Griffith UNIVERSITY

Numeracy, Youth and Employment:

A study of numeracy demands in contemporary workplaces

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- Centrelink
- Gold Coast City Council
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Executive Summary

This project was a partnership between the Chief Investigator (Prof Robyn Zevenbergen) from Griffith University (for part of the project at Charles Sturt University) and The Gold Coast City Council; Centrelink; Gold Coast TAFE; Queensland Studies Authority and SCISCO Inc. The project was initially developed out of a concern of the consortium regarding access to and retention of young people in work within the Gold Coast region. It was recognized that numeracy was an important element of how young people were selected for work as well as their on-going retention in work. Within such a context, it was also recognized that little was known about the contemporary demands of workplace numeracy such that if recommendations were to be developed they needed to be aligned with contemporary practice. As such, the project sought to identify contemporary demands of workplace numeracy through a range of methods.

The study was conducted over a period of three years from 2002-2004 with 2005 being a phase for final analysis of data. An iterative approach was used where the outcomes from one phase were built upon in following phases. The Industry Partners were involved throughout the development of research protocols and on-going analysis, thus providing valuable insights into various aspects of education, training, selection and retention of young people. The approach used a mixed method approach and involved a large scale survey with almost 1000 responses in the first phase. This was followed by 19 case studies of young people in work across a range of industries and skill levels. Arising from the first two phases came a realization that young people approached numeracy in ways that were quite different from those anticipated at the commencement of the project. The final phase, thus, involved two distinct process: first community consultation where focus groups were held to discuss outcomes and reaction from stakeholders; the second was the development of recommendations arising from the outcomes of these three distinct actions.

The outcome of the project was substantially different from the assumptions that underpinned the initial project. Where it was anticipated that the project would seek to develop strategies to support existing assumptions about workplace numeracy practices, the project highlighted very different expectations and views about numeracy in the workplace between younger and older people. The initial survey showed statistically ($p<0.01$) that there were differences in what the senior respondents (teachers, employers and job placement officers) identified as important aspects of contemporary work when compared with younger participants (students in work; workers and job seekers of 22yrs of age and under). Using a “” analysis it was found that nine variables were identified as being statistically different between the two cohorts – 5 related to aspects numeracy (number – mental calculation; statistics; measurement) 3 related to the use of technology; and 1 to literacy (non-verbal communication). What was interesting in this outcome was that 8 of the discerning variables in the two cohorts could be tied to numeracy and ways of working mathematically in the workplace. It was also noted that senior people saw that mental calculation was a key important numeracy skills whereas younger people were more likely to identify applied areas of numeracy (statistics, measurement etc) as more important in their work. Open-ended responses and interviews further elucidated the ways in which the two cohorts saw these as important.

The second phase of the study involved 19 case studies of young people in work. A preliminary interview was conducted, 3-5days of workshadowing; and a final interview. Interviews with employers were also conducted. It was found that the young people worked very effectively in their workplaces but in terms of their ways of working mathematically, the case studies confirmed the differences found in the survey. It was found that young workers tended to use considerable estimation; informal methods; holistic thinking; and problem solving as they undertook tasks. Furthermore, the impact of technology in the workplace was significant whereby it was found that as an integrated component of the workplace, it had not only changed the ways in which young people undertook their work, but also that they saw technology as a tool to support their work. This also confirmed the survey data in the ways in which the two cohorts viewed technology. Young people were happy to defer cognitive labour to technology whereas senior people were more likely to value mental methods over the use of technology.

From these phases, it was concluded that young people have substantially different ways of working mathematically in contemporary work, often shaped by the use of technology. This technology could be an integral part of the workplace, but equally it is an integral part of their worlds both in and out of work. It has, thus, shaped how they come to see tasks, particularly mathematics, and how they undertake such tasks. It was found that in many cases, the technological dispositions of young workers meant that they offered new and often more effective ways of working in the workplace but this was not capitalized upon by employers, job placement officers or teachers. Focus groups, public dissemination meetings and other forums have been used to seek reaction from older stakeholders. It has been found that the outcomes confirm the experiences of such stakeholders. However, there is some resistance within some sectors as to retaining old values and methods while dismissing the potential of new ways of working.

Background to the Study: Youth numeracy and work

The Local Impetus for the Study

The project arose from the interests of group of people working with young people and whose roles varied but were all concerned with the preparation of youth for the world beyond schools. Many issues impact on the employment and employability of contemporary youth, each of which presents different ways of conceptualizing the complex myriad of issues and variables. Each, in turn, offers different formulations for thinking about addressing the social phenomenon of youth in work. Perhaps one of the loudest voices that are heard when the topic of young people are framed in deficit models whereby young people are seen to be lacking particular knowledges or dispositions for contemporary work. Juxtaposed with this view, is the emerging recognition that society, work and modes of knowledge are undergoing significant changes and that such changes may be paramount in theorizing changing demands and expectations of work and youth. The dramatic changes brought about through technology have been recognized by contemporary theorists of workplaces and literacy but the impact of these emerging positions has had little impact on the lived experiences of young people as they enter the world of work.

This study sought to explore the *nature* of contemporary work and the implications this has for theorizing and enacting numeracy practices. It was not intended that a particular standpoint be taken but to investigate the demands of contemporary work for young people and how they enacted numeracy practices in such contexts. Suspending judgment on practice does not come easy since the histories of those who construct research impacts on what they see and how they interpret actions. It was more important for this project was to understand how young people undertook their numeracy practices from the viewpoints of the participants rather than seeking to identify potential school mathematics in workplace practices.

The Consortium

This project was unique in that a consortium of key stakeholders, each with their particular viewpoint, developed a multidisciplinary approach to understanding the practices adopted by young people in the workplace. Some stakeholders were involved in statewide curriculum development and implementation; some concerned with the development of core/basic skills of young people; some concerned with the placement of young people in work and the pressure of employers to ensure that candidates were able to undertake the work expected of them; others were concerned with the placement of young people traditionally excluded by schools and in need of non-traditional pathways through education, while others had a socially negotiated role of ensuring particular views of mathematics were reproduced by young people. Collectively, the consortium represented a diverse range of interest groups – each concerned with the employment (and employability) of young people, but drawing on very different histories and interests. These considerable differences made for a wealth of experiences and viewpoints to be developed in theorizing and researching the numeracy practices of young people in contemporary work.

Review of the Literature

In considering the relevant literature, a number of perspectives framed the review. In the first instance, it was recognized that workplaces, life, families and social infracture have changed considerably over the past decades. Such changes, argue some social commentators, is akin to the change from Agrian Society to an Industrial society. The rapid growth and impact of technology (particularly digital technologies) has changed societies, locally and globally, from Industrial to post-industrial times. As such, this theme is central to the literature review.

Post-Industrial Times

Current theorists suggest that society, work, families are undergoing serious changes. Akin to the radical changes brought about through the industrial revolution where society changed from agrarian to industrial; families changed from extended to nuclear; economies became defined by national boundaries and related to the means of production, contemporary theorizing about the radical changes in today's society are seen to be reflections of a similar shift from an industrial age to a post-industrial age. Economies are moving from models related to production of goods to the production of information; economies are becoming global and multinational. Families are shifting from nuclear to blended and/or single parent; divorce rates are running at 50% for first time marriages and significantly higher for second and third time marriages.

Where powerful knowledges rested with the sciences (which includes mathematics), computing knowledges are becoming more powerful. These changes are significant in terms of the effects on what are seen to be key foundations for education of young people.

Within these changed economic conditions, the patterns of work are radically different. Whereas those students who did not have strong academic records could assume postions where they were able to rely on manual labour, these types of positions are increasingly declining, in part, due to the technologised workplaces. Full time work is being replaced by casualised, part-time work. Many employees are becoming self-employees and many of them work from home. These changed circumstances create the need for a very different worker.

