

2011 Innovating with Technology Games-based Learning Research Trials

Findings to inform school practice



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2 Treasury Place, East Melbourne, Victoria, 3002.

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1. Executive Summary

Background and Research Approach

In 2011, the Innovating with Technology Research (IWT) Trials focused on Games-based Learning. The trials are conducted by the Innovation and Next Practice Division within Department of Education and Early Childhood Development (DEECD), to stimulate innovation in teaching and learning practice and encourage and support schools to engage in research. Thirty-eight schools from across Victoria embarked on the implementation of Games-based Learning within their classrooms in one of three strands identified for research; Serious Games, Virtual Worlds or Game Development.

The overall evaluation of this project was designed to investigate the extent & nature of the impact of games-based learning on teacher practice and student learning and the circumstances that influence this impact. A mixed method approach to this evaluation resulted in an extensive range of data collected from principals, teachers and students across all schools. More focused studies were also conducted in selected schools.

The Impact on Teaching Practice

For many teachers in this project, the use of online Games-based Learning was relatively new. Their plans involved ways in which they would use the games to address specific teaching and learning goals and curriculum outcomes. For many, the games provided a strong basis for the development of a comprehensive unit of work that included a range of supplementary and extension learning activities.

The project resulted in some significant changes in teaching practice. Teachers were recognising the value of games across a range of learning areas but they were also developing a clearer understanding of the teaching approaches required. Most significant was the changing teacher/student relationship. The majority of teachers believed that using games in teaching and learning had led to a more student centered and student driven learning environment. Their role became one of facilitator, as their students took more responsibility for their own learning and as peer to peer teaching and collaborative learning increased markedly.

Strategies that foster inquiry and problem solving skills, and opportunities for students to work independently in self-paced activities also featured very strongly in the trial classes. In addition, the use of games provided extensive opportunities for developing student creativity, group work and working on current ideas and authentic issues and practices.

At the end of the project, the teachers strongly agreed that Games-based Learning was relevant to and supportive of their curriculum goals and requirements. It also aligned well with the Principles of Learning and Teaching (POLT), particularly in regard to the promotion of independence and self-motivation, the development of deep levels of thinking and application and the use of assessment practices that were integral to teaching and learning.

The Impact on Student Learning

Over the project period, there were many examples of the positive impact of Games-based Learning on students. The trials led to significant increases in student motivation, confidence, effort and involvement in their learning and, subsequently, their willingness to take risks and drive their own learning.

Across all strands, students were collaborating and cooperating more effectively.

With the shift towards student centered learning, students had also significantly increased the extent to which they were initiating and taking responsibility for their own learning, building new knowledge, developing their inquiry and problem solving skills, and thinking more critically and creatively. The self-paced nature of the learning activities catered for students at a range of levels and increased the extent to which they could learn independently. Also noted by many of the teachers were the very positive changes in the learning attitudes and outcomes of students who were previously considered reluctant learners.

Improvements in specific skills, such as reading, comprehension and communication skills were particularly notable in classes using Quest Atlantis, while those involved in Game Development made significant advances in technology skill development.

Students were also presenting their learning in a variety of ways, leading to changes in the way that teachers were assessing this learning as well as what they were assessing. Student self-assessment and peer assessment was prominent across the schools involved in each strand.

The Circumstances Influencing Impact

Teachers highlighted a range of factors that influenced the extent to which they were able to implement Games-based Learning successfully in their classroom and generate positive outcomes for students. The trials involved substantial support for the participating teachers in the form of funding for teacher release time and access to targeted professional development. Advice and support from DEECD personnel and DEECD technical assistance was also available where needed.

Over the project period, teachers were also able to collaborate, discuss progress and share ideas and practical information via a Ning and through web conferencing sessions. Most also appreciated the support they received from their principal and their teaching colleagues.

The capacity of the teachers to recognise and plan for a range of possible learning outcomes that could be generated through Games-based Learning and embed the Games-based Learning activities effectively within their curriculum, resulted in a broad and rich range of learning outcomes for their students. It also reinforced the fact that the value of the games extended well beyond being 'just a way to engage students in their learning'.

The Future

All teachers are intending to continue the use of games in their classroom. Many plan to look at new ways to integrate games into their lessons or are looking at using games in different ways that will extend their students' learning further. They believe that the Games-based Learning Project has provided them with new insight into effective teaching and learning and has changed the way they will teach in the future.

Extending the very positive outcomes from the Games-based Learning Project beyond the trial schools requires consideration of the various factors that influenced success and the extent to which these factors can be replicated on a larger scale. It also requires the ongoing sharing of the knowledge, ideas and documented plans and strategies that were generated through this project.

2. Introduction and Context

The 2011 Digital Learning Statement for the Victorian Department of Education and Early Childhood Development (DEECD), states that ‘teachers and students will have access to contemporary technology and world class digital content with which to create, communicate and collaborate both locally and globally’ (Digital Learning Statement 2011).

The **Games-based Learning Project** stems from this commitment. It builds on the learnings from a range of research projects that have investigated the implementation of different technologies within schools. It was designed to stimulate further innovation in teaching and learning practice and encourage and support schools to engage with research.

This project also reinforces the prediction in the 2011 Horizon Report: K-12 Edition¹, which claims that games-based learning is one of the emerging technologies most likely to be adopted in the coming years. This Horizon Report also identifies the following key trends, which have further informed planning of this evaluation.

Technology is increasingly a means for empowering students in their learning. Communication and socializing are a ubiquitous, transparent part of students’ lives.

Technology continues to profoundly affect the way we work, collaborate, communicate, and succeed.

The perceived value of innovation and creativity is increasing.

The way we think of learning environments is changing.

Teachers selected one of three concurrent games-based research strands that were included in the trials: serious games, virtual worlds (*Quest Atlantis*) and game development.

The **Serious Games** strand included a wide range of games that are designed for a primary purpose other than pure entertainment and in educational terms provide purposeful learning environment that targets key curriculum areas and explicit learning outcomes.

The **Virtual Worlds** strand focused on *Quest Atlantis*, a game developed at Indiana University that uses a 3D multi-user environment to immerse students in educational tasks.

The **Game Development** strand involved students using game development software to create their own games.

To provide deeper understanding of the use and impact of Games-based Learning (GBL) in the classroom and to identify the factors most likely to influence and sustain this impact, an overarching evaluation project was also established. Drawing on the data mentioned above, as well as collecting additional qualitative and quantitative data from a range of sources, it was designed to investigate the following:

What is the extent & nature of the impact of games-based learning on teacher practice and student learning?

What are the circumstances that influence this impact?

This is the final report on the outcomes of this evaluation. It covers all trials conducted over the period from April to November 2011.

