

## **WHY ARE THEY STUDYING MATHEMATICS? TERTIARY MATHEMATICS STUDENTS TELL ALL!**

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### Introduction

The findings from three data gathering sources used in an ongoing research project are presented in this paper. The aim of the study is to determine the factors involved in motivating mature age students to begin mainstream tertiary mathematics courses and in influencing their decisions to persist with, modify or drop-out of their studies. There were four distinct phases to the study: (1) determining relevant factors to explore, (2) determining enrolment patterns of mature age mathematics students, (3) a large scale quantitative survey questionnaire, and (4) a semi-longitudinal in-depth qualitative investigation of a smaller number of mature age mathematics/science students. The first three phases were described in detail by Brew (1998). The qualitative component of the study included four data gathering methods: (i) interviews, (ii) regular e-mail (or snail-mail) correspondence, (iii) 'tagging' for part of a day, and (iv) monitoring of daily activities using a beeper-activated signal. This paper focuses on the first three of these qualitative data sources.

Based on the potential contributing factors identified in the literature (phase 1 of the study) and within an understanding of the context in which mature age mathematics students are found in the Australian tertiary population (phase 2), the large scale survey data (phase 3) provided a broad brush perspective on a large sample of mature age mathematics students and enabled comparisons to be made between them and their school leaver counterparts. An examination of the individual survey responses of two students, Howard and Ann (not their real names) who also participated in the in-depth component of the study, contextualised these two individuals in relation to the larger sample (see Brew, 1998).

Data gathered in the qualitative component of the study provided further insights into students' personal lives and university experiences at various layers of specificity. In the next section, the methodological considerations and the strengths and weaknesses of three data gathering methods - the interviews, regular e-mail (or snail-mail) correspondence, and 'tagging' students for a period of time - together with findings for Howard and Ann are discussed. Leder (1998) discusses the fourth data source, the 'beeper-activated' monitoring of daily activities.

### Data sources and methodological considerations

#### The interviews

About 50 students indicated on the survey questionnaire that they were prepared to participate in the qualitative component of the study. After extensive follow-up, a final sample of 26 students was identified. Of these, two students did not complete survey questionnaires. They were recruited later because of the small number of volunteers from two of the five participating institutions (Universities 2 and 3 listed on Table 1). However, we gathered a range of relevant background information from them at interview. A summary of comparisons between the smaller sample of mature age students (N=26) and the larger

sample who completed the questionnaire (N=99) on several background variable is shown on Table 1.

Table 1: Comparisons between small and large samples of mature age students (%)

	Gender		Language		Age		University Attended				
	%	M	F	ESB	NESB <sup>1</sup>	21-25	26+	1	2	3	4
Small sample	65	35	65	35	50 <sup>2</sup>	34	31	8	12	23	27
Survey sample	68 <sup>3</sup>	30	52	48	63	37	19	13	13	28	26

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Students of non-English speaking background (NESB) were those who indicated that they regularly spoke a language other than English at home<sup>2</sup>

Three students in the small sample were 20 years of age when they commenced their studies<sup>3</sup>

Eight students did not indicate their sex

The interviews with each of the 26 participating students were conducted during semester 1 of the year following the collection of the survey data. The interviews took place at the university campuses of the participating students, were audiotaped and subsequently transcribed. A semi-structured protocol was used. The aims of the interviews were to elaborate on aspects of the data gathered from the survey data and to explore students' expectations and experiences of university life and their reasons for continuing or discontinuing mathematical studies. Issues and specific questions from the interview protocol included the following:

Confirmation of details from survey questionnaire (e.g., course and enrolment details, living arrangements, and age)

Can you tell me about your life pathway that has lead you to being enrolled in your current course?

What were your expectations of university life? (e.g., time commitment, level of support, resources). To what extent have these expectations been met?

To what extent do you think your experience of university life differs from that of: school leavers; of women/men in your course?

If mathematics has been dropped, what was the reason for this?