Schools in Post-Industrial Times

In the study of schooling, educational theorists suggest that the behavioural problems being observed in many Western schools are a sign of system designed in Industrial times to serve a particular need and clientele (Luke, 2004). Those needs are changing, so too are the clients – students, employers of school graduates. The system is unable to cater to the learning styles of young people who have grown up in a highly technologised world where multiple sources of information (mobile phone, television, electronic games; and radio) are commonplace. Rapid bursts of information bombard the sensory systems of young people. The traditional modes of teaching where only one form of information is being given, typically from the teacher, and where lessons can be 90 minutes related to a particular topic are counter to the ways that young people live their out-of-school lives. Youth are seen as not engaging with the modes of schooling and for many students, they rebel overtly or withdraw from what they see as irrelevant experiences.

The Changing Nature of Work

Undeniably the nature of work has changed considerably over the past 3 decades. The shift from permanent full-time work has been replaced with a much more transient role in the workplace where the employee is more likely to be engaged in casual and part-time work. The contemporary employee is more likely to have created his/her own position within an existing industry or to have created their own company. More than any other period in time, people are required to become self employees, to undertake contract employment with a given company and to have flexible hours. The notion of a 40 hour week between 9 and 5 from Monday to Friday is less the norm than in the past.

Declining Standards: Are Contemporary Youth Innumerate?

The current educational and political arena has portrayed young people as being deficit in many ways. Youth are seen as lacking the literacy and numeracy skills needed for working, they are portrayed as lacking the literacy and numeracy skills for success in working in contemporary workplaces. Employer and other lobby groups have successfully campaigned politicians to develop numeracy and literacy initiatives that seek to redress perceptions that young people are not capable of undertaking core tasks that are imbued with literacy and numeracy demands. In the US, Wieck (2003) reports that young people are exiting from school with lower literacy and numeracy basic skills.

Within Australia this is evident in the development of national literacy and numeracy strategies (Department of Education Training and Youth Affairs, 2000).

Media are happy to report the demise of Australian youth as being incompetent to complete the most basic of numeracy or literacy tasks, often blaming schools and teacher as being the source of the problem. This project does not take this position. In the past, schools and teachers have been very successful in developing an informed populace for an expansive workplace so questions need to posed as to why the general population decide that schools are to blame for the current demise of young people – or at least the perception of that young people are not exiting from school with the prerequisite skills for contemporary work. Little consideration is made of the rapidly changing workplace as if the workplace has remained impervious to the wider social and technological changes that are impacting on society in general.

The Changing Face of Numeracy

Literacy educators have been forthright in theorizing and researching the changing face of literacy as a consequence of technology. The multiple layers of text that are part of the technology interface create new ways of reading and producing text. The linear models of traditional modes of paper text have been significantly altered with the advent of digital technology. Gee has suggested that young people having grown up in a highly technologised world are very different from their counterparts from other generations. While there have been serious considerations of the changing nature of literacy, there has been little concurrent theorizing in numeracy. There has been some suggestion that statistical literacy is an emerging field that will have greater importance in the future due to the changes brought about through the massive generation of information (Steen, 1999). Younger generations will need to have good statistical savvy if they are to make sense of the bombardment of information that is commonplace in post-industrial times.

Post Industrial Youth: Generation Y

Cultural theorists have proposed that young people are a product of their times. In his study of Australian generations – the baby boomers, their parents and their offspring, Mackay (1997) shows how social conditions have produced very different generations in terms of work ethic, patterns of consumptions, values and so on. Further to Mackay's work, other theorists have differentiated youth into generational groupings, again reinforcing the differences between groups. These studies have suggested that youth fall into two categories – Generation X and Generation Y. While the dates of these generations vary, they can be broadly conceived as Baby Boomers who were born between 1946 and 1964; Generation X or Baby busters between 1965 and 1979 and Generation Y or Nexters or Internet Generation or Millennials which is the current generation and turning 24 now. (Rodriguez, Green, & Ree, 2003; Salopek, 2000; Zemke, 2001). Unlike the baby boomers who lived to work to supply their lifestyles, the later generation work to live (Tulgan, 2000). In a large study of differences between baby boomers and Generation Xers (Rodriguez et al., 2003), the authors reported significant differences between the two generations where Xers preferred to complete a challenging task within a day (as opposed to longer periods of time); purchases were made through the internet (as opposed to the telephone); working alone and with flexibility in hours (as opposed to teams and set hours);and where the work environment needs to be challenging and fun but not necessarily secure whereas Baby boomers were seeking stability in employment and retirement funds. These differences have implications for how young people engage in work and how they see their working lives. Salopek (2003) has argued that the younger generations have grown up in a technology-rich world so have had the instantaneous gratification afforded by technology. She argues that the affordances of the "digital native" generation has meant that they excel at multitasking and parallel processing; where there is asynchronous processing in a global environment; graphics are an important part of representation; seek active rather than passive involvement; and are less patient with experiences where there is no big payoff (p. 18)

Perhaps the most discerning difference between Generation X and Generation Y is the level of technological fluency in the two generations. This difference has been used to refer to Generation Y as the "techno-savvy' generation (Zabel, 1999). Having grown up in a world immersed with technology, they seek the quick feedback afforded by technology, the multi-tasking made possible through multi-media; and see technology as a tool for enabling work. Given the age of the Millennial, the impact of their involvement in the workplace is only just beginning to be felt by employers. In some cases, those responsible for training are suggesting that employers and trainers will need to radically alter how they go about training these young people as they have significantly different orientations to learning, work and life.

Coming to Understanding Contemporary Work and Youth

Given the changing workplace and the changing clientele, questions need to be posed of the assumptions that underpin education and training reforms. Do they match the needs of the workplace? What are the needs of the workplace? How do young people – Millennials in particular – undertake their work? Is it similar are different from previous generations? If there are differences, what are they and how do they impact on those involved in training and employment?

Questions of these types need to be posed of contemporary work in order to develop and expand the competencies and dispositions of those involved with employment and training of young people if a competent workforce is to be developed that will enable Australia to be a competitive force in an international market.

Methodology: Coming to Understand the Issues

Understanding the numeracy demands of contemporary work is complex. Stakeholders hold strong views about what is needed for success in the workplace and these views are governed by history - individual and collective – as well as positions that people hold. Unsurprisingly, groups of people are more likely to have particular views about what is a numerate person and how important numeracy is for a particular position. Separating perceptions and biases from reality is a complex task, but one that is needed if a valid account of the demands of contemporary work is to be developed. Central to the task of identifying the numeracy demands of work is the suspension of individual's values and assumptions.

The complexity of the issues surrounding the three elements of this research project – numeracy, youth and employment - is multifaceted. Coming to understand the complexity and intersection of these three issues demanded a multidisciplinary team. The project was unique in that it consisted of a range of people from various sectors to develop and extend the research from a variety of perspectives. Collectively this process enabled the project to develop a holistic understanding of the issues than would have been possible had individuals attempted it.

The Research Context

The region in which the study was conducted is a major tourist destination in Australia. It epitomizes the post-industrial city where there has been no history of heavy industry and as such, the region relies on new industries to support the populations of half a million people who are permanent residents and is the second largest local government area in terms of population. The Gold Coast City Council (2003) is growing at a rate of 3.5% per annum which is considerably higher than the national average of 1.2%. As a major tourist destination, the population is considerably transient with approx 11% of the population being visitors to the region. As a region reliant on tourism and allied industries (accommodation, cafés, hospitality), the Gold Coast has considerably greater number of people engaged in part-time and casualised work than similar national figures. The highest proportion of young (age 15-24) people were employed in clerical, sales and service, trades or labouring positions. The population is aged with 18.3% of the residents being over 60 (the national average is 16.8%) that contributed to the significantly higher proportion of unemployment in the region. The population is bimodal with the highest numbers of people being youth (15-24) and retirees (+65). The area has been growing in new industries that are allied to leisure (in particular, the marine industry) and tourism.