¹ The New Medium Consortium, 2011, *The Horizon Report 2011*

3. The Evaluation Approach

A mixed methods approach was used for this evaluation to ensure that multiple perspectives were gained and rich and reliable data was captured. The following components were included:

- Building contextual understanding, through analysis of documentation relating to the GBL project.
- Review of the project plans from all participating schools, including their project focus, goals and strategies and the specific games and other technologies used.
- Study of the reports/reflections generated by participating teachers at the completion of their trial.
- Review of student assessment data, collected by the trial teachers as part of their research.
- Observation and discussions with participating teachers at the Induction session, Game Development Showcase and professional development sessions.
- Ongoing observation of contributions and discussions via the Project Ning.
- Observation of GBL Web conferencing sessions.
- Review and analysis of the written reports/reflections, and other relevant documentation developed by the trial schools.
- Review of available student outcome data collected by the trial schools, (e.g. VELS, class specific assessment data and student work samples).
- Development and conduct of online surveys for participating students, teachers and principals in each trial school. These were conducted at the completion of the project to gather quantitative and qualitative data. Response rates were as follows:

Table 1: Survey Response Rates

Principals	Teachers	Students (% of schools represented)
44% (17 responses)	77% (30 responses)	62% (24 schools - 573 responses)

Table 2: Breakdown of Responses - Sector

Respondent Category	Principals	Teachers	Students (% of schools represented)
Primary	77%	72%	66% of schools
Secondary	23%	28%	33% of schools

Table 3: Breakdown of Responses – Game Strand

Respondent Category	Principals	Teachers	Students (% of schools represented)
Serious Games	29%	33%	35% of schools (32% of responses)
Quest Atlantis	47%	40%	33% of schools (51% of responses)
Game Dev't	24%	27%	33% of schools (17% of responses)

- Conduct of case studies (Appendix 1) in selected schools. This involved school visits (to observe related activities, review student work samples and data and interview and/or conduct focus groups with principals, teachers and students) along with follow up discussions and further review of student work and other forms of student activity such as blogs.

4. The Nature, Focus and Requirements of the Schools

The Schools

The schools participating in the Games-based Learning Project were drawn from across all Regions within Victoria, representing school sizes, locations, and demographics that ranged from small, rural primary schools to large, metropolitan, secondary colleges with students from diverse cultural backgrounds. Classes from Year 2 through to Year 10 were involved.

Each school had submitted a proposal to DEECD that outlined their project, including the particular strand they had chosen – Serious Games, Quest Atlantis or Game Development, and details on the targeted student group and the goals and approach to be taken. Successful schools were provided with funding for teacher release time for professional development and planning.

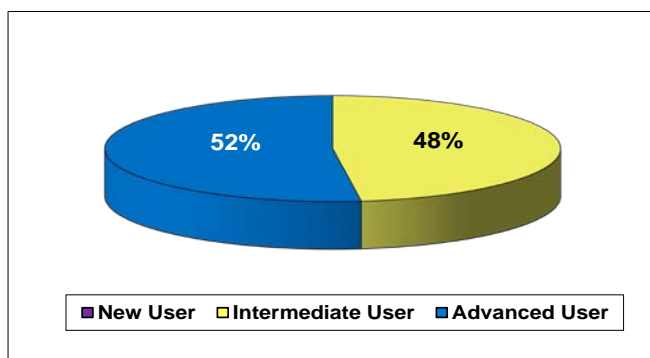
The breakdown of the different game strands across primary and secondary schools was as follows:

	Primary	Secondary	Total
Serious Games	12	2	14
Virtual Worlds	7	5	12
Game Development	7	5	12
All	26	12	38

The Teachers

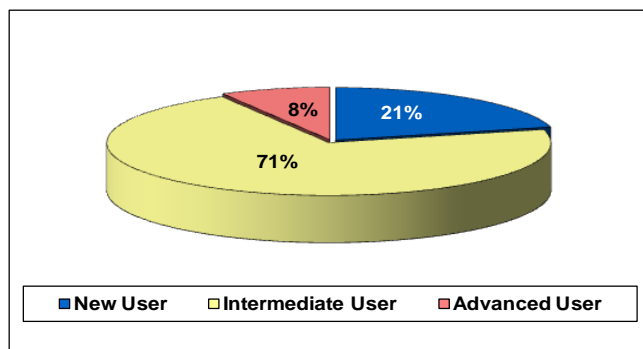
While the majority of the responding teachers were classroom based (**63%**), a significant number had an ICT coordination role (**22%**), either exclusively or together with their classroom teaching role, and were therefore very comfortable using technology. There was also a small percentage of specialist teachers (**13%**) and a Teaching and Learning Coach. Just over half rated themselves 'advanced' users of technology in teaching and the remaining teachers considered themselves 'intermediate' users.

Figure 1: Experience in using technology in teaching and learning



Most had used games in their classroom previously, although discussions highlighted that this was mostly games that were not technology based.

Figure 2: Experience in using Games-based Learning in the classroom



Support and Sharing Opportunities over the Project Period

The development of a '*community of practice*' around innovative teaching and learning underpinned the Games-based Learning Project. The Induction Program at the commencement of the project provided the participating teachers with an opportunity to discuss and consolidate their ideas, hear about previous activities in Games-based Learning and clarify the requirements of their project. Assessment instruments, such as rubrics, for use during their project were also discussed and developed as a group, providing a basis on which teachers could develop rubrics for their specific needs.

Over the project period, a range of opportunities for professional development and sharing were provided. These included specific, strand based development sessions and joint sessions. They included the following:

- Web conferencing, which provided an avenue for participants and the project team to meet online for discussions around project requirements, progress and issues arising. They were also used for targeted professional development with guest speakers
- Training sessions specific to Quest Atlantis (conducted online) and the Game Development Strand (face to face)
- Interaction and support as required from the DEECD Project Manager
- Support, through school visits and online interaction, from the DEECD Digital Learning Innovation Leader
- Technical Support, where needed, from the DEECD Technician, specifically assigned to the GBL Project.

The Innovation and Next Practice Division established the 'Educator's Guide to Innovation' site (a secure online 'Ning' for a range of network groups and involved in using technology in education).

A Games-based Learning group on the Ning was set up exclusively for GBL participants and the Project Team.

<http://guidetoinnovation.ning.com/group/2011innovatingwithtechnologygamesbasedlearningresearch>

It provided a forum through which the GBL Project Team could notify participants of events and requirements, highlight activities and examples of best practice that were occurring in the various schools and raise and discuss information of interest or issues arising. Participants could use it to share ideas and experiences, seek answers, gain new information, suggest solutions to problems that arose or notify others about valuable resources or upcoming professional development.

5. The Findings

Introduction

The Games-based Learning Project provided a supported opportunity for teachers to investigate the impact of using games in their teaching practice. Their reasons for becoming involved were varied. Most recognised the interest their students had in using games. Some saw the potential of online games in addressing specific curriculum areas such as literacy, maths, history and environmental studies. Many believed that using games was a way to re-engage and also challenge their students, providing them with opportunities to make decisions, problem solve, role play and see the consequences of their actions. Those who were teaching specific groups of students (gifted and talented, ESL and autistic students, for example) were keen to explore new ways to address the very specific learning needs of these students. The scope to increase students' technology skills and understanding was also recognised, particularly for those involved in the Game Development strand.

