Narrated visual answers to FAQs: Leveraging student learning and academic productivity with accessible technology

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Abstract: Teaching larger, more diverse classes is an increasing challenge as globalisation increases and public funding of higher education contracts. Feedback and reflection are important components in improving the learning process yet are relatively under researched. When teaching such classes there are often insufficient resources to firstly diagnose individual learning difficulties and secondly to provide adequate and timely feedback to assist future learning.

The motivation for this research was to develop learning resources that use inexpensive easy to use learning technologies that would not only improve academic productivity and the management of large diverse classes but also improve the quality of student learning. In this paper we report on the use of online narrated presentations called FLASH FAQs, produced using off-the-shelf software, to assist students to overcome common conceptual stumbling blocks. We found that their use both improved academic productivity and enhanced student learning while providing a means of formative self-assessment.

Keywords: FLASH, formative feedback, audiovisual, web delivered tutorials.

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Introduction

Teaching large classes has always provided a challenge. This challenge is exacerbated by the cohorts comprising students from increasingly diverse educational and cultural backgrounds. Standard higher education texts (Biggs, 2003; Ramsden, 2003) note that feedback and reflection are important components in improving teaching and learning whether that feedback relates to summative assessments or formative learning activities. Dissatisfaction with the quality and quantity of feedback is a common student response to questions in regard to the aspect of the course (and or subject) most in need of improvement. Higgins et al (2002, p. 62) report that "the meaning and impact of assessment feedback for students is an area that still remains relatively under researched, particularly from the students' perspective".

Building on Vygotsky (1962), Black and William (2000) develop a theoretical framework of formative assessment that emphasises the importance of students interactions in a community of practice and the active construction of knowledge. Biggs (2003) also emphasises this constructivist approach to learning, especially the importance of learning activities that allow students to construct meaning by engaging with those activities. Clearly, feedback on formative activities that students use to practice for later assessment, as well as feedback on

those used for assessment is crucial since assessment is a major incentive for focussing student effort. Aligning assessment to requisite learning outcomes is essential since from 'our students' perspective, assessment always defines the actual curriculum (Ramsden 2003, p. 182).

While students appreciate formative feedback on both formative and summative activities, it is not costless to provide. Hence academics are keen to find ways to efficiently provide useful and timely feedback. Providing assessment criteria and descriptors for different standards of achievement on each criterion is one way of achieving this since the same rubric can be used as a marking guide by assessors. For some time technology-supported solutions have been suggested to assist in the delivery of this feedback. For example, multiple-choice question quizzes can be delivered in-class and immediately marked (and feedback displayed) using electronic response systems (Sharma et al 2005) or subsequently scanned for electronic marking and feedback. Brosvic et al (2004) have pioneered a paper-based approach to providing immediate feedback. Called IFAT (Immediate Feedback Assessment Test), students scratch a light coating off their preferred choice and continue to do so until the right answer is achieved, thus receiving feedback at each decision choice. They show that providing feedback during a test has lasting learning benefits over traditional multiple choice papers that are typically marked after the test.

Asynchronous access to learning and assessment activities is also possible. In recent years tailored online activities, once the luxury of courses with large discretionary budgets, are now possible. Using the quiz feature of a traditional learning management systems (Blackboard 2006,WebCT 2006), an academic instructor with no HTML programming knowledge or skill can easily produce multiple choice quizzes that provide automated feedback.

What is not so easily achieved is for academics with limited skills and or budgets to develop multimedia explanations to requisite concepts or concepts over which students typically struggle to grasp. Much time can be spent repeating explanations of such concepts especially if they are complex, involve a series of steps and interact with symbols and/or mathematics. While such explanations can be placed into text and/or accompanied by graphs, it is often quicker and easier for students to grasp if the explanation combines text, animation and voice. Various off-the-shelf easy-to-use tools for digitally recording and compressing such files are currently available for example, PresentationPro and Camtasia. Providing access to these explanations online, for example via a learning management system, would be potentially useful to students seeking to overcome common stumbling blocks in their understanding. Macromedia Breeze is a more integrated system for academics to seamlessly develop and distribute multimedia content. The key to success is to produce media that provokes a formative response from the observing student rather than developing content that is simply a long recording of a 'talking head'. Distribution of such content is much less of a problem with the common availability of web servers and learning management systems in particular.