E-mail/snail mail

Regular communication with participants was maintained via e-mail (snail-mail was an option open to those who could not access to e-mail). This form of communication allowed us to gather more information about individual students and to monitor their reactions to changes in personal circumstance and university experiences that took place during their courses of study. Initially it was planned that the format of the regular monthly e-mail correspondence (or snail-mail option for those not able to access the Internet) would be the same each time so that changing patterns of

response could be traced. We devised a format that required a minimal response time. Students had to mark boxes, select one or more responses from a list etc. (Sample items are shown in the appendix). However, feedback, coupled with a greatly reduced response rate to the second message, convinced us that the message format should vary. The third message, our last to date, consisted of six open-response format questions. It was sent out at the end of semester 1, 1998 and the questions focussed on reactions to end of semester assessments, circumstances which may have affected learning and study time, and comparisons between experiences during semesters 1 and 2. For example:

Summarise how you felt about your experiences at university last semester? [You might like to write about: lectures, tutorials, class work/assignments/ laboratory sessions etc., the examinations, your achievements, your disappointments]

In what ways did your home life / your work / your social life etc. assist and or hinder your progress last semester?

How do your experiences at university this semester compare with last semester?

"Tag" for a day

In their longitudinal, ethnographic project to explore why relatively few American college women chose subjects and courses that could lead to the traditionally male-dominated fields of science and mathematics, Holland and Eisenhart (1992) followed students around for periods of time to learn more about their lives on campus. We planned a similar data gathering activity - "tagging" students for a day. On the day that we would meet students for 'tagging', we would also hand them the pagers for the "beeper-activated" activity which would commence the following day.

On the whole it was not easy to arrange to meet students. Times were often constrained by students' home and work responsibilities. Sickness, memory lapses and difficulties in communicating last minute scheduling changes meant that several appointments were missed and difficult to re-arrange. Study pressures meant that students were also often very anxious to spend any spare time they had between lectures, tutorials or practical sessions studying alone in the library or working on assignments. We also felt that our presence in crowded lectures and tutorials was somewhat intrusive even though we had permission to be there. The "tagging" thus turned out to be the least effective of our qualitative data gathering methods and was missed or abandoned altogether for some students.

One of the aims of the "tagging" exercise was to observe the learning environment and gather an overall impression of it. We believed we would then be able to contextualise students' comments about their experiences. Since we had several participants at each institution, we were able to gauge our impressions of the learning environment at each despite gathering less data than initially anticipated.

## Results

The themes from the four clusters of items in the survey instrument - biographical/ background information; tertiary enrolment issues; affective factors; and perceptions of the tertiary learning environment - were used to analyse the data gathered about Ann and Howard from their interview transcripts, e-mail (snail mail) messages and the 'tagging' exercise.

Table 2 shows a summary of the data gathered from Ann and Howard. The findings from the data sources are aggregated in the descriptions of the two students that follow.

Table 2: Summary of data gathered from Ann and Howard

E-mail/snail mail Interview May July September Tagging Ann ( ( ( ( meet only Howard ( ( ( (

### Ann

Ann is 38 and is now in the second full-time year of an Applied Chemistry course. Originally from interstate, her husband's work was the catalyst for a recent move to Melbourne. When Ann finished school she trained as a Telecom technician, intending to go to university after a year. However, marriage and then children intervened. Wanting "to do something" as well as being "at home with the children", she enrolled part-time in a teacher education course, believing that it would fit in well with having children at school. However, she became pregnant and discontinued the course. Reflecting on that time she noted that: "Kids just grow up so quickly, I didn't realise that... It would have been such a waste to have been a teacher... you know one's 17 now".

Before coming to Melbourne, Ann had worked in a family day care centre. Without qualifications, she realised a similar job would be difficult to obtain in Melbourne and decided that she needed qualifications in order to work. She consulted a TAFE handbook, marked courses of interest, and decided on laboratory technology, even though she had never studied chemistry. Subsequently she got a job as a laboratory technician and realised that she did not know enough about the job and that "it was worth putting the time in to come to uni. to learn more about chemistry". Although she considered that "it may not be as good a degree", she wanted to take an applied course because "it's more practical". Gaining experience through the industry-based component of her course and the high employment rate of graduates were other considerations in her course choice.