Over the trial period, the teachers developed and implemented projects that, for many, resulted in significant changes in the way they teach and the way their students learn. The focus of this research has been to investigate in more depth the nature and extent of these changes, the outcomes for students, teachers and schools, the challenges faced and the requirements for sustaining and building on the effective use of games in teaching and learning.

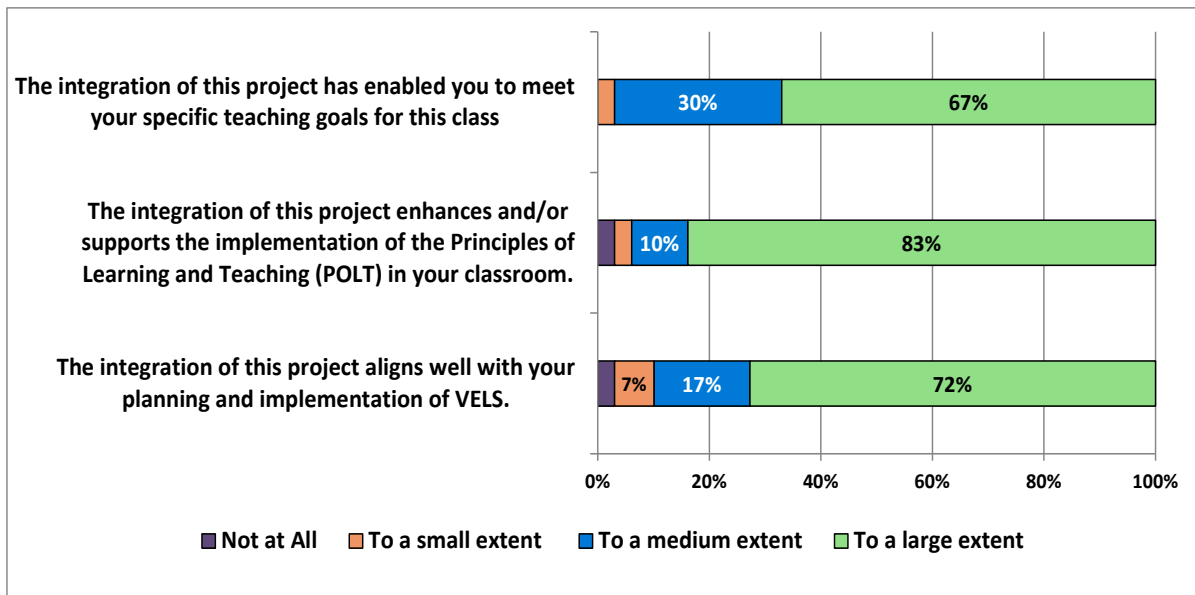
This section draws together the qualitative and quantitative data gathered from all participating schools, along with the more detailed data provided by a small selection of schools participating in the focused case studies (Appendix 1).

Relevance of Games-based Learning in the Classroom

Support for Curriculum and Teaching and Learning Requirements

Teachers wishing to be involved in the Games-based Learning Project were required to submit a detailed application setting out their intended goals and approach, the VELS domains to be covered and how the game would support their curriculum program. This provided them with the incentive and guidance to carefully consider the rationale and potential outcomes for their project, as well as focusing their plans on specific teaching and learning needs within their class. As indicated in Figure 3, at the completion of their trial, the participating teachers strongly agreed that their projects were relevant to and supportive of their curriculum goals and requirements, and the teaching approaches they had used aligned well with the Principles of Learning and Teaching (POLT).

Figure 3: Extent to which trial projects were relevant and supportive of curriculum and teaching & learning requirements



In line with the e5 Model, teachers also planned their projects to include learning opportunities whereby students were able to engage, explore, enquire, elaborate and evaluate.

Alignment to the Principles of Teaching and Learning (POLT)

The strong alignment between the trial activities and outcomes and the six DEECD Principles of Teaching and Learning (POLT)²² was very evident in the teachers' planning and reporting documents, their survey responses, the classroom observations and the discussions with teachers and students. In particular, four of the Principles were clearly being addressed through the effective use of Games-based Learning in their classrooms:

- The Learning environment promotes independence, interdependence and self-motivation
- Students are challenged and supported to develop deep levels of thinking and application
- Assessment practices are an integral part of teaching and learning
- Learning connects strongly with communities and practice beyond the classroom.

In keeping with POLT, the games also provided teachers with the scope to introduce new ways of teaching, which were responsive to the needs and interests of their students, encouraged and supported students to take responsibility for their own learning and supported different ways of thinking and learning. For example:

- Quest Atlantis and many of the Serious Games allowed students to work independently and at their own pace
- Students across the three strands had opportunities to work collaboratively in teams as well as being involved in peer to peer teaching

²² DEECD Website
www.education.vic.gov.au/studentlearning/teachingprinciples/principles/unpacked.htm

- Many of the game activities required development and communication of ideas and solutions, which increased and enhanced their problem solving, deep thinking and reflection skills and capacity
- Students were encouraged to reflect on their learnings from the games and discuss and plan strategies and progress with their peers. Their communication involved different mediums, including blogs wikis, email and, for those using Quest Atlantis, Virtual Worlds
- Students worked through progressive activities, striving to move to a higher level of expertise. Particularly in the Serious Games, they received immediate feedback, through the resulting impact of their decisions. This provided them with the incentive to reconsider any incorrect responses and persist in their improvement. Reaching a certain achievement level challenged them to move higher
- Learning connected strongly with communities and practice beyond the classroom, particularly for those involved in Game Development who were able to work with industry based Game Developers
- Assessment practices varied as students were challenged to use Games and Game Development to develop new skills, knowledge and understanding and to present their learning
- The activities across all strands were designed to promote students' self-confidence and willingness to take risks with their learning.

Addressing Curriculum and Teaching and Learning Goals

The trials provided opportunities for the participating teachers to use games and game development in ways that addressed a range of curriculum and teaching and learning goals. Teachers designed their projects to align with their particular curriculum and assessment needs. The different goals they hoped to achieve reflected the diversity of levels and learning areas covered, although there were many common aspects and outcomes across the range of projects.

Developing Students' Thinking Skills

The development of skills in problem solving and strategic and creative thinking was considered a key goal for many teachers across the three game strands. In a class involved in game development, for example, the teacher built in time for '*sustained discussion, deliberation and inquiry*', providing support as students '*explored processes, identified patterns and cause and effect relationships*' and '*elaborated, analysed and developed logical arguments*' as they created their game.

The various Serious Games required students to think strategically and creatively in order to progress within the game or solve problems that would take them to the next stage. Their decisions typically required consideration of a range of perspectives and the impact of these decisions was often immediate, impacting on their success in the game and often leading to rich discussions, as a class or within small groups, about the consequences of each decision. One teacher extended her students' thinking strategies through the development, as a class, of graphic organisers that assisted them to visualise their thinking and assess their own progress.

Quest Atlantis also provided teachers with a new medium through which students could develop and apply their thinking and negotiation skills. As the students made their way through the virtual worlds they were required to make decisions, based on their assessment of the situation and their interpretation of the information they were presented with. The decisions they

made would lead to the achievement of particular milestones within their mission.