This research was conducted in an undergraduate engineering context where no well-supported integrated system for developing multimedia content existed and academic productivity was paramount. The aim of the trial was to develop bit-sized multimedia explanations to complex requisite engineering concepts. Typically these concepts were the source of questions frequently asked by students that in answering required a multi-stepped verbal explanation which interacted with formulae and figures. These multimedia presentations needed to be simple to develop and editable by staff while their content needed to help students overcome their learning gaps.

This paper reports on the outcomes of our research and in particular on the use of online narrated presentations to achieve the above-mentioned aims.

Background

Multimedia components are often enthusiastically included in courses to make use of the available technology sometimes with only a little thought as to how they will improve the student learning experience. Kirkwood and Price (2005) report that "although information and communication technologies (ICTs) can enable new forms of teaching and learning to take place, they cannot ensure that effective and appropriate learning outcomes are achieved". It is the educational purpose and not the technology that must provide the lead. In addition, "students need to understand not only how to work with ICTs, but why it can be of benefit to do so." Hence, for educators to reap the full benefits from producing multimedia material the use of technology must be well-planned and targeted. Before considering how to best apply any multimedia technologies we should first consider how students learn.

Cognitive research has shown the while people have a very limited working memory (Miller, 1956) they have a large long-term memory (Newell 1972). Long-term memory deals with previously learned combinations of elements known as Schemas (Bartlett 1932; Chi 1982; Larkin 1980; Tindall-Ford 1997). Working memory is limited in that it can only handle a very small number of elements simultaneously. However, working memory treats Schemas as a single element. Hence by using information stored in long-term memory schemas allows our limited working memory to process large amounts of information. Chase and Simon (1973) demonstrated that the difference between expert and novice chess players was not the number of elements held in working memory but rather the amount of information embodied within each element. Therefore, it is apparent that although the number of elements that can be processed in working memory is limited, the size of those elements is not. Thus material requiring interactivity between a large number of elements is difficult to understand until some of these elements have been incorporated at least partially into Schemas. Hence Schema construction is vital for learning.

While our working memory is limited research has suggested that its capacity can be increased if both auditory and visual channels are used to deliver information. Frick (1984) found improved recall in memory tests when some items were presented visually and others by audio rather than using a single mode of delivery. The modality effect suggests that the visual and auditory working memory is partially distinct, hence working memory may be increased by using both auditory and visual processes simultaneously. Tindall-Ford, et al (1997) found that "The modality effect was only obtainable using instructional materials which, because of their high-element interactive structure, imposed an intrinsically high working memory load. When the intrinsic working memory load was low, no effect could be found even though the material was difficult to learn because it was extensive."

Hence the substitution of an auditory component for visual presentation will have a more positive effect on learning when element interactivity is high. Thus, for maximum benefit neither the audio nor the visual material should be able to be understood in isolation.

FLASH FAQ's

FLASH FAQs are presentation slides (produced using Microsoft PowerPoint) with recorded narration that have been compressed for online distribution by conversion to Flash format (using PowerConverter, an off-the-shelf software program distributed by PresentationPro) (PresentationPro, 2006). These FLASH FAQs are then posted on the web via the university's learning management system for viewing or downloading by students.

Two types of FLASH FAQs were produced. The first type took the form of an online tutorial where we explained a difficult subject concept with a supporting example. The second type took the form of answers to common conceptual stumbling blocks or frequently asked

questions. In these FLASH FAQs a topic often raised in tutorials or on the subject discussion forum was discussed.