The Consortium

The study was funded by the Australian Research Council Linkage Scheme. As part of this funding scheme, a number of criteria are important. The project must be linked to industry and supported by industry partners (financially and in-kind). This project had five industry partners, each serving a unique part of the educational and work landscape for young people. Collectively, the industry partners formed a consortium that provided the overall direction of the project. A brief description of the partners is provided below:

- Gold Coast City Council is the local governing body whose role is to manage the region. In particular, they play a key strategic role in the economic management and

direction of the region. As a city which has grown at a rapid rate in the past 50 years from a series of little holiday towns dotted along the coastline to a unified city supporting a large population, the Council is developing strategies to ensure employment opportunities for its residents.

- SCISCO is a major provider of services that link young people to work. It has won several national prizes for its excellence in service provision for young people, schools and employers in the development of programs to suit a range of clients. Funded through grants by State and Federal governments, the organization is committed to developing strong links with young people, schools and industries in the transition of youth to work.

- Gold Coast Institute of TAFE (GCIT) is the regional college of Technical and Further Education. It provides educational services to people ranging from young to old; needing basic literacy and numeracy support through to diploma level awards. It is a key provider for apprenticeship training. The consortium members were staff from the Access program that supports people in literacy and numeracy. Many young people are referred to GCIT to undertake courses in literacy and numeracy as part of their requirements for government support.

- Queensland Studies Authority (QSA) is the peak curriculum and assessment body for the state of Queensland. It is an independent authority whose role is to develop curricula for the schools across the state – state, Catholic and independent. It is also the body that controls the state testing protocols and senior level courses for students in their final years of schooling. The QSA assumes responsibility for developing the state's mathematics curriculum and senior vocational education courses. Both of these curriculum areas were central to the project.

- Centrelink is a government agency delivering a range of Commonwealth services to the Australian community. Centrelink is set up so people can get more of the help they need in one central place. It offers a 'one-stop shop' for a range of services delivered on behalf of ten client government departments including financial assistance, accommodation, emergency assistance (fire, floods etc) and policy to ensure viability of industries.

Each industry partner represented key areas aligned with youth, numeracy, employment and schooling. This partnership allowed the project to develop a complex understanding of the issues related to young people in schools and work; the workplace and the intersection of these areas. The collective wisdom of the group allowed for greater appreciation of the issues, ways to explore the territory; and understanding the issues from various perspectives.

The Role of the Consortium

The Consortium played a key role in the development of the project and the on-going management and direction of the project. When the initial project was touted, a group of people who work with young people in relation to numeracy and work were invited to a brainstorming session to develop a project. Not all of these participants linked in with the final project, but collectively, the meeting raised issues and concerns about the employability of young people in the region. This was seen from the range of

perspectives of the participants – employers, educators, job placement officers, youth workers, curriculum developers, agencies associated with young people and so on. Collectively, the knowledge of the group identified issues relevant to their interest areas and issues to do with the placement of young people and the sustainability of young people in work. A project was drafted and redrafted so that those who remained within the collective had ownership of the research and that the outcomes would have practical outcomes for both the consortium members as well as the wider community.

The team met usually 4-6 times a year as a group. Throughout each year, other meetings were held as needed for particular aspects of the project. At each phase, the Consortium worked collectively in the design of research. Each member's unique experiences across the range of areas – young people, employment and education, enabled the consortium to ensure a range of issues were addressed. Similarly, since the consortium members were affiliated with the various sectors associated with the schools – young people, employers, education facilities and so, they were able to provide strategic advice on how to progress with the project. Issues of access were a continual issue in a project of this nature so the consortium members played a critical role in enabling the research to be undertaken. Consortium members addressed many of the unspoken protocols for access to workplaces. Indeed, if it had not been for the Consortium, access to sites would have been extremely difficult, if not impossible.

Design of the Study

The study was designed so that there was a progressive refinement of the issues. In the first instance, a broad sweep of the issues was needed to gain a sense of what the key issues were and then to follow this up with more intense data collection. Together, both quantitative and qualitative data were collected in order to supplement each other in order to gain a deeper understanding of the issues.

Phase One: Mapping the Field

In order to gain a broad sense of the issues that confront stakeholders working with young people in work, a large scale survey was developed. A range of literatures were drawn upon in the construction of the survey. Australian Chamber of Commerce and Industry, for example, built upon the Mayer key competencies to identify "employability skills". It proposes these skills/competencies and attributes are lynchpins to the sustainability of young people in work. The authors of this document identify the key skills that young people need for contemporary and future employment, recognizing the changes that are likely to occur across the work lifespan. They list personal attributes; planning and organizing; communication (which includes numeracy); teamwork; problem solving; technology; learning; and self-management (ACCI, 2001, p.50).

Informing the construction of the literacy and numeracy questions was the National Reporting System categories that are used within the Vocational education sector. This framework. Numeracy categories were developed around common curriculum frameworks used to underpin most state and/or federal syllabus documents. Unlike most other areas of knowledge, mathematics is relatively consistent across contexts.

The team members also drew on much of the contemporary research that identifies emerging areas of literacy and numeracy as they apply to New Times. In these areas, the use of computers and other forms of digital technologies are seen to have a significant impact on ways of working and thinking. This knowledge was incorporated into the survey.

The Participants

To gain a sense of the field, the survey was distributed across the region, to include those people who work with young people (teachers, employers and job placement personnel) and young people (in school engaged in part-time work; employed and job seekers). Almost 1000 participants completed the survey with representations of a wide range industries and employment types.

Industry partners played a significant role in the dissemination of surveys across the region. Through their databases of local industries, the Council was able to disseminate surveys to employers so that industries could be selected so as to ensure a range of industries. The schools network was approached through the SCISCO partnership where they were able to identify schools who were engaged in work placements and supportive of school networks. Centrelink, due to confidentiality, could not provide access to job seekers directly but were able to allow access to their clients through an open-door action. Research assistants were able to work from local service centres and ask people if they would be able to complete the surveys.

The Survey

The Consortium designed the survey so that consideration was made of the literatures that focus on young people's skills and competencies for work. Four key sections were developed - literacy, numeracy, computer and generic skills. These areas were then broken into components that drew on the literatures for each area. Young participants were then asked (from their perspective) to rate how important each item was for them in their current (or most recent work). In contrast, employers, teachers and job placement staff were asked to rate the importance of the items for work as it related to their area or views of work in general. The stem for each set of questions was designed for the particular survey type with the intention of the participants rating items of perceived importance to relevant work.

The survey also included open-ended sections where participants could write extended responses or offer comments n particular elements. In a number of cases, follow up interviews were conducted with respondents (who had indicated that they would be available for further interviews). These interviews were based on responses offered by participants in order that better understandings of responses could be developed.

Analysis of the Survey

SPSS was used to analyse the quantitative data. An experienced statistician was seconded to the project to analyse this aspect of the data. Various analysis were conducted to identify themes and significances in the data. NVivo was used to code the open-ended responses and follow up interviews. This software package uses a grounded theory approach (Strauss & Corbin, 1997) whereby interview data are coded and themes can be identified from the data. This process enabled cross referencing between the groups to identify trends in the qualitative data.

Phase Two: Workshadowing

The second major phase entailed workshadowing young people as they went about their work. This phase of the research involved workshadowing across 19 worksites. The occupations included builder, boatbuilder, hairdresser, printer, painter, sign writer, room services, short order cook, chef, receptionist, sales assistant, research technician (concrete testing), bricklayer, motor mechanic). Sites were selected as being a representative employer of young people in the region. Industries were selected so as to ensure a representation of the major industries in the region (hospitality, building and construction; marine; service; and retail) and those occupations where both young men and women would gain employment. Typically the workshadowing was undertaken over a period of 3 to 5 days depending on the work being undertaken. In most cases this was undertaken on consecutive days but in some industries (such as bricklaying) where the job is repetitious over a period of time, the shadowing was

undertaken over a period of time in order to gain a greater sense of the variety of work being completed. The aim of this phase of the research was to gain a broad description of the work that young people completed and how they went about that work, particularly in terms of mathematical thinking and processes.