Knowledge Building

The Serious games provided opportunities for more specific knowledge building and were often the centerpiece for a broader integrated unit of work. For example:

- ‘Civilisation’ was used to link the ‘big ideas’ of History (movement, exploration, building cities, combat and conquest, colonisation, technology) to the content being learnt by more traditional means, such as reading and responding or hands-on tasks (such as model making)
- ‘Stop Disasters’ was used to enhance students’ understanding of community needs, in regard to assisting in the prevention of natural disasters, and developing an understanding of the economics and decision making involved
- ‘Lure of the Labyrinth’ provided scope to ‘challenge and support students in their maths learning in an online environment that eliminates the fear of failure’ as well as developing skills in communication, collaboration and team work
- ‘Electricity’ provided a platform on which students explored different renewable and non-renewable energy sources and investigated their benefits, disadvantages and impact on the environment and on communities, as well as increasing understanding of ways to balance community needs with the impact on the environment (Case Study 2)
- ‘Sim City’ was used to explore the concept of leadership and develop students’ understanding of the different styles and qualities of leadership across different places and in different times. The game was central to an integrated unit that also involved a wide range of activities targeting learning outcomes across different key learning areas (Case Study 1).

Quest Atlantis also provided scope, through its wide selection of Quests and Missions, to develop knowledge and understanding around different topics and support the development of problem solving, creative thinking and negotiating skills:

- It was central to a unit in one class titled ‘*How can I make the world a better place?*’ which challenged students to respond to political, ethical and environmental issues that were faced through the game. The strategies learnt in this environment would then transfer into real world situations through a ‘Make a Difference’ (MAD) Project. The aim in this class was to make Quest Atlantis ‘*a virtual manifestation of student action that would take place in the real world*’
- Students in a secondary school were engaged in ‘*big questions about how understanding where we have come from sheds light on where we are now.*’ They were able to visit an ancient civilization to learn about it ‘firsthand’. The gaming experience allowed them to *immerse themselves in an ancient civilization in a way that would not have been possible in a ‘real’ classroom*’
- Quest Atlantis was used as ‘a seed’ for students’ creative writing sessions. ‘*It was fabulous to see many students starting to write their own quests. Some students even created characters and tasks that individuals would need to complete. Their writing demonstrated a sound understanding of the structure of the program*’. This also led to students writing about issues and problems they experienced with

the program and identifying areas for the program to be developed further.

Game Development provided opportunities to engage and involve students in the use of very different technologies. Teachers saw it as a way to increase students' skills, knowledge, confidence, independence and creativity in using ICT.

They also recognised its potential for:

- Building on students' established knowledge of video games
- Focusing on the process of game development, including the history of game development, the verbs and nouns that underpin games and the factors that attract players to a game
- Increasing problem solving skills
- '*Infusing*' game development in the literacy curriculum, and
- Providing a new way for students to present their research and their work.

A feature of this strand was the professional learning that was provided for both teachers and students. It involved three sessions with game developers for the teachers and a full day for students (together with their teachers).

The opportunity to present their game at a showcase provided an authentic opportunity in which students could discuss, develop and demonstrate targeted and persuasive communication and presentation skills.

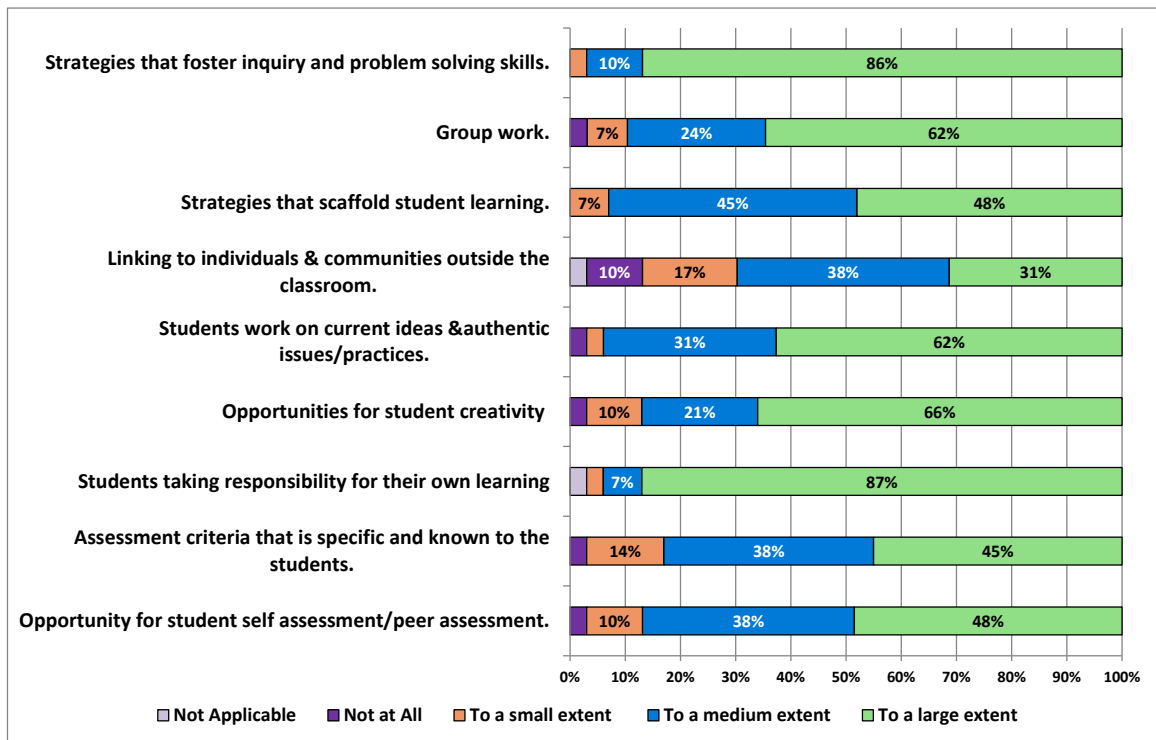
The Impact on Teaching Practice

While some teachers had used games previously in their classrooms and many were 'online game players', the more strategic integration of games in their curriculum was, for most of those involved, relatively new. Teachers developed and submitted their plans for using the games at the commencement of the project. Some developed detailed unit plans that covered a wide range of curriculum areas and student learning outcomes, while others had more general ideas on the approach to be taken, although this was underpinned by sound teaching practice. Many of the activities evolved over the period of the project as teacher understanding of the potential of these games grew.

Teaching Approaches Used

As shown in Figure 4, strategies that foster inquiry and problem solving skills and opportunities for students to take responsibility for their own learning featured very strongly in the trial classes. In addition, the use of games provided extensive opportunities for developing student creativity, group work and working on current ideas and authentic issues and practices.