The subject chosen within which to conduct this research was a third year subject in the Electrical Engineering course at the University of New South Wales. The subject called Telecommunication Systems 1 is offered in both semesters each year. The number of students taking the subject each semester typically varies from 150 to 250. Telecommunication Systems 1 introduces students to Analog and Digital modulation and transmission techniques. The subject is compulsory for Electrical, Telecommunications and Computer Systems Engineering students. The fact that students from three different degree programs take the same subject simultaneously means that the knowledge of the pre requisite material between students varies widely. This is especially true of the Computer engineering students who despite covering the mathematical theory of transform methods and signal processing techniques prior to this subject, they have been relatively less exposed to their practical application. To facilitate high levels of learning in a large class, it is imperative for students to be able to independently obtain the required prerequisite knowledge. This is even more important when the class contains students who have a wide variation in their understanding of this prerequisite material. In this paper we report on the use of FLASH FAQs to facilitate this function.

Implementation

The steps necessary to generate audio visual FLASH FAQs are shown in Figure 1. Each step is briefly elaborated below assuming that Microsoft Powerpoint is used to generate the slide graphics and audio narration and PowerCONVERTER to produce the FLASH files.

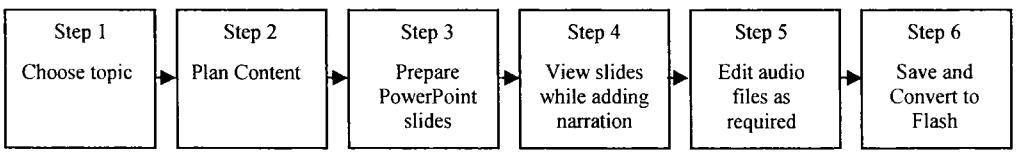

Figure 1. Stages required in the production of FLASH FAQ's

Step 1. Choose topic: There is no one rule to choosing the most appropriate topics about which to generate FLASH files. However, the reporting lecturer has most frequently chosen topics from the following three categories:

i. In response to a frequently asked question raised on the subject discussion forum.

ii. Related to a particularly difficult aspect of the subject material.

iii. Summarise and reiterate pre-requisite knowledge for the current subject.

Step 2. Plan content: Decide on the structure and content required. In doing this it is important to consider what students need to learn, what level of understanding they are expected to have and how they might be subsequently assessed on it.

Step 3. Prepare PowerPoint slides: The slides may include text, graphics, pictures etc. To assist in the explanation of technical content the reporting lecturer sometimes included figures (mainly generated using Matlab) that were discussed in the narration.

Step 4. Add narration: We found an effective strategy was to record the initial narration while viewing a slide show of the PowerPoint slides. Alternatively, the recording can be started on any slide needing narration and then stopped after any slide by pressing ESC. In this trial we chose to have the slides change on click, allowing students to

have control over how long they continued to view each slide after the audio was finished.

Step 5. Edit narration: When producing FLASH FAQs for the first time it is highly likely that you will want to change your audio files. This can be achieved in two ways the first is to re record the audio for an individual slide as described above. The second is to use software to edit and re record parts of the recorded audio file. This is best achieved by using an audio editing software package (there are a number of packages available for free download on the web).

After completing the editing and saving the audio file, it should be added to the appropriate slide by using: insert>movies and sounds>sound from file on the PowerPoint menu.

Step 6. Convert the completed PowerPoint slides with narration to FLASH (or executable) using Power Converter.

Method

As previously stated, two types of FLASH FAQs were produced for the reported subject. The first type took the form of an online tutorial where a difficult subject concept was explained with a supporting example. The second type answered a frequently asked question (FAQ) raised in a tutorial or on the subject online discussion forum. Again the discussed material was supported by an example.

A total of seven FLASH FAQs were produce for the semester reported in this paper. Four of these were of the online tutorial type while the remaining three discussed answers to FAQ's. The FLASH FAQs were made available to students via WebCT (WebCT, 2006). While students could view the FLASH FAQs as often as they liked, they were particularly encouraged to view them when the related subject material was being presented in lectures, before attending open consultations sessions and as a means of assessing their level of understanding.

