

ePortfolios for Student Learning at the Australian Science and Mathematics School

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Abstract:

The Australian Science and Mathematics School was established as a specialist high school for students in years 10 to 12. It is a government high school, co-located with the Flinders University of South Australia. The ASMS has a mission to transform teaching and learning in science and mathematics. From the beginning of the school in 2003 students have developed Personalised Learning Plans which guide their progress through the school. In 2004 we began the journey of learning how to produce the PLP as an ePortfolio. This paper describes the journey.

THE PURPOSE OF THE RESEARCH

This research by the Australian Science and Mathematics School on the development of student ePortfolios is intended to generate discussion at a school and system level about the uses of ePortfolios. We believe that ePortfolios increase the possibilities for students to personalize, to document, to reflect on and to present their learning to a variety of audiences. We are encouraging students to develop web based ePortfolios as they can be personalized and customized and are highly transportable. Data collection from an ePortfolio by central agencies may also be possible. Students may use the ePortfolio for multiple purposes including:- as an archive, as a reflective tool, as a showcase, as a planning tool and as an aid to gaining access to further study or employment.

THE LEARNING CONTEXT OF THE ASMS

The ASMS operates with pedagogies which reflect our beliefs that:

- Student learning is supported through interaction with and guidance from significant adults and significant peers working as a community of learners. Therefore at the ASMS every student is a member of a Tutor Group of about 14 students from years 10 to 12 who work with their Tutor in a 40 minute pastoral care session each day.
- Education is most effective when the needs and interests of students shapes their curriculum and learning experiences and supports their development as independent, life-long learners. Therefore time and resources are provided for student to develop Personalised Learning Plans.
- Learning is enhanced when students possess deep understanding of their preferred approaches to learning and are able to self-direct and individually plan their learning. Therefore time is devoted to students learning metacognitive skills through a *Learning to Learn* program as part of the Tutor Group Program.
- An experiential and inquiry-based, interdisciplinary learning environment deepens understanding. Therefore students' learning is centred on fertile questions in an interdisciplinary curriculum.
- A thorough understanding of science and mathematics, their interrelationships and applications through innovations within the wider community is essential. Therefore students study real world ideas, problems and issues and make connections with their learning that are meaningful to them in their present and possible future life circumstances.
- The development of learners is enhanced through rigorous intellectual challenge and the opportunity to explore issues in depth. Therefore all students engage in deep study in

personal projects of major significance, especially through problem based, inquiry based learning approaches and mentoring.

An Interdisciplinary Curriculum and Framework

Phenomena in the real world are not confined to disciplines. Life is interdisciplinary and the way we think is naturally interdisciplinary. At the ASMS students in year 10 and 11 take part in a two year sequence of nine interdisciplinary Central Studies.

We believe students need skills to:

- become knowledgeable in the traditional subject disciplines and be explicitly taught to make connections
- see multiple perspectives on knowledge and appreciate diversity
- problem solve and be able to hold a view point on various issues
- work effectively and efficiently in collaborative groups
- repackage knowledge to create new understandings to meet the complexities of the modern world

In the Central Studies students are exposed to both traditional subjects and to new sciences which tend to be interdisciplinary in nature. The unique characteristics and distinctions between the subjects are retained but connections between the subjects are emphasised. Each Central Study has a fertile question as the focus for learning and enquiry. The fertile questions require knowledge, skills and dispositions to be synthesised from all the disciplines to transform or generate new knowledge.

Students work within three educational frameworks; the SACE framework, the ASMS curriculum framework and the ASMS Graduate Capabilities Framework. Within the ASMS we want our students to collect and showcase evidence of their Graduate Capabilities, to earn the Australian Science and Mathematics School Graduate Certificate.

Why ePortfolios?

There is a growing realisation that life long and life wide learning requires learners to take an active role in constructing their learning and that multiple assessment measures are necessary to interpret the complex demonstrations of learning produced by independent learners. ePortfolios, by their digital nature, are an appropriate way of archiving complex demonstrations of the multi-literacies expected from today's students. Students can select, reflect on and interpret their own learning. Students are able to demonstrate their learning to teachers, parent, employers and communities through their ePortfolios.

The work of the ASMS contributes to an international movement toward ePortfolios. A goal of the EIFEL, the *European Institute for eLearning* is "An ePortfolio for every citizen by 2010." The Australian Government is supporting the development of ePortfolios through its Employability Skills Portfolio project. The South Australian Government expects all High School students to develop a Transition Plan including a Learning Pathways Plan, a Transition Portfolio and a Transition Pathways Plan, and the DECS Futures Connect Team is developing a web-based Transition Plan for this purpose.