Figure 4: Specific teaching practices included in the implementation of the trial projects



There were some differences in the responses between the strands. For example, although teachers in all strands were very positive about the extent to which their Games-based Learning project aligned with POLT and addressed their VELS requirements and specific learning goals, those using Serious Games rated these aspects at a very high level. They also indicated that their games provided extensive opportunities for students to take responsibility for their own learning, work on current ideas and authentic issues and practices and engage in problem solving.

Those using Quest Atlantis were particularly positive about the opportunities for students to work on current ideas and authentic issues and practices, develop reading and communication skills, take responsibility for their own learning and self-assess.

Game Development teachers highlighted the extent to which students were problem solving, working collaboratively in groups, working very creatively and taking responsibility for their own work.

Changing Teacher/Student Relationships

Across all strands, the Games-based Learning Project was stimulating significant changes in teaching practice. Teachers were recognising the value of games across a range of learning areas, developing a clearer understanding of the role of these games in learning and, as a consequence, were adopting new teaching approaches. In particular, they were:

- Providing more opportunities for students to direct and take responsibility for their learning
- Placing greater value on peer to peer teaching.

Most striking was the changing relationship between teacher and student as students worked more collaboratively with their peers and in many cases took on a leadership role as they embarked on the independent, authentic and often challenging learning experiences provided through the games.

The majority of the teachers believed that using games in teaching and learning was leading to a more 'student centred' and 'student driven' learning environment. They were seeing their role as one of facilitator as their students took more responsibility for their own learning. They were also learning themselves: *'I suppose the students and I were learning together as peers, with me guiding them in certain areas.'*

These teachers recognised and acknowledged with their students that they did not have all the answers and they did not need to have all the answers and this led to 'shared problem solving responsibility'. One, for example, looked for ways that would 'encourage students to think for themselves and not simply rely on the teacher for answers'. Another felt that using games in learning 'allowed for far greater decentralisation of the role of teacher in the classroom...This is something that I try to do, but Quest Atlantis made this much easier'.

In many cases, the classrooms were changing towards 'a community of inquiry and collaboration'. They were places where students were:

- seeking answers
- developing shared problem solving responsibility
- collaborating to find the answers.

At the same time the teachers were ready to hone in on opportunities for teaching new skills and understanding that linked to the students' progress with games:

'In my year 10 programming class I tried to make the emphasis on learning from each other (especially when coding problems occurred). Alongside this was more emphasis on direct instruction, explaining the big ideas of programming'.

Peer to peer teaching was significantly strengthened and teachers were now planning to include it in future classes. One, for example, felt she '*understood the value of peer to peer teaching through this experience.*' Others detailed the extent to which they were changing and further developing their teaching style to accommodate this new approach:

'I am now far more confident in allowing students to guide their own learning. I have been able to develop questioning skills that help students to make their own discoveries. I have also been able to see how, by providing students with genuine opportunities to showcase their learning it can help other students to learn from their peers'.

'Given the unfamiliar nature and themes presented in Food Force (people displacement, civil war and civic disaster) I would typically find that a teacher driven model would be required. However the experience I had with my class was that they would openly discuss what they had encountered. I was able to take more of a backseat and simply become a facilitator, supporting students when they came across new terms and concepts that they needed some help to fully understand. I think the use of Food Force helped to alter my student's learning more towards the experiential model and as the teacher I was then able to drive the learning from the back end to ensure that concepts were more firmly embedded.'

Quest Atlantis provided opportunities for students to work through the quests and missions at their own pace, progressing and gaining feedback within the virtual world. This led to more independent learning as teachers took on a more indirect role.

'Being part of this trial has broadened our perspective on the many opportunities for students to work alongside others in an online environment'.

In schools that were involved in game development, the selected group of students that attended the professional development day with game developers took on a more formalised role in sharing this learning with their peers. In one school, for example, this role was given to a student who would not normally have the '*confidence or the capacity*' to pass on his learning to others. But once given the task, he did so most successfully, significantly lifting his self-esteem and his standing amongst his peers.

In three other schools, the group of students who formed the game development team were given the role of passing on their learning to the students in their class and then to the other classes in the school.

Catering for Individual Learning Needs

Self-paced, personalised learning and assessment for students was particularly evident in classes using Quest Atlantis.

'It has been fabulous to see students progressing through the program at different rates. Students haven't felt rushed or held back.'

Quest Atlantis was therefore considered ideal for a class in which the students were from an ESL background with very different levels of English and learning abilities. In this class the teachers added complementary activities that focused on a particular learning need. As detailed in Case Study 3 the students were supplementing their online QA activities by documenting the missions they undertook. This highlighted student differences in developing ideas and problem solving, helping to identify those needing additional support.

'It provided great extension opportunities for some students'.

Quest Atlantis was also implemented very effectively in a class for Gifted and Talented students, drawn from Years 2 to 6 (Case Study 4). They were able to work through Quest Atlantis activities that extended their learning according to their individual maturity and learning levels. Teacher planning and the development of challenging assessment tasks ensured that students at different levels were being catered for, challenged and excited.

Teachers were catering for individual learning needs through the Serious Games. In games such as Lure of the Labyrinth, students were able to progress through at their own pace, but the teacher was able to monitor this progress online and provide support and explicit teaching where needed, either individually or in small groups.

The development of supplementary activities around these games also enabled teachers to reinforce specific learning, teach new skills or, as observed in one class, focus on and further develop particular themes or aspects in the game that will '*spark interest*' in reluctant learners.

Increasing Opportunities for Collaborative Learning

Collaborative learning increased substantially across the three game strands. Many students were jointly '*problem solving*', '*sharing ideas*' and '*engaging in positive risk taking*' and much of this was occurring outside school hours.

This was particularly evident in the Game Development strand, where students worked closely in teams, often during and after school hours, to develop their games. The opportunity for the Game Development students to participate in a full day session, in which they learnt from industry based game developers, provided a further, very unique opportunity to extend their learning beyond the classroom and interact with teams of students from the other Game Development schools.

Quest Atlantis provided students with the incentive and capacity to continue learning and collaborating beyond the classroom, interacting in their virtual worlds with classmates and also those outside the school who were involved in the game.

Many of those involved in Serious Games were also continuing their game at home. In one school, the teacher would set them tasks for completion. In others, they were playing with their families, increasing parental involvement in their learning and awareness of the benefits of games. Blogs and wikis, established as part of the project in some of the schools, provided a further avenue for continuing their Games-based Learning activities beyond the classroom.

Teachers were typically very comfortable with this change to more collaborative, student learning: *'Peer to peer teaching became the norm in this classroom, students only came for support from me if they were really stuck. Most of the time they were able to solve the problem themselves, either through the experiences of advanced students or collaborative problem solving.'* For some teachers, however, it was a very new approach, requiring changes to their perception of a learning environment: *'I am now more willing to accept productive 'noise' in the classroom!'*

Providing 'Authentic' Learning Opportunities

Games across the three strands, provided students with learning opportunities that could readily be linked to real life experiences. Many of the Serious Games allowed students to immerse themselves in different situations *'in a way that would not have been possible in a 'real' classroom'*. For example, they could visit and take an active role in an ancient civilization to learn about it first hand, or become mayor of a large city, making decisions and seeing the immediate consequences of those decisions. As a teacher in one class noted *'When the assessment tasks came in it was obvious that students were becoming immersed in the narrative of the game world. They tapped into an emotive element that charged them with meaning and purpose as they felt they were dealing with authentic, real world problems'*.