The process involved a short preliminary interview where the participant described their work; the mathematics they did in their daily activities; how well they were prepared for the job; their background and experiences with school mathematics; and the links between their school experiences and work so as to gain a sense of what the job entailed. This was followed by the shadowing phase where the researcher would follow the young employee as he/she went about his/her work. Photographs were taken and these were used in the final interview where the young person was asked to talk about what they were doing and what they were thinking as they went about their work. These interviews were audio-recorded and transcribed.

The workshadowing emulated the ethnographic tradition where the researcher's task is to describe the activity from the perspective of the participants. A total of 19 case studies were undertaken and included:

Baker	Shop fitter and cabinet maker	Laboratory technician (Concrete testing)
Retail assistant	Boatbuilder (3)	Painter
Chef	Bricklayer	Room attendant
Hairdresser	Motor mechanic	Laundry attendant
Builder	Short order cook	Printer
Sign writer	Receptionist	

Stimulated Recall

A novel approach was used within the workshadowing, partly out of necessity to ensure minimal disruption to employees. However the method that was adopted has been well documented in the methodology literature. Stimulated recall has been used in recent history with the use of video data and where participants are asked to reflect on their actions as they view excerpts from the video (Artzt & Armour-Thomas, 1997). In some cases, all of the video is shown whereas in other cases selected sections are used. These may be temporally selected or purposively selected. However, in this study, still photographs were used as the purpose of the workshadowing was to capture the variety of tasks undertaken by the employee.

The workshadowing involved the use of a method where photographs were taken of each activity that the participant undertook (see example). The amount of photographs taken within any one occupation varied considerably depending on the nature of the work. For example, in boatbuilding and shop fitting, there was considerable variety in the work undertaken, whereas the chef and retail assistant there was a high degree of repetition in their work. At the completion of the workshadowing, each participant was shown all photographs (in chronological order) and asked to comment on the work they were doing and what they were thinking as they undertook that work. In particular, they were asked to talk about the mathematics, if any, they used as they worked. This method, stimulated recall, has been used extensively with video data and found to produce insights into the metacognitive processes of participants. As such, the method was particularly useful in this study in order to access young people's thinking about their work. It was shown to be highly effective in most cases. Where the data was limited it was through other factors – mostly the unwillingness of the participant to talk about their work in detail. This difficult is not uncommon in qualitative data collection.

Phase Thee: Community Consultation and Recommendations

Arising from the findings from the first two phases, a number of initiatives were taken. As the main focus of this phase of the project had been to develop recommendations, the Consortium wanted the outcomes disseminated to the wider community for feedback to gauage the reaction from various stakeholders. In the first instance, interviews with employers were undertaken to validate the observations in Phase Two, and to confirm (or refute) the analysis of the survey. These were semi-structured interviews where the employers were asked about the demands of the work, the skills young people had and needed for the work, and how upskilling was undertaken in the workplace. As results from these phases of the research emerged, the Consortium developed recommendations which were then trialled with stakeholder groups to ascertain their viability within the market place. and support mechanisms needed for implementation. All interviews were audio-taped and transcribed for later analysis. Furthermore, in the case of the focus groups, members of the consortium worked as notetakers throughout the meetings so as to record notes that stakeholders could monitor in terms of representation of their views.

Phase One: Intergenerational Differences

To gain a sense of the issues surrounding the employment and employability of young people, a wide scale survey was developed. The aim of the survey was to identify the perceptions of participants as to the importance of various elements of literacy, numeracy, ICT and generic skills in the workplace. The survey consisted of a likert-scale ranking in which four key areas were investigated. Participants were asked to rank their experiences of each of these categories in terms of importance in work. Depending on the participants being surveyed, different stems were needed to cater for the particular background of the participant. For example, employers were asked to rate the items as being important in their industry, job placement officers were asked to rate the items as being important in placing young people in work whereas young people were asked to rate them as being important in their current work (or most recent job for job seekers). Each of the four categories were divided into a number of items, each of which was informed by relevant literature and curriculum documents. Examples were provided for each item so that the participants could have a shared understanding of the item's meaning. An example of this format is shown below:

Numeracy Skills	Strongly Disagree	Disagree	Agree	Strongly agree	Not applic
Number work counting,	☐	☐	☐	☐	☐
Calculating adding, subtracting, multiplying, dividing	☐	☐	☐	☐	☐
Calculating proportions, fractions Mixing foods, working out percentages, deposits	☐	☐	☐	☐	☐

The Consortium played a significant role in the development and auditing of the questions. It was seen as important that the participants would be able to make sense of the survey so prior to distribution, the Consortium members provided feedback that enabled the survey to be in a format that was accessible to the breadth of participants being sought.

The survey was distributed to over 5000 people and just under 1000 were returned. These were then compiled into two major categories – young people and senior people. Due to ethical considerations, age was not asked on the survey. However, due to the positions held and information about time in positions, it could be estimated that the age of most participants was in the 40+ range. There were some younger people, but these were minimal. For the younger people, they needed to be 22 or under. This age was an arbitrary one but one which is used in many studies and policies to define youth. Once the data sets were combined, there were relatively equal numbers in the two sets. The participants represented the range of industries and sectors common in contemporary work so that a reasonable representation of the field was obtained.

A step-wise comparison was undertaken and nine items showed significant differences between “senior” and “junior” participants ($p \leq 0.001$).

- Computers for general use
- Statistics – graphs, statistical information, (younger)
- Industry-relevant technology
- Non-verbal communication (senior)
- Computer technology
- Number – counting, calculating (senior)
- Industry-specific technology- cash registers, theodelites, (younger)
- Volume – measuring volumes in litres, mls, cups, buckets (younger)
- Location – reading maps, finding locations (younger)

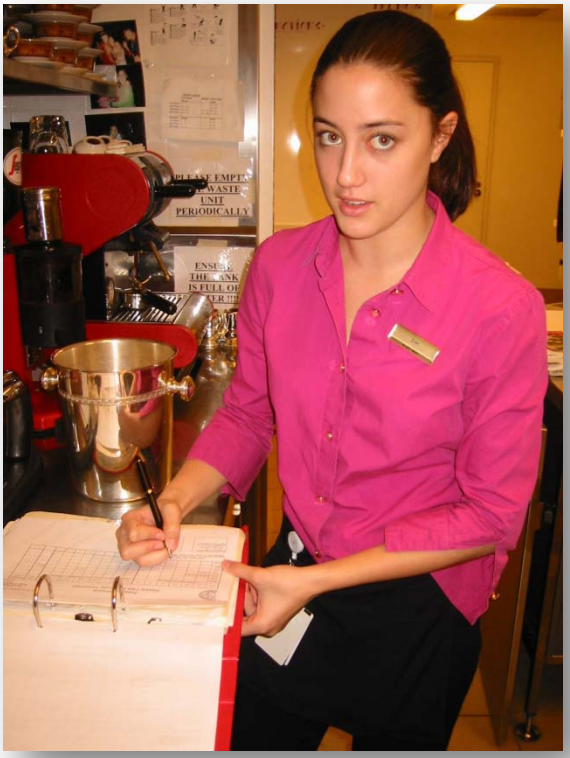
These findings point to a number of trends that emerged from the open-ended responses offered by participants to the survey and in interviews with a number of people. Of the nine items, five related to mathematics and three related to the use of technology. Only one related to literacy (non-verbal communication) and no generic skills were noted as different between younger and senior participants. In terms of the numeracy items, senior people saw number as important whereas younger people identified applied areas of numeracy (statistics, volume, location) as important. In considering these outcomes, the interview data and subsequent data collection have shown that senior people place considerable importance on mental calculations whereas younger people did not see this as important. Indeed, they felt that technology was a better means for calculation. Senior people interpret this disposition of youth as being lazy, inappropriate and/or innumerate.

