	6
NGC	92	98	70.5	86.8	75	80	72	74.2	78	80	75	76.6	80.7	75.6	78.8	6
WJH	91	82	93.5	88.8	83	83	83	83.0	83	83	70	75.2	74.3	73.8	78.5	6
MW	94	96	67	85.7	77	75	77	76.6	87	87	75	79.8	90.0	64.6	78.0	6
AY	100	92	65.5	85.8	70	73	70	70.6	85	80	62	70.2	87.1	67.7	76.0	6
RBK	89	96	67	84.0	73	75	72	72.8	78	75	75	75.6	80.7	67.7	75.5	6
GSR	88	94	89.5	90.5	67	75	68	69.2	70	80	72	73.2	80.0	62.8	74.3	5
CSO	56	88	64	69.3	80	80	85	83.0	82	70	85	81.4	83.6	63.4	74.3	5
DL	100	98	71	89.7	70	73	65	67.6	85	80	65	72.0	76.4	66.5	74.1	5
JJJ	76	76	67	73.0	67	60	68	66.2	70	80	66	69.6	86.4	64.6	71.6	5
TBC	94	90	82	88.7	77	75	67	70.6	87	84	75	79.2	69.3	56.7	71.1	5
CLP	83	87	84.5	84.8	73	86	72	75.0	78	86	75	77.8	59.3	54.9	68.2	5
JDS	66	88	73.5	75.8	77	80	75	76.4	87	80	78	80.2	64.3	50.6	66.7	5
SW	91	100	73	88.0	70	73	73	72.4	85	80	68	73.8	65.0	46.3	66.4	5
DJZ	98	86	77	87.0	70	60	70	68.0	55	70	60	61.0	55.0	53.0	63.7	4
KLN	68	85	76.5	76.5	40	70	55	55.0	70	65	66	66.6	74.3	48.2	62.8	4
LL	66	87	78.5	77.2	40	70	55	55.0	70	65	66	66.6	47.9	48.8	57.9	4
JOP	86	30	58.5	58.2	70	55	60	61.0	55	73	60	61.6	69.3	45.1	57.4	4
SLT	51	62	73.5	62.2	55	70	40	49.0	50	70	75	69.0	60.7	49.4	57.1	4
MSG	90	95	0	61.7	70	60	62	63.2	55	70	60	61.0	43.6	49.4	54.5	4
CKT	68	85	76.5	76.5	40	70	55	55.0	70	65	66	66.6	28.6	36.6	50.2	4
MDP	76	32	64	57.3	67	60	67	65.6	70	70	66	67.6	40.7	23.2	46.5	3
AS	67	52	85	68.0	55	65	30	42.0	50	67	62	60.6	27.9	31.7	44.1	2

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