Ann is highly motivated to complete her course. She enjoys the pressures of study but has recently felt very tired. As well as studying full-time, she works part-time four evenings a week including weekends. It appears that it is a question of pride and independence rather than financial necessity that she does so

... to pay to come here because it's not cheap. I probably don't need to... But I feel guilty because I could be out earning money and it's a bit of a luxury to come to uni... I feel I have to work to put some money into the house.

Completing the course and getting a good, well-paid job afterwards were personal goals for Ann: "I have the right to a good job, because he's got a good job because I stayed home and looked after the kids". Conflicts between Ann's perceptions of her family responsibilities and her academic and paid work were evident and reflect a degree of gender-role stereotyping:

The kids are really helpful... [but] they still need time, still need to talk to them and just hear about their day. But it's good they have responsibilities too. Like it's 'I'll be out, you get the washing in tonight. You have time, you can vacuum'... And we all do homework together.

Ann appears to be extremely well-organised. She studies hard during the week preferring not to come into university on the weekends "because I'd rather spend the weekend with the kids". Her grades in first year were outstanding and she recognised the effects on her self-esteem: "It's nice to get the results. It gives you a lot of self-esteem". Even in mathematics, a subject in which she claimed her background was not strong, she had gained a high distinction. She had found the assistance available through the mathematics learning centre had been adequate and the staff helpful. She recognised the usefulness of mathematics in what she was studying. She was disappointed that she was unable to continue with mathematics in second year, but it had not been offered as an elective. She had approached the mathematics department to take mathematics as an elective and claimed that the person she approached "said that he was going to take it from there, but didn't".

Ann was aware of a difference in attitude in her school-leaver classmates and herself as a mature age student:

I approach it from a different... This is my last chance to do something whereas they're kids. [e.g.,] 'he wants our assignment by Friday, well he can go jump'... Whereas I think 'No'..."

She mixes with younger students but felt she really did not want to tag along with them: "I'm so much older. They're the same age as my kids... I can't imagine they'd want me to". But, she felt she always had someone to speak to during breaks if she felt like it. Despite there being a few other mature age students in her course, they did not appear to be consequential to her studies.

During first semester this year, her attendance at lectures and practical sessions has been high (100% or near to) despite several frustrations. Building renovations had caused timetabling havoc with some practical classes, some lecturers were boring and she was very disappointed with the content of her elective subject. She was worried when studying but had not contemplated dropping any of her courses. The timing of assignment work has been somewhat disorganised, leading to an uneven distribution of the work load. She felt that her paid work had hindered her progress somewhat and was very tired. Her social life had been curtailed: "[it] is the easiest to change, my responsibilities for family and work being reasonable inflexible". She was not enjoying second semester as much as in first semester. There were several reasons. Some lectures were boring and she was not keen on organic practical work: "everything seems carcinogenic and smells bad [and] none of them have quite worked". She was less motivated to do well:

First year I was surprised when I did well. Last semester I expected to do well and put the work in. This semester I'm feeling a bit like I've proved I can do it. I'll slack off a little because if my marks drop I'll still get distinctions and that's OK. Danger... is I'll go too far but I am very tired.

Howard

Howard is 26 and has one young child. Originally enrolled as a full-time student, he is now part-time. The change in enrolment status resulted from his ineligibility to draw Austudy because he had completed a previous degree in commerce. Financially, he and his partner are dependent on social security payments although he has called on his parents for assistance in times of need. Howard does not work. Despite his part-time enrolment status he is taking as many subjects as he can to complete his degree in minimum time.

Howard was raised in the country and when he first came to university was supported by his parents. He described himself as "wide-eyed" and took advantage of the extra-curricular social side of university life. He lost interest in his course and it took him five years to complete his commerce degree. Having no motivation to be an accountant, he has never used the degree to gain employment. He ended up working in a warehouse as a storeman but got bored with it. He began thinking about what he would like to do. Having always been interested in computers he decided on computer science.