The role of technology was another area of discrepancy between the two cohorts. Younger people were more likely to report that technology was a tool to be used in the workplace. Senior people reported similarly but were more hesitant, and in some cases, in awe of the technology. In comparison, younger people did not have the hesitancy with technology. Indeed, some employers reported that young people did not have “respect” for the technology that they felt was necessary. In part, this may be due to the financial imperative of employers who need to provide the technology. However, what was clear were the different dispositions towards using technology in work.

Phase Two: Case Studies of Young People in Work

Nineteen case studies were undertaken. The diversity of sites allowed for a deep understanding of how young people undertook numeracy practices as they went about their work. Follow up interviews were undertaken with the employers of the workshadow case studies, and further interviews with other employers were also undertaken to supplement the data set. These two data sets (i.e. the workshadowing and employer interviews) confirmed the survey data whereby younger people approached their numeracy quite differently from what was expected by the senior staff.

Five summaries of the workshadowing process are included in the following pages. In presenting these exemplars, the intention is to demonstrate the process taken, the pre-interview process (and outcomes) and the ways in which the stimulated recall methodology allowed access to the participants' ways of working while on the job. The inclusion of these summaries does not capture the depth of the interview process but allows access to the types of data collected. In the first two cases – builder and laboratory technician - considerable amount of school mathematics could be observed in the workplace, however, the processes by which the participants undertook these activities often did not resemble those encouraged in school contexts. In the second two case studies – hairdresser and chef – there was anticipation that considerable mathematics would be used in these occupations, however the workshadowing suggested that this was not the case. The final case – retail assistant – is included to show the ways in which numeracy was used and shaped by the retail context.



Builder/Carpenter

Company: Nu Concept Constructions

Background

Position	3rd year Apprentice Builder
Time in position	3 years
Confidence in maths	Pretty confident with maths in trade
Level of school maths	Passed Year 10 maths
Value of school maths for job	It helped out a little bit, but when you're working with a boss and everything, like they show you what you need to know for this trade, so the school gets you started with maths, and then the boss like continues it on in a different direction, so like advances your knowledge in mathematics. It's very applied in this job.
Specialist maths for this job	None really.
Typical experience of school maths	Rocked up, sat down in a boring classroom, the teache told you what to do, and you had to do it that way, no other way apart from that way. That's about it.
Advice to educators	I reckon they're pretty good, even though it doesn't seem like it when you're there. But now that I'm out in the workforce, it seems more relevant.

Participant's own description of the job and the mathematics in the job

"We do different things on different days. One day we might be doing frames, another day it might be fit outs so you never know what you are going to do from one day to the next"

"Every second word that comes out of my mouth is probably a mathematics thing."

Mathematics observed

- Lots of measuring lengths
- Finding levels
- Ensuring buildings are square

Other comments

Considerable amounts of time were spent on formal measurements of length.
Team work was evident throughout the day-to-day work, particularly since modern techniques of building involve the construction of frames off-site and the builders assembling large frames on site.

Workshadowing

Putting molding on, take the measurement, and work out the short point and long point and everything	Measuring for a suffeat sheet just measure each end to make sure they are both square	Leveling out so that we can find out where the wall is going so we can make sure it's square.
		

Summary

In the building industry there were considerable aspects of the job that required formal measurement. A shown in these episodes, the young worker undertook formal measurement throughout his daily routine. There was a considerable degree of accuracy observed – in measuring lengths for cutting or prior to placement as well as checking that objects were level (horizontally and vertically). Unlike school mathematics, the form of measurement was in mms rather than cms. This issue arose across all industries.

Lab Technician

Company: CSR Readymix

Background

Position	Trainee lab technician
Time in position	6 months
Confidence in maths	Relatively confident with maths, when applies self.
Level of school maths	Finished year 11 maths A
Value of school maths for job	Prepared me well, cause it gave me the basics, you know, maths, plus, minus, divide, times.
Specialist maths for this job	Not really, but touched up. Brushed up on all the percentage working out. And volume, brushed up on volume working out. But all the stuff was basically at school, just had to brush up on it, pretty much.
Typical school maths lesson	In my classroom? (Laughter). It was pretty good at my school, the teacher helped us out heaps, and we used textbooks, work sheets and stuff like that. Every week you'd do a quiz, say on a Friday morning, but other than that it was pretty good. Sick classes, yeah, mad.

Participant's own description of the job and the mathematics in the job

"I'm in raw materials, I go out to the quarry, sample aggregates, sands, dust, road bases, all that sort of stuff. We bring it back and test it for size, strength, work ability, shape, flakiness, solidity, silt content, organic impurities and so on."

"We do heaps of maths. It is pretty much basic stuff - percentage working out, basic maths, addition, subtraction, that sort of stuff."

Mathematics observed:

Calculations - mental and calculator
Data entry (computer)
Sorting, classifying
Estimation
Problem solving

Other comments:

This occupation used considerable arithmetic/calculations, using complex formulae. There was a strong emphasis on data entry and analysis. Most of the calculations are undertaken with the aid of a calculator or computer.

Workshadowing

That looks like doing the moisture, working out the moisture. What is it, minus the wet weight by the dry weight to get the moisture content, then divide that by moisture weight to get the percentage. Are these formulas are written on the report sheet? Yeah, yeah they are. 	That's actually going through the Australian standards to make the solution. What was that for. That was for the Washington degradation test. Where we get four increments of a grading, each different size, 250gm each to make up a kilo, then we put that kilo sample into a container, put 200ml of distilled water, shake it for 20min, decant it into a cylinder, shake it up and down ten times, put it into another cylinder, shake it 20 times, that cylinders got the solution in it. Let it sit for 20 minutes, and it will drop down. Once it gets to a certain level in that 20 minutes, we take a reading, and we divide it by something, and times it by something, and we get what's called the Washington degradation, and it's the fines that are left on the rock after its been washed, so you shake them, and the friction between the rocks pulls off all the dirt and fine particles, and that's what its finding out. Get you a percentage of what fine particles are on the washed rock. You put the data into the computer and it works it out That's doing data entry, just off the grading sheet, typing in the initial weights for each sieve and the computer works it out, same method.

Summary

Initial data suggested that in this industry there was considerable mathematics, at least in terms of arithmetic and data analysis.. However, as more data were collected, it became apparent that the employee collects data and then various tools (such as computers) are used to undertake the calculation. The employee deferred calculations to various technological tools.

Chef

Company: Grand Mercure Hotel

Background

Position	1st year apprentice chef
Time in position	12 months
Confidence in maths	Pretty confident with maths
Level of school maths	Year 11 maths
Value of school maths for job	I don't use much of it in my job. I was in trade and business maths, so it pretty much was, they were setting me up for trade and business.
Specialist maths for this job	None at this stage
Typical school maths lesson	It was pretty boring, we didn't get much help from the teachers, not much support, the teachers think that because they think its easy, you should find it easy too. It wasn't really my thing at school, I was more into the applied subjects, like home ec, and tourism and stuff.
Advice to educators	I get a lot of support from my employers but for teachers I would suggest that they Be patient and try and get on the friendly side of kids, get on their good sides before you try to put stuff into them.

Participant's own description of the job and the mathematics in the job

"I start at 2.30, I do all the preparation for the buffet dinner. So every day is different, we have themed nights, like Mediterranean, Australian, Seafood, etc. At the moment, for the next 2 months, we have a Christmas theme, but its still different food every night. I used to do the cold larder, which is the morning shift, that's just the prep of all the cold meats and stuff, but know I prep the hot food, so cook the meats, make soups, vegies, that sort of thing."