Although working in a Virtual World, students using Quest Atlantis also felt they were involved in 'real' problem solving situations and, as detailed in Case Study 4, they were able to link to authentic sources of information (in this case N.A.S.A.) in order to complete the required task.

For students involved in Game Development, the activities were truly authentic. They were involved in a development session with Industry Game Developers, created their game and then presented their game to a real audience at the Game Development Showcase.

Expanding the Assessment Strategies

'With a less traditional learning unit such as this, creativity helps in developing appropriate assessment'.

Students were presenting their learning in a variety of ways, leading to changes in the way that teachers were assessing this learning as well as what they were assessing. Student self-assessment and peer assessment became more prominent across the schools involved in each strand.

Many of the games also had assessment structures built in, enabling students to clearly follow and understand their progress. Quest Atlantis, for example, gave students instant feedback and guided their progress through the activities. Many of the serious games were also providing direct feedback with each action or step that the students took. Peers were seen encouraging and sometimes teaching students to achieve at the next level. Teachers using these activities in their class were typically monitoring and documenting

progress and providing explicit teaching for individuals, groups or the whole class as required.

In some classes, teachers were also introducing different technologies for students to demonstrate their learning. For example students using 'Sim City' as a basis for studying leadership, developed re-election speeches for their role as Mayor, using a Voki to present it on their class blog (Case Study 1). Class blogs, typically established on the Ultranet, also provided an avenue for students to record their reflections and learnings and submit their work, as well as enabling teachers to provide individual feedback to their students. Twitter was also used as a means of communication in one of the classes. Teachers also noted that students were more likely to review and improve their work when it was to be used or viewed by others through these online sites.

Rubrics, online surveys, reflection charts and graphic organisers were also used to develop and support further student self-assessment and reflection on their progress. These tools were further encouraging them to take greater responsibility for their own learning.

Over the trial period many of the teachers also began to more clearly understand the learning generated through the games and ways that this could most effectively be assessed:

'Having had this experience I will be better equipped to assess student learning, not just the ICT skills they develop, but also other curriculum learning they achieve'.

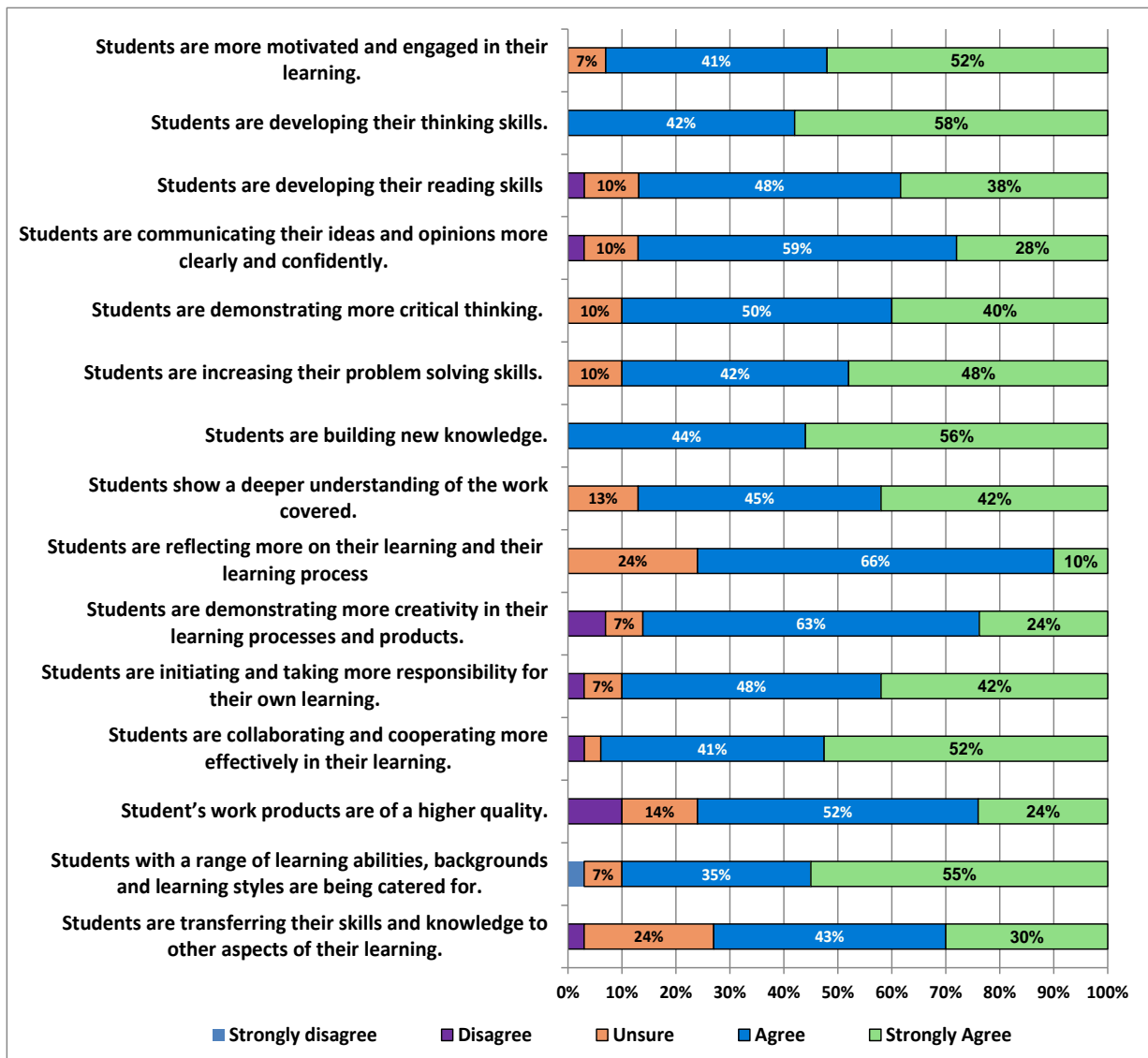
'The use of online testing didn't always lead to improved results but it did ensure that my assessment was valid and that students were accountable. Parents were aware of what was expected (I sent letters home) and I was able to gather clear evidence of where students improved, where gaps in learning occurred and where I'd got it wrong. If students know what they are learning and why they are learning it, they will usually perform better'.

The Impact on Student Learning - Teacher Perspective

With the significant shift towards student centered learning, as discussed above, students had, according to all responding teachers, significantly increased the extent to which they were developing their thinking skills and were building new knowledge.

As indicated in the graph below, teachers also believed that their students were more motivated and engaged in their learning, were collaborating and cooperating more effectively and had increased their problem solving skills. They were also more creative in their learning processes and products. In addition, most teachers felt that learning through games was more effective in catering for students with a range of learning abilities, backgrounds and styles.