The evaluation of this innovation relied on three forms of data. Students feedback was collected via both a pre and post-course survey (n=121 and n=89 representing a response rate of 88% and 64% respectively). These surveys aimed to explicitly evaluate students' perceptions of the innovation and their learning experience. In addition student comments posted informally via the WebCT online discussion forum were used as unsolicited feedback. The effects on the responsible academic and feedback from discussions with an experienced academic developer were recorded in an electronic reflective journal. Regular journal entries were made as feedback, problems, relevant issues or possible ideas to improve the development of, or access to the innovation arose.

Results

The survey respondents were predominantly male (20% female), of age 25 or less (98%) and with 80% indicating that English was not their first spoken language. In addition, 34% of the respondents were overseas students. 39% of the respondents undertook some paid employment even though all studied full time.

Although 94% had home internet capabilities, only 82% of respondents used it as their primary method of internet access. Home access was preferred despite 75% having to use slow dialup connections and even though 50% indicated it was easy to access university computing facilities. Although almost all students indicated they were experienced web users only 59% indicated WebCT was a productive way to learn. Further, although 60% indicated

little or no experience learning online with the combination of text and audio, 71% expected this kind of delivery to be a productive way to learn.

Pre-course survey

A section of the pre-course survey examined student learning patterns and expectations. In particular, we were interested to find out how students expected FLASH FAQs would compare to other existing methods of learning. Table 1 shows that the pre-course survey respondents expected that lectures (83%), labs (87%), past exam papers (87%) and working with others (88%) would be more productive than FLASH FAQs (71%) as a way to learn.

Pre Course Survey: Previous flexible learning experience			
	(Strongly) Disagree	(Strongly) Agree	No Opinion
Coming to lectures is a productive way to learn	14%	83%	2%
Working with others is a productive way to learn	7%	88%	6%
Participating in labs is a productive way to learn	8%	87%	5%
Doing past exams is a productive way to learn	2%	87%	11%
I expect the audio FLASH FAQ files to be a productive way to learn	9%	71%	20%

Table 1: Pre Course Survey: Previous flexible learning experience

Post course survey

After completing the subject students were asked to complete a post course survey. Of the 89 respondents 88% indicated that the FLASH FAQs were useful in helping them to understand difficult concepts. The respondents (85%) also indicated that being able to replay the FLASH FAQs many times helped them to understand the subject material. In addition, they (80%) found that downloading the FLASH FAQs rather than viewing them online facilitated their frequent use. Most students (84%) found using the FLASH FAQs in conjunction with subject notes and textbooks increased their usefulness. In addition, 67% of the respondents indicated that it was beneficial to view the FLASH FAQs before the relevant material was presented in lectures. A majority of respondents found that the FLASH FAQs increased their understanding of the subject material more than the online interactive demonstrations (62%) and video presentations (54%) that were also used in the subject.

The survey also showed that by the end of the subject 98% had web access at home and primary usage at home increased to 90% (from 82%). These results reflect the use of online learning within the subject. Students who relied on narrowband access through a phone modem found their usage of the FLASH FAQs was limited either because there were competing demands on the phone or because the FLASH FAQs were bandwidth intensive. This may have contributed to broadband home connections increased to 32% (from 25%) during the subject. In response to this complaint the FLASH FAQs were made downloadable enabling students to exchange copies or at worst only having to download them once. While making the FLASH FAQs downloadable prevented us from gathering usage statistics 80% of respondents agreed that making them downloadable increased their usage.

Post-exposure survey responses (Summary)	(Strongly) Disagree	(Strongly) Agree	No Opinion
The FLASH files were useful in helping me to understand difficult concepts	7%	88%	6%
Being able to download the FLASH files rather than just viewing them on the web enabled me to review them more frequently	11%	80%	9%
Even when the FLASH files contained difficult concepts being able to replay them many times meant that I was able to understand the material	11%	85%	3%
The FLASH files are most useful when you use them in conjunction with the subject notes and textbooks	10%	84%	6%
The FLASH files helped me understand the subject material more than the online demonstrations	22%	62%	16%
The FLASH files helped me understand the subject material more than the video presentations	30%	54%	16%
It is beneficial to view the flash files before the material is presented in lectures	17%	67%	16%

Table 2: Summary of the Post-exposure survey responses

Somewhat surprisingly students who spoke English as their first language (ESB) found the ability to replay the FLASH FAQs many times more useful than those from non-English-speaking backgrounds (NESB) 90% and 84% respectively. Only 49% of NESB found that the FLASH FAQs helped them over come the difficulties they encounter in lectures by not having English as a first language.