Howard is approaching his studies quite differently from the past. He knows what to expect and is more motivated:

...like previously I was just in real sit back and cruise mode and just basically bludged. And now I'm sort of quite motivated and so my approach to university is completely different... I mean I sort of know what's involved... It's not overwhelming any more. It's not scary. You know, I feel completely comfortable in the situation.

Howard did admit that he had some qualms about coping with the content of the course he had chosen because of his time away from study. In his second year of study, he was, however, feeling more confident:

Oh, I feel more confident, definitely, that I can do this and that I'm interested in it, I can do it well... that I'm going to follow through and it's going to lead somewhere.

He had studied some mathematics in his commerce course and had not found it particularly difficult to return to mathematics despite it being "very conceptual". He has found the mathematics teaching well structured and the lecturers enthusiastic and particularly good. He puts the onus on understanding on students and not the lecturers: "[if] you don't understand the concepts then you're not going to follow them anyway". With the exception of one lecturer, he was not at all effusive about the teaching in the computer science area. Poor teaching in this area was a persistent complaint.

Observing Howard in a computer science tutorial, it was clear that, compared to many other students, he was focussed on the task at hand. He also assisted a student who arrived late and had missed the previous tutorial.

Howard works on assignments with one other mature age student and some school leavers but does not have the time or energy to be involved in the social scene at university. He would like to but realises that he already spends a lot of time away from home and "I do want to spend a bit of time, you know, looking after my child, participating and helping out my partner. So... I basically chose that instead". He does not feel far removed from his school leaver counterparts but recognises that his lifestyle is quite different:

I have a child... Like the responsibilities of home whereas they don't. They're responsible only for themselves but now I'm responsible for someone else. And... within a family, so have family responsibility. I feel that

Howard spoke at some length about his decision to return to study and the effects this had on his partner. She had been a student, got pregnant, and had not been able to complete her course. This, Howard said, was "really frustrating her". She had recently commenced 'dancing classes' as a hobby but eventually wanted to return to study. He said that she felt that he had decided to return to study without thinking

about sharing the burden of parental responsibilities. He believed that he would be able to spend more time at home than he had while working as a storeman but it had not turned out that way. Howard felt that his first year at university had probably been "the most intense year in my life". He admitted that he had been "avoiding responsibility all my life as much as possible".

Howard's lecture and tutorial attendance during second year has been fairly high. He is interested in most of his subjects but was occasionally frustrated and annoyed during lectures and tutorials. He was pleased with his achievements in semester one although he had "found it increasingly difficult to get after hours study done at home - general fatigue from having a small child and the constant learning process of university"

What do Howard and Ann tell us about being a mature age mathematics student?

Both Ann and Howard were aware of the differences in their lifestyles compared to younger students. For these two students, family responsibilities were clearly impacting on their opportunities to study and socialise. Gender-role stereotyped differences emerged, however. Although Howard is required to take on some child-rearing roles, his partner has major responsibility. Ann, however, did not mention her husband's involvement at all and appeared concerned to fulfil her 'motherly' role. For both, however, there appeared to be some guilt attached to being a student. Howard had given up all involvement in social activities at university. Ann, too, was not involved. She, however, also felt compelled to work part-time to cover the costs of her university study and contribute to the household finances as well as organise her life around her family. Both felt the pressures of their family roles and fatigue was mentioned by each student.

Although their financial situations were different, both could be considered to be in secure financial circumstances, enabling them to study and pursue their goals without immediate concerns for basic needs. Howard was dependent on social security but had the safety net of parents who could and had assisted. Although Ann was working part-time, this was not necessary. For her it appeared to be a sign of independence to be able to cover the costs of her education and to contribute minimally to the household's finances. Perhaps she wanted to prove to her husband that her studies were worthwhile and not just an expense incurred to satisfy a whim.

Clearly both students are highly motivated to complete their courses, aware that this will open future employment opportunities for them. Recognition of mistakes in decision-making about life and study directions at the end of their schooling was common to both students, although having taken place at different stages in their lives and under different circumstances. Each appeared to have a personal goal and was striving to achieve it and were aware of the potential obstacles that might hinder progress.