Helen Barrett (Barrett 2005) describes ePortfolios as a student's story of their learning. We believe that it is imperative for our students to tell the story of their own learning and plan their story, in digital form, to show their achievements and future goals.

Students today are part of the information age and technology is part of everyday life. ASMS students report that they spend an average of 29 hours per week using computers (Treilibs 2005). Their familiarity with the technology, the development of new media production methods and the distribution capacity of everyday technology gives easy access to ePortfolios for our students. Internet chat, blogging, texting on phones and sending images are popular forms of communication. We want to harness the interest in new media in the construction of ePortfolios.

Personalised Learning Plans and ePortfolios

From its inception in 2003, every student at the Australian Science and Mathematics School has developed a Personalised learning Plan. The PLP is a portfolio of the student's past achievements, information about and reflection on their learning preferences, plans and hopes for the future. The PLP guides the student to map their pathway through the school's curriculum, giving multiple entry points and pathways into lifelong learning. Students can use the PLP as a way of co-constructing projects of significant learning. The PLP also becomes the basis for regular Learning Conversations between the student, their Tutor and their parents about educational pathways through the school's learning experiences.

ePortfolios as a learning tool

We believe that the ePortfolio is an appropriate vehicle to develop PLPs because students are tuned to learning using electronic media. The internet and digital media are more engaging than standard text on paper.

The ePortfolio is (Barrett 2004):

- A dynamic and flexible document, capable of embedding multiple media forms
- accessible at any time for students to build their PLP within all learning programs
- a tool for building self esteem - a collection of evidence, an archive of demonstrations of a student's learning and achievements
- a digital CV or a digital resume - multiple ePortfolios for multiple goals and purposes can be drawn from the archive
- a metacognitive tool - "*The Power of Portfolios to support deep learning is personal*", "*The heart and soul of the ePortfolio is reflection*"
- a celebratory tool - to showcase achievement
- a sharable object, written for a variety of audiences
- a tool to develop critical multi-literacies
 - Students develop their own criteria for selecting materials
 - Students develop the meaning of the portfolio for themselves
- an assessment tool
 - for authentic assessment
 - a collection of demonstrations of learning
 - students prove what they know by selecting from what they have done

The *ePortfolio* can be understood using metaphors (Ravet and Barratt 2004).

- Digital clone – the student's *e-self*
- Butler – providing a personal service
- Dashboard – providing feedback on the state of learning
- Planner – a tool to plan learning
- Management assistant – a tool to exploit personal assets
- Work companion – blending learning and the work environment
- Mirror – to look at oneself
- Map – where you have been and where you are going

- Sonnet – a personal poem or song
- Storyboard – a digital story of oneself

Students use a wide range of traditional and twenty first century technological skills to build the ePortfolio:- collecting, selecting, reflecting, directing, celebrating, archiving, linking, thinking, planning, composing, story telling, collaborating, publishing, hyper-linking, etc.

THE METHODS OF INVESTIGATION

We have conducted research on the implementation of the ePortfolio at the ASMS using the Action Research model. For purposes of this paper Action Research involves cycles of planning, implementation, information gathering, reflection and planning for further action (Marsik and O'Neil 1999). This project has involved a series of Action Research cycles through the following stages:

1. 2003, Initial plans for Personalised Learning Plans
Implementation of student PLPs
Evaluation of the use of PLPs at the ASMS
2. 2004, Development of a web based template for ePortfolios
Trialling of the template
Reflection on the trial through examination individual portfolios
3. 2005, Plans for all students to develop an ePortfolio
Work with all students to implement ePortfolios
Data gathered term 1, 2005 re student engagement and staff reflection
4. Mid 2005, Plans made to embed ePortfolios within curriculum
Curriculum activities to embed ePortfolios
Data gathering via individual students surveys
5. 2006, Provision of refined ePortfolio templates for students
Redefined purposes for student ePortfolios
Further information gathering via student, staff and parent interviews and surveys
Examining proprietary portfolios which are part of a learner management system
6. Formal assessment of ePortfolios used as Personalised Learning Plans as part of SACE
Integrated Studies
Data gathering regarding student engagement