Students who do not have English as a first language	(Strongly) Disagree	(Strongly) Agree	No Opinion
The FLASH files were extremely useful as I was able to replay them many times to aid my understanding	6%	84%	10%
The FLASH files were extremely useful in overcoming the difficulties I sometimes have in lectures due to English not being my first language.	25%	49%	26%
Students who have English as a first language			
The FLASH were files extremely useful as I was able to replay them many times to aid my understanding	0%	90%	10%

Table 3: Responses of students who do not have English as a first language

Free-response analysis

The post course survey also asked the respondents to identifying the three best features of the FLASH FAQs and the three features that most needed improvement. Table 4 records the most popular responses. The best features of the FLASH FAQs most frequently reported were that they aided understanding, they maintained the students interest and that they could be reviewed as many times as required. The features that needed the most improvement were that they needed to cover more of the subject topics, that they should be extended to cover practical examples or tutorial solutions, they should be easier to download and have improved sound quality. The unsolicited feedback in the course discussion board recorded in Table 5 reinforced this feedback.

Best Features About FLASH FAQs	Features That Need To Be Improved
Clear explanations / aids understanding	Need to cover more topics
Graphical explanation / Interactive/ more interesting than notes	Cover practical examples / tut solutions / learning objectives
Review as many times as you want	More Depth
Voice supported / narrated / explanation	Smaller in size / easier to download
Downloadable	Improve sound quality

Table 4: Student's most frequent free responses when describing the best features of the FLASH FAQs and the features that need to be improved.

Unsolicited feedback (online discussion forum and email)
Student A: It is good to view the FLASH files before the actual lecture. This helps to get more out of the lecture. I also view them after the lecture.
Student B et el: The FLASH FAQs do help and are convenient and accessible.
Student C: I currently only have a narrowband internet connection. Which means the loading time of the FLASH animations can be time consuming.
Student D: Hey, just wanted to say thanks for those downloadable FLASH files that you created, they've helped my understanding a great deal.
Student E et el: A Number of the International students commented that the FLASH files were "good for them". They can watch them several times, then read the text, then watch them again. They found the FLASH files really helped them to understand and learn the subject material.

Table 5: Examples of Student's unsolicited feedback from the online discussion forum or received via email

Discussion

Effects on students

As previously reported cognitive research has shown that humans have a very limited working memory (Miller, 1956). However, their long-term memory is large (Newell 1972) and deals with previously learned combinations of elements known as Schemas (Bartlett, 1932; Chi 1982; Larkin 1980; Tindall-Ford 1997). Working memory is limited in that it can only handle a very small number of elements simultaneously. However, working memory treats Schemas as a single element. Hence using information stored in long-term memory schemas allows our limited working memory to process large amounts of information. Tindall-Ford et al (1997) found that working memory may be increased by using both auditory and visual processes simultaneously. FLASH FAQs use both an auditory and visual component to maximise the available working memory. The fact that they can be replayed assists students to develop schemas in regard to the presented material. Once developed the schemas allow students to solve more complex problems using their working memory. The results in tables 2 to 5 indicate strong student support for narrated visual explanations and answers that were made accessible online.