"We don't use much math, not really, only for counting like bread rolls! I guess estimation is pretty important. That's where I have to guess how many guests we might have for dinner. So if I prepare enough for 60 people and we get 80. Stuff like that. We don't use a lot of measuring, not really, just guessing. We have to know about temperatures as well."

Mathematics observed:

Estimating the cut of meat – to ensure aesthetically pleasing but maximum profit
Most tasks involve informal, intuitive feel for the outcome – taste testing is used to ensure that mixes are appropriate.

Other comments:

Minimal amount of mathematics

Workshadowing

Yeah, for weighing ingredients for the sauces and all that. I guestimate it, but its still some form of measurement. But we don't use a cups or weights, only in pastry.	Just slicing the ham, keeping the slices nice and thin. R: Do you measure them? No, you do what you like.	Here I am adding octopus, to make the chowder, I don't check weights or anything, I just make sure it's consistent.
		

Summary

While it had been anticipated that this industry would involve considerable school mathematics, the converse was observed. The chef used judgements to ascertain quantities and recipes. In most cases, a taste test was used to check whether or not a mixture was up to standard. Alternations were undertaken if needed.

Hairdresser

Company: Last Tangle

Background

Position	3rd year apprentice hairdresser Also, School based trainee, Hungry Jacks.
Time in position	2.5 years
Confidence in maths	Average confidence with maths. Medium, except when my brother comes home and he has his maths questions, and I have no idea what he's doing, he's in year eight, and I have no idea what they're doing, they're doing like year 12 maths. And he has no idea, and no one in our family has any idea, and my dad's really good at maths.
Level of school maths	Trade and Business Maths
Value of school maths for job	Useful for this job, but I wasn't very good at maths, so not very good, I only just passed.
Specialist maths for this job	None needed
Typical school maths lesson	Teacher was teaching us, and we had textbooks, the textbooks didn't help at all, they just stayed in my bag.
Advice to educators	I think that on a Wednesday afternoon, or whenever they do sport, they should go to TAFE and work through modules and stuff. So the kids who aren't doing sport are doing a qualification at TAFE. My boyfriend went to Kingscliff TAFE and they did that, so they got traineeships done on Wednesday afternoons.

Participant's own description of the job and the mathematics in the job

"Typical day for me is to eat, open up, I always open up and close, by myself - everyone likes to come late. Clean the shelves, do stock orders, a lot of men's cuts, a lot of ladies cuts, streaks, foils, sweep the floor. Do the till, run through the prices, cash, EFTPOS."

"There's quite a bit of maths what with colours out the back, you have to use portions, like a quarter would be, oh its all different for different brands like Joico and all that, so we use portions and mls, measuring."

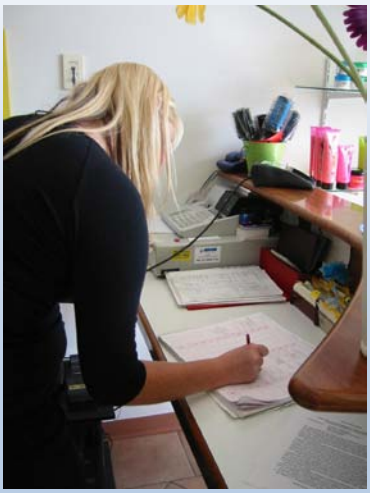
Mathematics observed:

Measuring volume
Measuring time – usually with pre set clocks
Calculating prices – these are standard

Other comments:

Most of the work undertaken related to interactions and other aspects of hair treatments. Minimal mathematics used in the profession.

Workshadowing

Writing appointments in the book – usually they take 45min, haircuts take 15-30min, so you have to cross it out, otherwise you get behind, and the clients get angry. 	Getting measuring cup and bowls, for measuring mls for colouring 	Blow drying the client's hair 

R: Can you tell me a bit more about the colours?

P: *There's four types of peroxide, there's 10 fold, which is 3% which you usually mix for semi's just to um, semis don't get into the hair cuticle, they just cover the hair. 20 fold which is 6%, you can mix that in to get a permanent colour. 30 fold which is 9% you can use that for highlight tinting, the higher volume you go, the more brighter and the more it eats your hair away. And 40 fold, which is 12%, its like bleach to get it down to white, its really strong.*

Retail Assistant

Company: Bakers Delight

Background

Position	Has had other positions in retail, has second job at surf shop
Time in position	6 months
Confidence in maths	Pretty confident with maths
Level of school maths	Passed Year 12 Maths B
Value of school maths for job	Yeah, pretty well, I'd say pretty well.
Specialist maths for this job	Don't need any with this job, but next year will probably be a test, cause I'll be doing a lot more baking, and you have to work with percentages and, I mean we use a calculator, we do. And you don't have to for some of it, its like 2% of whatever, but I'll need to know percentages. So probably in the next 6 months.
Typical school maths lesson	The teacher would stand at the front, we'd do a chapter from the textbook, and she'd go over it with us, and leave it up to us. Lots of assignments, oh my god. Actually there were a lot of things that I learned in maths that I thought I would never, and I probably have never had to use. Like how tall is that tree. I remember doing that assignment thinking why am I doing this. Maybe if I'd done civil engineering or something like that I might have needed it, but no. Just the really basic stuff, I think even the stuff I learned in Year 10, from Year 8 to Year 10 would have got me through what I'm doing now. It's pretty basic.

Participant's own description of the job and the mathematics in the job

"It is pretty busy, we can serve up to 600 customers per day so there are lots of transactions, occasional EFTPOS, and then if I do a close shift, I will do the takings for the day, the banking and stock count."

"For maths, it is just adding, just totalling up things, when they've got vouchers, we have to take off the $2.60, and what you're left with, and stuff like that, probably adding and subtracting. Everything's done through that register, but if you know someone's going to fart arse around, and you already know how much something's going to be, then you tell them without putting it in. That way before I even put it in the register, I can take their money, and go thanks very much, and when they walk away, that's when I'll put it in."

What kind of maths does the banking involve?

"Again, I think its all adding, we take out the float, we keep $150 in our float, so we put that aside, and we have a register read at the end of the night, and that shows up how much I should have, and then I have to go through and count up all the money, and make sure it adds to the same. It's all adding."

Mathematics observed:

Arithmetic/calculations
Money handling
Problem solving
Stock count

Other comments:

Register is keyed to items so that staff only need to know how many of an item. The register undertakes calculation of price and change. Most of the work undertaken relates to customer service and where a challenge is required, then mental arithmetic related to costings and change are undertaken. In other cases, the cash register undertakes calculations.

This type of technology is increasingly common in retail – either in this form or the scanners found in supermarkets.

Workshadowing

I'm probably taking an order, I don't know if I'm saying goodbye to someone, or, my hands are on a tissue, so maybe someone's giving me an order. Sometimes when they're doing that I'm, thinking about how much it will be. So when there's lots of people there I can go that's an apple scroll an apple walnut scroll that $3.40 thank you, take the money, and then go how are you going while I put the money into the register, if they've given me the correct change.

On the register, it would be basically adding up, and how many products, putting in the products and adding up how much it would be. Or maybe if I've got their money in my hand, it could be how much change I'm going to give.

Probably merchandising bread there, bringing it to the front. At the end of the day we have to count everything that's left over, and its donated to the salvation army, and whatever we want to take home, but you get over that!

Summary

The employee saw her role as holistic, not only about calculations but about customer relations and stock management. The cash register in this store kept tallies of all product sold so employees had to enter specific details of sales so that the managers could keep data on daily sales and use this for forward predictions. As such, technology was an integral component of the work routine. The employee had good number sense, was able to estimate costs for customers so as to ensure quick and timely service recognizing that keep the customer happy was critical to the position.