Implementing ePortfolios at the ASMS

The process of implementing ePortfolios at the ASMS is complex and developmental. In the school's first year, 2003, while the school was housed in temporary accommodation within Flinders University, students worked with paper based Personalised Learning Plans. Students were provided with a series of stages for the development of their Personalised Learning Plans and a set of question to guide their work. In 2004 Thom Burns successfully trialled web based ePortfolios with interested students. The trial was based on a template created using *Fireworks* and *Dreamweaver*. Students were attracted to the use of the template because it gave their ePortfolio a sophisticated look without the need for students to be familiar with the intricacies of web page design. Other students had their interest raised in the ePortfolio because they had a 'real example' to look at and develop their own style. On the other hand some students took on

the task of designing web pages to express their ideas but were unable to go beyond the graphics. For these students the substantial elements of an ePortfolio, the reflection on learning and the connection with their learning experience was not developed. Because of the early successes with some students the decision was taken that in 2005 all students would develop their Personalised Learning Plan as an ePortfolio. Throughout 2005 the process of developing ePortfolios was monitored and reviewed. From information gathered in the review, modifications were made to the process of developing student portfolios and new goals and templates presented to students at the beginning of 2006. Throughout 2006 the school has monitored student engagement with ePortfolios as a learning tool.

ePortfolios and the Curriculum

We believe that the ePortfolio should be a management assistant, a tool to exploit personal assets, and a work companion, for blending learning and the work environment (from Ravet 2004). For students to successfully work with ePortfolios, the portfolio must become an everyday part of student learning and reflection. It must be an easy to use, personalized tool that can be called on seamlessly in the student's day.

To support this notion we have linked the ePortfolio to significant activities in the school curriculum:

- Integrating the ePortfolio into learning within the Central Studies by linking ePortfolio development to assessable learning tasks
- building reflection on learning in Central Studies within the ePortfolio
- building Central Studies learning tasks around reflections on learning made by students in their ePortfolio
- planning to link the ePortfolio to other transition tools, including the *myfuture* website, the online Futures Connect Transition Plan and the Education Australia's online Employability Skills portfolio
- offering students significant accreditation within the South Australian Certificate of Education for working with an ePortfolio
- Use of ePortfolios as a gateway to access a range of activities and programs within and outside the school, for example: Overseas student visit, work experience, VET programs.

ePortfolios for assessment

- When students graduate from the ASMS they receive the Australian Science and Mathematics School Graduate Capabilities Certificate. This certificate verifies that students achieved a significant level of capability in working scientifically, mathematically, communicating effectively, working collaboratively and independently, demonstrating personal and social enterprise and demonstrating critical literacy. Students use evidence of their learning, stored within their ePortfolio, to demonstrate their capabilities to achieve the ASMS Graduate Certificate.
- At the time of writing this report we are aware that Scholaris, The school's new Student Management System, has a portfolio builder which will automatically create a portfolio from demonstrations of learning so that student work can be matched against one or more curriculum frameworks including the ASMS Graduate Capabilities, South Australian Certificate of Education, Key Competencies, Essential Learnings or the Future SACE Student Capabilities.

ePortfolios for reporting

Twice a year, as a mid-semester report students use the ePortfolio to guide Learning Conversations - discussions between the student, their parent and the Tutor about the student's learning successes, areas for growth and learning pathways.

ePortfolios for planning

- When a student wishes to negotiate more time on an aspect of learning they are expected to be able to refer to the ePortfolio for evidence of their interest in a special project. The PLP should also provide evidence of having substantially addressed the learning outcomes of tasks in which the student wants to negotiate less time.
- Incidental opportunities arise when students express an interest in special program. Students who participate in international exchanges are asked to present their ePortfolio as a demonstration of their reflections on learning at the ASMS.

Staff ePortfolios

We are encouraging staff to model the building of their own ePortfolios. We began with staff posting details of their role in the school, and their career pathways, on the school's web page. This has lead staff to reflect on the types of thinking students need to do to build their ePortfolio including selecting parts of their learning journey to include, making statements about achievement which are open to public scrutiny, decisions about how the information will be kept current and privacy issues. The aim is for staff to extend the school web pages into their own ePortfolios, see the power of such portfolios and lead students by example. A number of the staff have begun the process of developing their own ePortfolios.

THE MAIN FINDINGS FROM THE INVESTIGATION

Quantitative data

Below is a table comparing results of a survey of student engagement with ePortfolios at three points in time:- the end of term 3 (October) 2005, the end of term 1 (April) 2006 and the end of term 3 (October) 2006.

Year level	Not yet started			Made beginning steps			Using ePortfolio effectively		
	October '05	April '06	October '06	October '05	April '06	October '06	October '05	April '06	October '06
10	23%	5%	9%	48%	47%	52%	30%	48%	39%
11	23%	9%	20%	57%	54%	47%	20%	37%	33%
12	60%	36%	31%	31%	41%	45%	9%	23%	24%
Total	37%	19%	21%	45%	47%	48%	18%	35%	32%

At the end of April 06

It is very clear that there has been a substantial increase in engagement with ePortfolios among the students from 2005 to 2006. In 2006,

- 82% of all students had an ePortfolio.
- 93% of students in years 10 and 11 had some form of ePortfolio.