Since the FLASH FAQs were a new innovation, to use them students had to modify their usual approach to learning. These changes included students learning how to make the best and most efficient use of the FLASH FAQs. The optimum approach will vary between

students. Some students found it best to view the FLASH FAQs before lectures or before they started reviewing a particular topic. Other students preferred to learn the material first then use the FLASH FAQs to check their understanding. Still others used them as a guide to how well they were achieving the learning objectives. Students would keep reviewing and / or consulting the text or other reference material until they could understand the entire content of the FLASH FAQs. The fact that students could assess their own competency provided a level of formative feedback that would have been difficult to achieve with a similar amount of academic effort using other methods such as class assignments. Some students find it difficult to modify their learning process. However, we found that students adapted quickly to using the FLASH FAQs if the lecturer enthusiastically sold their benefits and described the different ways that students have used the files. Starting lectures with a relevant FLASH FAQ is useful if access to audiovisual facilities is available. This enables students to be familiar with the concept. In subsequent semesters students adapted more rapidly to using the FLASH FAQs for learning as word of mouth from their peers who had previously completed the subject had promulgated what to expect and how best to use the narrated presentations.

Academic's Reflections

Analysis of the coordinating academic's reflective journal revealed that the development of these narrated visual explanations and answers (FLASH FAQs) produced a range of impacts, some unexpected.

First, do-it-yourself production of the FLASH FAQs had lasting payoffs. While generating your initial FLASH FAQs is time-consuming, it will probably not take much longer than your typical weekly student consultations. The bonus with the FLASH FAQs is that they can answer the same question for the whole class semester after semester, giving a substantial return on invested time. If teaching the same subject for a number of semesters it is useful to produce a few FLASH FAQs each semester. This allows a FLASH FAQ library to be built up without being overburdened. The files produced for this research have now been in use for a number of years, providing a significant return on investment for the responsible academic. In addition, students continue to report that a consequence of using the FLASH FAQs was that they need less academic and tutorial support.

Second, support materials can accelerate production efficiency. One of the biggest overheads in producing FLASH FAQs is the production of graphics. Where possible select a subject text with good instructor material that includes PowerPoint slides with graphics. By using these graphics you may be able to produce FLASH FAQs with much less effort, assuming of course publisher permission to do so is granted.

Third, presentations should be tightly focussed and limited to one concept. The FLASH FAQs used in the research reported in this paper, even though focussed on a common conceptual stumbling block varied in length. In hindsight student feedback suggests that it is more effective to produce short punchy FLASH FAQs that cover a single point or topic and are easily digested than larger files that cover several aspects of the subject material These smaller files reduce the chances of overloading working memory, assisting schema production and hence improve learning outcomes (Tindall-Ford et al., 1997). Shorter files are also quicker to download.

Fourth, another advantage of using FLASH FAQs is that it is easy to replace or update the audio component. Thus if at a latter time a better way of explaining a particular point becomes apparent, it is easy to keep the same slides and update the audio file. To facilitate editing, you should ensure that you link rather than embed audio files when making your original presentation.

Fifth, provide students with the option to download the FLASH FAQs making them more accessible and easier to use. Trying to view the FLASH FAQs online using a dial-up modem is problematic at slow connection speeds. Often the first slide is downloaded and played, there is then some delay before the next slide is downloaded and played. These discontinuities make it more difficult for the user to absorb the presented information. It is preferable to make the FLASH FAQs either online downloadable, available on laboratory computers for transferring to a USB memory stick or to distribute them with the subject material on CD.

Conclusion

Cognitive research has shown the while humans have a very limited working memory they have a large long-term memory. Long-term memory deals with previously learned combinations of elements known as Schemas. Working memory is limited in that it can only handle a very small number of elements simultaneously. However, working memory treats Schemas as a single element. Hence by using information stored in long-term memory schemas allows our limited working memory to process large amounts of information. Tindall-Ford et al (1997) found that working memory may be increased by using both auditory and visual processes simultaneously. FLASH FAQs use both an auditory and visual component to maximise the available working memory. The fact that they can be replayed as often as required assists students to develop schemas enabling them to use their working memory to solve complex problems.

Students reported that the FLASH FAQs not only helped them understand the subject material but also assisted them to identify gaps in their knowledge. The fact that students could assess their own competency provided a level of formative feedback that would have been difficult to achieve with a similar amount of academic effort using other methods such as class assignments. Students particularly liked the feature that the files could be replayed as often as necessary.