Boat Builder

Company: Riviera

Background

Position	Apprentice Boatbuilder – final year
Time in position	3.5 years
Confidence in maths	Very good with basic maths
Level of school maths	Year 12 Maths A
Value of school maths for job	The maths that I was interested in has prepared me very well, but a lot of the stuff that we learned in the higher grades, I don't use
Specialist maths for this job	A little bit, basically, just subtraction, adding, multiplication, division sometimes too. Just basic maths.
Typical school maths lesson	There was a lot of things they used, like market stuff, like they used banking , the way the did different interest rates for your problems. Building as well, with angles and stuff. We used textbooks mostly.

Participant's own description of the job and the mathematics in the job

Generally, I've been here for three and a half years now, so I know pretty much most of it. Apprentices get rotated through different sections, so for the last 12 months I've been in fitout 2, which is all your bulkheads, all your gloss bulkheads, putting them up, your lounges, making lounges, measuring and cutting, things like that.

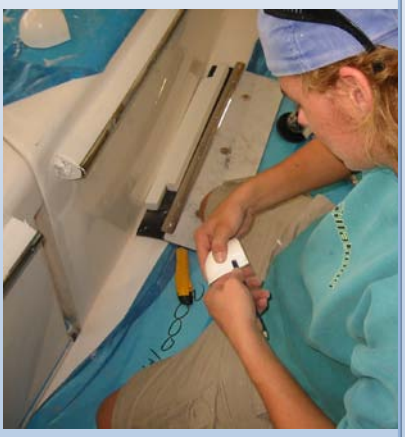
Mathematics observed:

Measurement (in mms), arithmetic, percentage.

Other comments:

This position involved a lot of estimation, informal measurement (using fingers or pencils).

Workshadowing

I was just drilling out the grab rail and the cup holder. We've got a template for that. If we didn't have a template, then we'd have to measure it to see where it went.	We measure with everything. Like say, two finger gap there, same on that side, that's what I was using my pencil for as well trying to line up gaps like that.	That was bog for the dash. R: How do you determine what the mixture is, how much you would put it? Depends on the time really, like if you want a hot brew, the darker the better. But if you got to work with it, if you need time , you just put a little bit in. You're supposed to measure up with scales and all that, but we don't have any scales. R: So you just guess? Well, yeah, say we've got a pile like that (gestures large pile) and we want it to go off really slow, we just put a little line about that much (small line) hardener in.
		

Summary

The boatbuilder relied on considerable estimation, informal units of measure that were practical; and aesthetics in his work. Given the difficulty in measuring curved lines (unlike builders where lines are almost always straight), there is a high degree of aesthetics in boat building. Objects are placed where they 'look right" or "look good".

Summary of Work Shadowing

From the 19 case studies, it appeared that young people approached their tasks in substantially different ways than had been anticipated at the commencement of the project. The following trends were observed across the 19 cases, to greater or lesser extents depending on the work being undertaken.

Estimation

Young people were observed to use estimation extensively. In retail, they were likely to estimate an amount that could be reasonable; in boatbuilding, they estimated the amount of bog needed for a particular job and the amount of catalyst need to be added to the bog in order that it would harden; hairdressers needed to estimate the time it would take to do particular aspects of hair –coloring long or short hair, perms, cuts/trims/styles in order to book clients into the diary without too many gaps or overlaps. In nearly all jobs, estimation featured very strongly.

Problem Solving

In all of the case studies, young people undertook problem solving of some sort or another. In some cases, the level of problem solving was quite high (such as the laboratory technician) whereas in other areas, it was relatively routine (such as the retail assistant). The level of efficiency with problem solving was linked to the participant's sense of number. For example, in the case of the retail assistant, on occasions, the shop would be very busy so that rather than rely on the technology (cash register), she would mentally calculate the items and change and then give the customer the change. When the trade had slowed down, she would then enter the sales into the cash register. She recognized that to do otherwise, would result in lengthy delays in serving customers.

Technology

Perhaps a significant finding from the research is the role of technology and the serious mismatch in perceptions of the two cohorts of participants. Younger people were very comfortable with technology in the workplace and saw technology as a tool. Rather than undertake mental computations, they were happy to defer the cognitive labour to technology. The technology available in various sites ranged from calculators through to computers and included relevant industry-relevant technology (such as the cash registers designed for particular industries). In these cases, the young participants differed from the older participants in that they saw technology as a tool. In contrast, older people bemoaned the fact that younger employees relied on technology to calculate their work and not working the mathematics out for themselves. As one older participant suggested "They [young employees] have calculators – on their shoulders - they should use them!" This ethos was very common among the older participants in the study and represented a significant difference in orientation to work.

Holistic and Lateral Thinking

Young participants were more likely to see their work holistically and see the tasks they needed to do as part of a bigger picture. Unlike older people who have grown up in an industrial age governed by a Fordist model of workplace organization, the participants in

this study were more likely to see their work as part of a larger context. They did not compartmentalize their thinking but saw the task as a complete task. For example, when working with retail assistants, it was often stated by older participants that the young workers needed to calculate items and know what the amount should be. When the assistant would sense that there was an error in a tally, rather than go back and add items (as expected of older participants), the young employee would search through the docket to see where the error may have occurred and then seek to address the error.

Aesthetics and Intuition

In most of the case studies, intuition played a significant role in how young workers approached their tasks. In retail, intuition about the cost of items and change was common. This intuition related strongly to number sense. In the building industries, an intuitive sense of measurement (length, volume, etc) was important. In these contexts, aesthetics correlated with intuition – a door being hung needed to feel right as well as look right. The two notions are closely related. For example, in the marine industry, placement of items on curved edges was difficult to formally measure, so the participants relied on a good sense of midpoints in length but used a “eye for it looking right” as being a tool for placement of objects.

Phase Three: Community Consultation

The third phase of the project involved two aspects of community consultation. The first was to consult with employers to check the validity of the outcomes of the workshadowing. We needed to ascertain whether or not the observations we had made were a fair representation of the work that young employees undertook and whether or not their performance in their respective fields was competent or not. The second phase involved wider community consultation in which the outcomes were presented to various stakeholders – those in education and those in workplaces. This aspect of the project sought to identify the reactions of the stakeholders to the outcomes and recommendations of the project.

Employers of Young Workers

In seeking input from employers, we wanted their views on the outcomes of the second phase. Prior to this phase, the data suggested a number of possibilities. In the first instance, the dissonance between the expected outcomes and those documented could be explained using the work of Lave and Wenger (1992) where what had been documented was the apprentice model of learning where the young participants were not fully fledged members of their respective communities of practice and as such the data was an embodiment of partial participation in the field. Seeking the input from 'experts' in the fields would either confirm or disconfirm the results that had been obtained.

A range of employers were interviewed, including those who supervised the workshadowed participants (along with others). The data yielded two significant outcomes. First was that the young employees were working quite confidently and competently in their respective fields, even if they did approach their work in ways that were different from the expectations of the employers. More significantly, the expectation that experts and novices may approach their work in quite different ways due to their experience within a given field was found to be flawed. This assumption was revealed with the experience of one particular case. In this instance, a master builder, the employer was a young man (25 years old) and hence more aligned with the young workers in terms of age, but more aligned with the older employers in terms of experience and status. However, his responses were quite different from older employers and more aligned with the young workers. It was this interview that opened Pandora's Box in terms of theorizing the outcomes of the study. Rather than seeing the different ways of working as being that of a novice learner, the Master Builder's suggested that the ways of working were more related to generational differences. In the following sections, comparisions can be made between the generational responses made by employers.