Frustrations associated with aspects of their learning environments were evident in the comments of both. However, they appeared able to circumvent these difficulties or, at worst, just put up with them. They did not appear to allow poor teaching, uneven workloads, disruptions or disorganised classes deter them from persisting with their studies generally or with the courses they were taking in particular.

Leder (1998) describes the findings from the fourth qualitative data source - the monitoring of students' daily lives. These findings shed further light on the lives of

these two students and highlight further the tensions they experience in their families, other aspects of their daily existence and the effects of these on their studies.

### Final words

At the time of writing, detailed analyses of the data gathered from the remaining 24 students participating in the study have not taken place. However, the issues identified in the portrayals of the lives of Howard and Ann described in the preceding section and by Leder (1998) raise a number of questions that will be explored further:

How do the lives of mature age students without family responsibilities differ from those with them?

Is mature age study only open to those who are financially secure?

Do all mature age mathematics and science students return to study to compensate for educational mistakes made on leaving school?

Do all mature age students cope with inadequacies in their learning environments?

Do they all share the same strong motivation to succeed?

Is there a pattern of difference in the roles and expectations of male and female students?

Are the perceptions of university courses and the daily routines and pressures that may affect studies the same or different for mature age students from overseas and from different ethnic backgrounds?

The data gathered through the research methods described in this paper and by Leder (1998) allowed a qualitatively rich picture of the lives of two mature age students to emerge and complement the more limited survey data findings on the same two students (see Brew, 1998). At the same time, the qualitative findings raised a number of critical questions that will be explored when the data from the other participants are analysed.

The final results of this study should be of interest to those concerned with the outcomes of the Australian higher education system. At present, the system is primarily geared to the needs of school leavers. However, it appears that mature age students are prepared to sacrifice much to fit into the situation. Should the system be more flexible to allow a greater number of mature age students to enter? Should the nation, through the social security system make it easier for those who are less well off and older to benefit from a university education? In the mathematics and science-related disciplines, answers to these questions may begin to address the problems of Australia's declining science and technology base.

### References

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Holland, D. C., & Eisenhart, M. A. (1992). *Educated in romance. Women, achievement, and college culture*. Chicago: University of Chicago Press.

Leder, G. C. (1998). *But what do you do all day?* Paper presented at the annual meeting of the Australian Association for Research in Education, Adelaide, Nov-Dec.

Sample questions from May and July e-mail messages:

2a. Has anything happened over the past month that has significantly affected your studies (include university, work or home related factors)? Yes / No. Please elaborate and explain how these events, circumstances or situations affected your learning.

3. Levels of attendance at lectures (Q5. tutorials)

For each subject you study, how would you describe your level of attendance at lectures over the past month? (Name the subject and mark your choice with an "X"):

Subject 1:

high (100% or near to); fairly high (70-80%); moderate (60-70%); low (<60%)

4. For each subject that you study, how have you usually felt during your lectures (Q.6 tutorials; Q.10 when studying alone) over the past month? (Name the subject and mark with an "X" as many words that apply)

Subject 1:

interested; relaxed; worried; successful; confused; clever; happy; bored; rushed; panicky

Write down one or more words of your own:

7. How could lectures (Q.8 tutorials) be improved? (Please identify subject/s in your response)

Over the past month, have you been able to keep up-to-date with your studies?

Yes / No. Explain:

11. Over the past month:

Have you contemplated dropping any courses? Yes / No. If 'yes', which one/s and why?

Have you been studying/working with other students? Yes / No. If 'yes', mature-age or school leavers?

Have you been mainly studying alone? Yes / No

Have you spoken with any of your lecturers/tutors? Yes / No. If 'yes', with lecturer/s in which subjects? Was the discussion related to your studies? Yes / No. If 'yes', was the discussion fruitful?

12. Are there any other events or issues that have occurred over the past month that you feel may be important for the purposes of this study?

Any other comments?