Year 10 students were very engaged with ePortfolios.

- 95% of the students had one, after 10 weeks of school.
- Almost half of the year 10 students were making substantial use of their ePortfolio.

Year 11 students were also well engaged with ePortfolios.

- 91% of year 11 had one, compared with 77% of year 11 at the end of 2005.
- Over a third of year 11 were making substantial use of the ePortfolio, compared with one fifth in 2005.
- In 2005 when these students were in year 10, 78% of them students had an ePortfolio compared with the 91% of these students having an ePortfolio in 2006.

Year 12 students continued to have some difficulty finding time or priority for ePortfolios,

- 64% of year 12s had some form of ePortfolio in 2006, up from 40% in 2005.
- in 2006 one third of year 12s were making substantial use of their ePortfolio.

At the end of October 06 – Assessment of ePortfolios

Generally there does not seem to be much significant change in the data overall.

While some of the percentages have changed, this may be due to the slightly different samples. Each time the survey was conducted, teachers were surveyed about their Tutor Group students' ePortfolios. We did not get a 100% return from all teachers for each survey. While we have over 75% of teachers responding each time, we had different teachers each time not responding which is likely to explain the minor variations in the data.

Students were given a grade for their performance at the October 06 Learning Conversations. We believed that this would be a factor in increasing student motivation to build their ePortfolio for their Learning Conversation. Give that the percentages have not changed between April and October 06, it seems a reasonable conclusion that grading the Learning Conversation has not acted to motivate students to work on an ePortfolio.

Staff and Student Qualitative Data 2005

At the end of term two, Tutors were surveyed regarding their impressions about student use of ePortfolios for supporting and enhancing their learning. Comments from the staff were positive about the possibilities of ePortfolios and about the way that some students were using them.

- *“[Students are] learning to collect things together. In the old days we all had books to show our grandchildren. Electronic pages seem to collect in the cosmos and disappear. This gives students the chance to see how wonderful they really are.”*
- *“[Students are] taking pride in creating their own ePortfolio, adding SACE results, describing their learning in Central Studies.”*
- *“An attempt to collect polished work builds self esteem and organisation skills”.*

Other comments indicated frustrations and disappointments encountered when students showed disinterest in creating or using the ePortfolio.

- *“Some students are unenthusiastic and do not see any relevance in ePortfolios. Some have few HTML, web page skills.”*
- *“Time pressures on students. Difficulties of not knowing the applications necessary for web page creation.”*
- *“There is a general resistance in my group to the use of these. They are unwilling to put in time that some think that they could use better else where.”*

In response to these comments a range of strategies was developed to embed the use of ePortfolios with the Central Studies curriculum, as previously described.

Students were surveyed during term 3, 2005 on the ways they were using ePortfolios to support and enhance their learning. As in the staff survey, student gave a range of very positive comments:

- “*In the school holidays I use my ePortfolio to reflect on my work. I write down what I have done, what I like and what I have found out about me as a learner.*”
- “*I had a full page dedicated to my sporting and educational achievements.*”
- “*I have links in my ePortfolio to some good work I have completed which suits each section in my ePortfolio*”.
- “*In my ePortfolio all my subjects have a section which has examples of work I have done to demonstrate what I have learnt.*”

Other students stated that they didn't have one or they were unable to outline any positive uses of their ePortfolio.

The issues from 2005

Students had responded to ePortfolios in a number of ways, from great enthusiasm and engagement through to disinterest. Our challenge was engage the school community in the process of developing ePortfolios for all students, examining the most useful programs and formats for constructing ePortfolios and discovering uses for the ePortfolio that most support student learning.

There were also a range of responses from staff. While Tutors worked very hard to assist students with their ePortfolios, some had little knowledge of *Dreamweaver* and *Fireworks*. These factors lead to varied level of support for students. Other staff members were not convinced of a real benefit for students from creating and using ePortfolios. Anecdotal evidence suggested that students who received the higher levels of teacher support were more likely to develop ePortfolios that supported and enhanced their learning.