Older employer

Older employers expected their employees to their employees to have a "proper workplace ethic", to be "punctual", They were more likely to see young employees as "impatient, they want things done, they want it done now. Instant gratification". In comparing younger and older employees, one respondent summed up comments of differences in orientations to working as follows:

> The older guys tend to take a more softly softly approach, they look down the line and see the end result, where the kids haven't, the don't have that concept initially, they say well ok, this is where we are now, I want it done now, and they don't have the planning abilities, and that's a cultural thing rather than an educational thing (Trainer, marine industry)

In terms of technology, older employers were less likely to see technology as an integral part of work, and indeed, technology was the antithesis of what was expected on the shop floor. As one employer noted, the use of calculators on the shop floor was most inappropriate as evident in his comment regarding the use of calculators - "they have one on their shoulders so they should use it"

Young Employer

In contrast the young employer saw the expectations of his employees as "I want them to be good tradesmen and hopefully help me run my business or have their own business in the future." In comparing younger and older employees, this employer commented thus:

> *I find the young guys are a lot easier to work with than the older blokes, cause you know the older blokes, some of them, some of the blokes I've had working for me have been like 30 odd, and older. And they, if they haven't go their shit together by the time they're 30, basically you know. And they rock up in shit box cars and they haven't got any idea, you know, they just don't have any idea, and that's why they haven't go anything.*

These comments were significantly different from other employers and were further reinforced by his comments regarding the use of calculators:

> *I use the calculator a lot, like with all my plans and stuff, but, the calculator is the way to go. The work is just basic sort of maths, multiplying, adding and subtracting, and measurements, lots of measurements.*

The differences between the two comments suggested that experience may be less of a determinant in how employers see their employees and the work to be undertaken. The young employer provided insights into the ways of working within the workplace that could be best theorized using a framework that centred on generational differences as opposed to expert/novice frameworks.

Key Stakeholder Groups

In the final phase of the project, the outcomes of the three phases were presented to community focus groups that included various stakeholders – educationalists and workplace personnel. While there were obvious differences between the two groups, in part due to their orientation to youth (education vs work), there were notable consistencies. Recognising that basic skills (mental arithmetic in particular) was a core skill for school and work; that young people have very different attitudes to work (whether in school or the workplace) that often did not align with the values of their teachers or employers; and that most were very familiar with technology, the focus groups recognized that the outcomes rang true with their experiences of young people. The data from the focus groups aligned with the outcomes from the initial survey data. However, over the period of the session, the stakeholders recognized that rather than see young people in deficit models, it was more productive to look at their strengths as this offered considerable potential for working with this cohort. Concerns were raised about selection processes for young people into contemporary work and the need for selection to account for the skills and dispositions that young employees bring to the workplace as well as the changing demands of contemporary work.

Conclusion

This study has shown that young people undertake their work in ways that are different from the expectations of senior people. They are often framed within deficit models of work and numeracy, but this study has shown that such perceptions of deficit may be misplaced and that what is occurring is a shift in orientation to work and numeracy. Young people approach their numeracy in ways influenced by technology and the context within which they work. They tended to see their contexts holistically and then work out ways that would produce the outcomes needed. Such pathways often involved deferring cognitive labour to technology. Those who were proficient in this process had some sense of number and estimation and would use these tools to be more effective in their work.

The outcomes of this study suggest that young people, who having grown up in a technology-rich society, see work and numeracy in ways that may be very different from other generations. They are less fearful of technology and see technology as a tool by which to make work easier and more efficient. Senior people were more likely to see this disposition as “lazy” or “innumerate” but this may not be the case. As found in this study, the use of technology has saturated many workplaces. The cash register at the store not only keeps a tally of individual sales, but also keeps a stock take of the items sold. For many organizations this is central to how they manage and predict sales. As such, technology is an integral part of many workplaces. Young people have the dispositions to use technology in ways that many senior members of the community are less predisposed to use.

The implications of this study suggest that schools needs have technology as a central part of their curriculum. This is not to suggest that it replaces those activities that foster and nurture the development of number sense but rather enhances it. Using technology – calculators and computers – can enhance students’ understanding of how better to employ such technologies to enhance understandings. Employers need to recognize that young people are more likely to approach their work in ways that are substantially different from previous generations. This is not to say that they cannot do their work, only that their ways of working may be different from those in the past. The knowledges and dispositions that young people have for work need to be incorporated into the selection and training of young people. Knowing that they are more likely to use the skills and knowledges noted in the previous sections, training needs to address these areas so as to enhance them – for the benefit of both employees and employers.

Publications Arising from the Project

Journal Articles

Zevenbergen, R. (2005) New Numeracy Practices: Numeracy Practices of Young Adults in Boat Building *International Journal for Literacy and Numeracy Studies.*

Zevenbergen, R. (2004). Technologising Numeracy: Intergenerational differences in working mathematically in New Times. *Educational Studies in Mathematics.*

Conference Papers

Zevenbergen, R. (2005). In P. Clarkson, D. Gronn, M. Horne (Eds.) Prioritising the Voice of Researched: Using Photographs to Elicit Mathematical Thinking of Participants. *Proceedings of the 28th Annual Conference of the Mathematics Education Research Group of Australasia*. (pp.) Melbourne: MERGA.

Zevenbergen, R., (2005) Habitus and New Numeracies for Contemporary Work. In M. Goos, C. Kanes & R.Brown (Eds.) *Proceedings of the 4th International Conference of the Mathematics Education and Society Group*. Centre for Learning Research: Brisbane

Zevenbergen, R. (2004). In J. Searle, C. McKavanagh & D. Roebuck (Eds*). Proceedings of the Annual Post Compulsory Education and Training Conference.* (.) Gold Coast: Centre for Learning Research.

Zevenbergen, R. & Zevenbergen, K. (2004). Numeracy Practices in Contemporary Work: Changing Approaches. I. Putt, R. Faragher, M. McLean (Eds) *Proceedings of the 27th Mathematics Education Research Group of Australasia Annual Conference*, (pp). Townsville, June.

Zevenbergen, R. & Zevenbergen, K. (2004) Numeracy practices of young workers. *International Group for the Psychology of Mathematics Education*, Bergen, Norway.

Zevenbergen, R. & Zevenbergen, K. (2003). Numeracies for Workplaces in New Times. In D. Roebuck (Ed.) *Proceedings of 11th Annual International Conference on Post-compulsory Education and Training.* Brisbane: Centre for Learning Research.

Zevenbergen, R. & Zevenbergen, K. (2003). Using Consortia Models in Community-Based Action Research Projects. In A. Erasmus (Ed.) Proceedings of the 6th ALARPM and 10th PAR International Congress. Pretoria, South Africa: University of Pretoria.

Zevenbergen, R. & Zevenbergen, K. (2003) Numeracy in New Times: Implications for Youth, Work and Employment. In L. Bragg, C. Campbell, G. Herbert & J. Mousley (Eds.) *Proceedings of the 26th Annual Conference of the Mathematics Education Research Group of Australasia*. (pp. 799-807) Geelong: MERGA.

Invited Conference Addresses

Zevenbergen, R. (2005). Invited keynote address at the South Australian Dept of Education Literacy and Numeracy Conference, Adelaide. Sept.

Zevenbergen, R.. (2005). Young women and their dispositions to school mathematics." Invited keynote address at the 6th Triennial Conference of the Women and Mathematics Group, Umea, Sweden, June

Zevenbergen, R. (2004). "The Emergence of the Millennial: Intergenerational Differences in Contemporary Workplace Numeracy." Invited keynote address at the International Post Compulsory Education and Training Conference, Gold Coast.

Zevenbergen, R. (2004). "Who counts in contemporary work: A study of Millennials in New workplaces." Invited Keynote address at the annual Queensland Council of Adult Literacy Conference Brisbane, April.

Zevenbergen "Mathematics in New Times: What mathematics is used in today's workplace?" Invited workshop at the Brisbane Catholic Education Teachers Conference Nov

Zevenbergen, R. "New Numeracies: What Numeracies are Needed in these New Times?" Invited address at the Queensland Association of Mathematics Teachers Annual Issues Conference. Aug

New Grants

2005-2008 – Australian Research Council Linkage Grant (LP0561934) *Intergenerational differences in numeracy practices: A study of contemporary practice.*

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