Figure 5: The impact of the Web 2.0 Trials on Student Learning – Teacher Perspective:



Increased Motivation, Confidence and Commitment in their Learning

The trials led to significant increases in student motivation, confidence and involvement in their learning and, subsequently, a willingness to take risks in their learning, and 'have a go'. Many of the teacher comments highlighted the immensity of these changes:

'Now when I say we are doing Maths the class cheers...a stark contrast to their reaction early in the year!'

'Students were stretched beyond their comfort zone in areas such as public speaking, sharing ideas, and needing to discover the answers to their own questions and when they found success they were far more likely to attack new and challenging situations with greater confidence. I genuinely believe that their participation in this

program will have a positive impact in their journey as lifelong learners’.

‘The narrative of the game world impacted upon student engagement - the class was more willing to suspend reality and really become emotionally involved with the plight of characters in the game world’.

For some teachers this was particularly notable in their lower achieving students:

‘All students became more consistently engaged in the tasks, producing improved outcomes in a more efficient fashion, but the lower achievers were among those who had the greatest level of improvement’.

‘I witnessed students that were not overly confident with technology become surprised and proud of their achievements because they were able to produce a high quality product.’

Some also saw an increasing confidence and willingness in their students to build on and demonstrate their learnings, both during and after the game. Teachers spoke of students who were:

‘Really keen to show their learning through the class Collaborative Space and by using recording devices’.

‘Building on their reflective skills and able to provide more evidence for their learning’.

‘More reflective when they play - seeking information to help the move forward in the game rather than just using trial and error methods’.

Others relayed notable changes in the willingness of their more reluctant learners to share their learnings and ideas. For example:

‘At the beginning of our program, few students were willing to stand in front of the class and share/celebrate their experiences. Toward the end, we had a clear increase in the number of students willing to stand up and present to their peers’.

In another class, the teacher, who would typically be *‘spoon feeding the information to his students’*, saw significant change in his classroom as students took on greater responsibility for *‘leading their learning’*. He noted the effectiveness of the pre and post testing he established for the trial, which enabled the students to understand their learning needs and take responsibility for *‘breaking into revision groups with a common purpose’*. This change was even more apparent where a group of boys, who were often disruptive, took on a leadership role and were teaching not only other students but also the teacher about the game.

A small number of teachers did, however, note differences in the impact of the games across their class. For one of these teachers, the experience highlighted the range of attitudes to Games-based Learning across his class and the need to address these differences.

‘By using different strategies such as problem-solving rubrics and activities that linked the game to historical concepts, I was able to engage students and add to their understanding of how decision-making influences history. But for a few students, some of whom are usually very high achievers in my class, I struggled to find ways to get them excited about the game, though they need to take some responsibility for this. I think that for this game to work for everybody, a culture has to be developed where the game is not seen as a ‘fun’ thing to do, but an activity with the same credibility

as a research report or essay. This is why I provided an alternative assessment option, so that I didn't lose those high achieving, well behaved students for whom the game just didn't appeal'.

Improved Effort and Quality of Work

Several teachers noted that the students who became 'the experts' were not necessarily those who would normally perform well:

'Some of our quieter kids have become the 'experts' in our classroom which has boosted their self-esteem and allowed others to see that they have great attributes'.

Students were also being '*stretched beyond their comfort zone*'. This was particularly evident in the Game Development strand where they were required to showcase their games, requiring them to develop a 'pitch' and present it to a real audience made up of Game Developers, teachers, department personnel and students. Watching them in this situation their teachers were both impressed and surprised at their confident performance.

Also noted, was the extent to which this increasing confidence was now transferring to more independent learning:

'When they found success they were far more likely to attack new and challenging situations with greater confidence. I genuinely believe that their participation in this program will have a positive impact in their journey as lifelong learners.'

'Students are building on their reflective skills and are able to provide more evidence for their learning'.

'Teachers were able to step back and allow the students to take ownership of their learning. All students became more consistently engaged in the tasks, producing improved outcomes in a more efficient fashion. Lower achievers were among those who had the greatest level of improvement'.

'Students were very engaged in the project even though technology was frustrating. They were very supportive of each other in giving clues about how to complete missions. It provided great extension opportunities for some students'.

In contrast, although not common, some concerns were expressed by a small number of teachers that the games had not impacted as positively on their students. These students represented both high and low achievers, as indicated in the teacher comments below:

'Lower achieving students have had an opportunity to demonstrate their understanding using the computer games but have not necessarily responded with improved written work'.

'Something that frustrated me was that some of the students who do well in a traditional learning environment (i.e. research tasks), struggled to adapt to change. I found it difficult to persist when these students, while not misbehaving, avoided taking the initiative to improve their performance in the gaming. I felt that if they had exhibited the same behaviours/work habits in, for example, an essay task, I would have had more power to put pressure on them to improve'.

Increased Collaborative Learning and Peer to Peer Teaching

According to one teacher, the most striking change in her teaching practice was her '*mindset towards student capability*'. Throughout the trial she was '*happily surprised by the ingenuity and resourcefulness of students working together*'. Other teachers reinforced this. They spoke of students helping and encouraging each other, working collaboratively and mentoring and

supporting one another *'without encouragement'*. This was particularly evident in a multi-age class in which the older students were now *'showing much patience and a willingness to listen to their younger classmates'*.

One teacher felt that it was because 'the collaboration was authentic and in an interesting environment'. Teachers also believed it was leading more generally to greater student independence, better group work and improved communication and collaboration skills within their classroom. They were able to 'step back and allow the students to take ownership of their learning'. In a class using Serious Games, the students were now 'an enthused, engaged group. They help each other, get excited – high five each other when have successes – very positive relationships are being built'.

In a Quest Atlantis class, the teacher saw significant changes in student interaction: *'They have started to work together and are united by a shared language that is Quest Atlantis'*. For another class, when challenges arose during their session the students were initially approaching teachers only. But over time, the student/teacher dynamic began to shift. The students began to feel more comfortable asking their peers for assistance, working collaboratively and supporting and guiding one another as they navigated through their quests and missions. They were also, as one teacher described, providing each other with *'encouragement, enthusiasm and motivation without taking control of each other's questions and wanderings'*. In classes with multiple levels, teachers noted the willingness of the older students to take on mentoring roles, helping and supporting the younger students through any challenges they were facing.

Where Game Development was the focus, teachers in most cases selected a Game Development Team. These students attended the Student Development Day, developed their game and presented it at the Game Development Showcase. However, they were also charged with teaching other members of their class the skills and knowledge needed to develop games and supporting them as they joined in the game development activities. In some classes, it was noted that the students who would typically struggle in their work quickly became knowledgeable and adept at using the game development software and understanding the process and requirements for developing a game. Their self-esteem and confidence rose as they became the experts that their peers would turn to for assistance.

The teachers, who *'still had a great deal to learn'*, were also calling on these students for assistance. This was changing the student teacher/relationship and generating a *'learning together'* environment, where it was *'OK to give it a go'*, even though you might not be sure how to do it. It also reinforced the notion that different students were 'experts' in different ways and that drawing on and sharing this expertise was an important part of classroom learning.