The FLASH FAQs produced for this research have now been in use for a number of years, providing a significant return on investment for the responsible academic. In addition, students reported that as a consequence of using the FLASH FAQs they needed less academic and tutorial support.

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Proceedings of the 17th Annual Conference of the Australasian Association for Engineering Education

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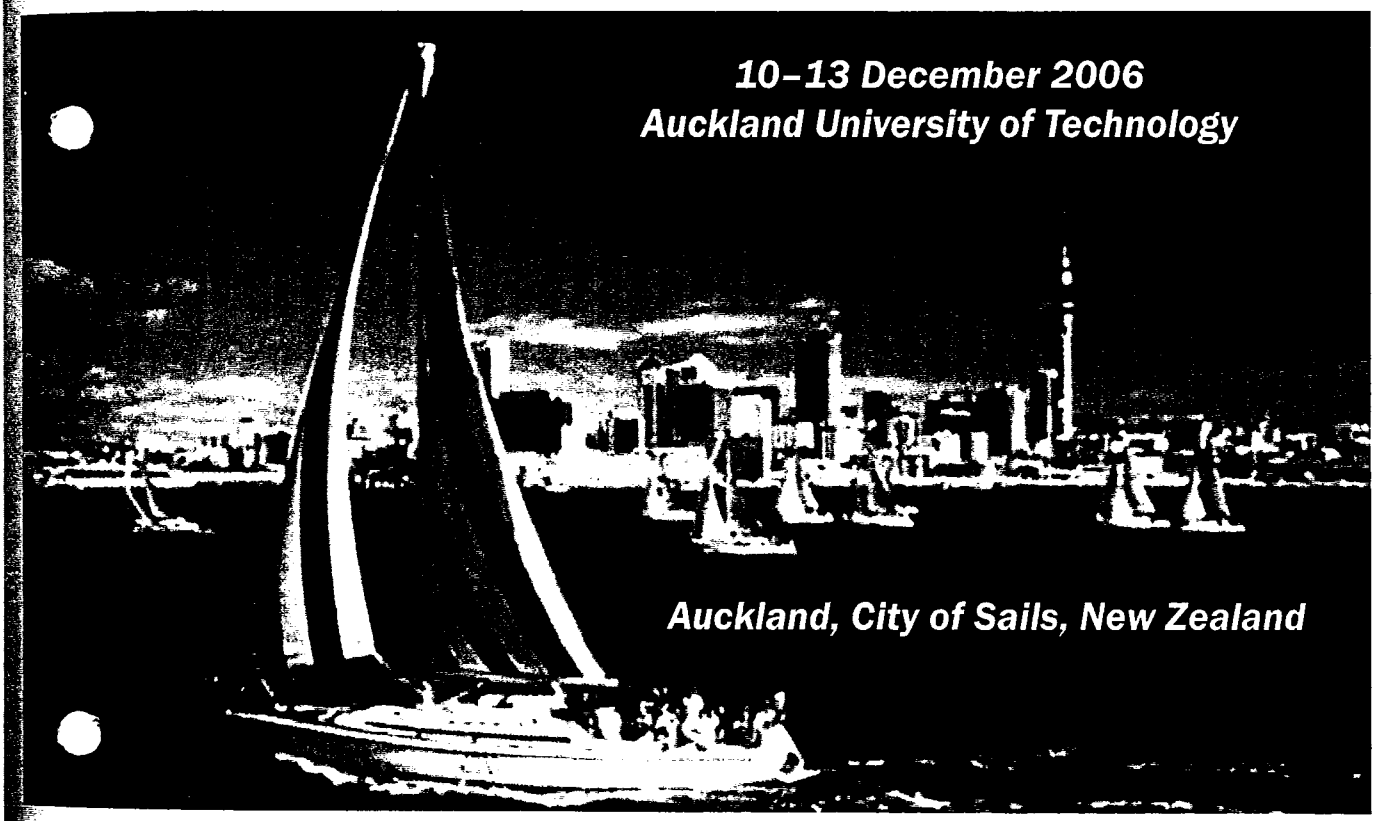

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