2006 Response to the Research

In response to the barriers to ePortfolios described by staff and students in 2005 a number of changes were made to the way we presented ePortfolios in 2006. The aim was to make the purpose of the ePortfolio much clearer and engaging for students and to provide templates tailored to student level of ICT skills:

- Only two purposes were outlined for ePortfolios:
 - A planning tool – for tracking and reflecting on learning to plan leaning pathways.
 - A showcase – for students to show their parents, Tutors and the wider community at Learning Conversations twice each year and to demonstrate capabilities to achieve the ASMS Graduate Certificate. This meant that students had to use their ePortfolio for a learning conversation involving the student, parent and tutor
- Three different ePortfolio templates were provided to students
 - A graphics heavy template for students who want to use *Dreamweaver* and *Fireworks*
 - A simple template built with *FrontPage* for students who want a less complex web based application
 - A hyperlinked *Word* document for students who don't want to work with web based applications
- A series of reflection and planning tools provided within each template.

Staff and Student Qualitative Data 2006

Qualitative data was collected from staff and students in a number of ways, including focus group discussions and individual interviews.

We found that students were using their ePortfolios for a range of purposes including: - as a vehicle for showing their individual personality, as an organizational tool, for connecting their learning across disciplines, for reflection and goal setting, as a gallery of demonstrations of learning, to showcase their achievements, as a vehicle for learning ICT skills and as a showcase of their ICT skills.

While some students found difficulty in recognizing the value of their ePortfolios, many students could see that the ePortfolio is a part of the changing paradigm of education envisaged by the ASMS. John's view of the school's role in motivating students outlines this point,

"My previous school was pushing you to do your work as opposed to helping you through it and using punishments as incentives as opposed to goal setting."

Students identified a range of issues hindering their use of ePortfolios in support of their learning at the ASMS, including the lack of time within the Tutor Program and the Central Studies to construct their ePortfolios and to reflect on their learning, their lack of experience with reflection as a learning tool, their lack of experience with planning their own learning and the low level of support and guidance provided by Tutors and Central Studies teachers in developing their ePortfolios.

There also remain a number of unresolved issues for the school regarding the use of ePortfolios for school purposes versus the students' purposes. These issues include the extracting data from ePortfolios for school / system wide data gathering and the implications for ePortfolio development, the problem of encouraging personal design of ePortfolios for student ownership versus the standardization of ePortfolios for comparison of standards and the possible use of portfolio data to verify school objectives and outcomes.

FUTURE DIRECTIONS

While this research has identified a range of micro-management activities that can improve student learning with ePortfolios, the literature indicates that there are further developments of ePortfolio use that can greatly enhance student learning.

ePortfolios as social networking

There are many writers and researchers who describe the benefits of sharing ePortfolios (Tosh and Werdmuller 2004; Greenberg 2006). Vuorikari, p1 (Vuorikari 2005) states that "through sharing one's digital knowledge artifacts with other learners one not only brings on-line learning in a social context that is sometimes missing, but also allows new paths of learning with peers to emerge." At the ASMS students are using a range of technologies that share their learning, including blogs, wikis, podcasting, and on-line journals. We will examine how these technologies can be included within ePortfolios along with enhanced opportunities for students to include video in their ePortfolios.

Staff mentoring students via ePortfolios

Gathercoal (Gathercoal, Love et al. 2002) writes that the critical factor in the success or failure of ePortfolios to enhance student learning is the central role of the teacher as a resource provider, mentor, and definer of quality. She believes that the major obstacle to successful use of ePortfolios is not student readiness but staff participation. She advocates a web based system

where students and staff interact electronically as a learning community, with students in control of the folio but staff linking the student work to a curriculum delivery and mentoring system. The ASMS will examine the role that staff can play as ePortfolio teachers.

ePortfolio and Learning Management Systems

In addition to ePortfolios we have been developing a Learning Management System which delivers curriculum materials in an organized and timely manner. Throughout 2006 and 2007 we will be participating in a trial of a Student Management System which tracks student attendance, records assessment items and reports to parents electronically. The system under trial has an automatic portfolio builder, which may contribute to simplifying the process of students building a portfolio as a story of their learning. Part of the challenge is to ensure that students have input into the portfolio creation and not leave it to an automatic process.

THE MAIN CONCLUSIONS

The ASMS mission states, in part, that the ASMS will “focuses on research, development and innovation of the pedagogy of science, mathematics and related technologies and on being a state, national and international focal point for enhancing science and mathematics in secondary schools.”

Traditionally schools have valued content based student learning. While the ASMS will continue to value learning, the school is undertaking a cultural shift to also value metacognitive thinking in Personalised Learning Plans to enhance learning. Our work is demonstrating that student ePortfolios are a valuable contributor to metacognitive thinking and students learning about their learning. Our challenge is to continue the work to find strategies that assist all of our students to engage with Personalised Learning Plans as ePortfolios. We will continue to examine the changes to the way curriculum, thinking skills and ePortfolios can be better connected. We will continue to examine the potential for ePortfolios to contribute to the development of innovative curriculum models.

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