Peer to Peer teaching opportunities were also evident in Quest Atlantis. For example, one class was running a *'mini inquiry into effective teaching practices'*. This was initiated when some of the students asked if they could run their own workshops in Quest Atlantis. These students had developed confidence in working with Quest Atlantis and were keen to become the *'experts'* as they had skills to teach and assist other students.

Over the project period, the class for gifted and talented students from Year 2 to Year 6 changed from one where the students across levels would rarely interact to one in which students were collaborating and supporting one another in their learning (Case Study 4).

Further peer to peer interaction and teaching was also occurring online in schools where the teacher had established collaborative spaces that gave students the opportunity to showcase their learning, discuss and share problems and work together on solutions. In a school that had established a

collaborative space on their Ultranet site, for example, the students were communicating after school with each other as they worked on the games, sharing progress, ideas and new discoveries’.

Knowledge Building and Skill Development

The online games provided teachers with wide ranging opportunities to target the development of specific skills and knowledge. Serious Games were selected to focus on learning areas such as maths, history and the environment. Where teachers developed comprehensive unit plans around the game, the skills and knowledge that emanated from the activities were rich and deep.

As detailed in Case Studies 1 and 2 for example, the teachers introduced additional activities that complemented the central game activities. Students using Sim City researched facts related to the development of a community, such as transport, power, recreation, industries, and environment and through their reading of ‘Animal Farm’, discussed and gained new perspectives on governance, leadership and community issues. Persuasive writing skills were developed as students in the class using Electrocitiy created brochures that justified and supported the decisions they were making within their city.

Student interest and abilities in maths increased significantly in the class using Lure of the Labyrinth. It was generating ‘fantastic strong conversations about maths – there was a lot of talking but it was all about fractions, fomulas and patterns and what will or will not work’

Quest Atlantis, with its range of different missions and associated quests also provided scope to focus on specific curriculum areas. Teachers selected Missions that addressed the curriculum needs in their class. As students interacted in the chosen virtual world they learnt and applied skills in communication, reading and comprehension and problem solving, as well as developing deep knowledge and understanding of the specific virtual world in which they were interacting. In some schools teachers were developing associated assessment tasks that challenged students at each level and enriched and extended their learning.

Students involved in Game Development were learning and applying complex ICT skills needed to create their game. But they were also developing and applying an understanding of the structure of games, the purpose and psychology behind games and the factors that created tension, excitement, and enjoyment in playing games.

‘They tapped into an emotive element that charged students with meaning and purpose as they felt they were dealing with authentic, real world problems’.

The gaming experience allowed students to immerse themselves in different worlds and different eras. The capacity for these games to provide students with deeper understanding and empathy for a different time or a different situation was highlighted across many of the teacher comments.

Development of Critical & Creative Thinking & Problem Solving skills

Through the game activities, teachers observed that their students were more willing to take risks with their learning and were becoming problem solvers. This was often the result of the problem solving requirements within the game or game development activity, but also the explicit teaching strategies that teachers built into the activities.

In one class the teacher had discussed explicitly with her students the strategies needed to work through obstacles and problems they faced as they developed their own game. Students were soon applying these strategies rather than coming to her for assistance.

The extent and nature of the problem solving undertaken by students as they worked through their games was noted by teachers across all game strands. For example:

‘Students needed to consider which strategies may be most appropriate for their game. They had to focus on tasks that require flexible thinking for decision making, synthesis and creativity.

‘The trial enabled students to participate in activities in which they identified problems that needed to be solved, developed a range of creative solutions and explored the advantages of generating unconventional rather than conventional solutions’.

‘QA has also prompted me to increase my documentation of student learning – especially blogging our journey on our classroom Ultraset Page, Twitter and Blog. The students and I are much more willing to ‘stay in the question’ longer to obtain a number of possible outcomes/solutions to a problem rather than simply speed toward the solution’.

In a class using Lure of the Labyrinth, with its focus on maths, the problem solving involved deciphering and then applying the mathematical patterns that emerged in their interaction with the ‘monsters’. Students enjoyed the complexity of the activities: *‘everything you do becomes a puzzle – you are thinking all the time. Moving from one room to another is a puzzle – you follow a map with coordinates. There are doors to go through – they have many numbers and you need to work out the pattern and identify the missing number’.* You learn different ways to do things’. Sometimes you do not realise till you have been working on it for a while that there is a pattern forming. Once you understand it you can work out what to do next’.

The development of critical and creative thinking and problem solving skills also featured strongly in the activities of the Game Development students. These students were, according to their teacher, increasingly using ICT tools and techniques to *‘support the organisation and analysis of concepts, issues and ideas, allowing relationships to be identified and inferences drawn from them’.* Also notable was their willingness to share their understanding with their peers: *‘We were impressed with the way the students started to articulate their thinking and were able to pass their skills and strategies to their peers’.*

Development of ICT Skills

All game strands provided opportunities for the development of a range of ICT skills. However Game Development provided students with significant challenges and learning opportunities as they created their games. This involved exploration of the Game Development Software to be used, a decision that was sometimes made by the teacher but most often involved students and teachers working through the pros and cons of different options before deciding on the most appropriate one for their needs.

As detailed in the Game Development Case Studies (5-7), the teachers were also very new to Game Development, so students were taking it upon themselves to explore ways to achieve specific effects and then share their knowledge with each other and their teachers. In one school, the teachers deliberately *‘did not learn the games development software program to ensure that the students took on this responsibility themselves’*, which they did very successfully.

Teachers in the Game Development classes were *‘amazed’* as they observed their students working together to develop an online game. Both the ICT skills and the problem solving skills they developed over the project period were immense. The students had been given wide scope to lead the development of their game and, with it, the responsibility to explore the requirements and develop the skills and knowledge required.

Development of Reading and Comprehension Skills

The development of reading and comprehension skills was a key learning outcome for students using Quest Atlantis. The requirement to read and then respond by following directions and making specific decisions gave purpose to the activity and resulted in progress through the virtual world.

This was particularly relevant in an ESL class made up of refugee students with limited reading and comprehension skills (Case Study 3). With additional strategies in place to supplement the Quest Atlantis activities, the teachers were able to identify and provide additional support to those needing assistance in this area. As students worked on their missions they were encouraged to take written notes on the key ideas they were gathering. Using these notes, the students could then discuss and document the missions they undertook. Their notebooks were reviewed by the teachers and used as a basis for discussion on how and why they were making their decisions and developing their ideas. This highlighted not only their reading comprehension skills and needs but also the student differences in developing ideas and problem solving, ensuring that they received additional support where needed.

For other classes using QA, the self-paced nature of the game and the scope for using the game to address learning needs at a range of levels, provided a valuable opportunity in classes with students with varying learning needs:

'We observed how beneficial this is for our students in encouraging them to become more confident readers. QA has given students the chance to personalise their learning through completing missions and quests at their own pace and has improved their literacy outcomes due to the rich reading and writing tasks embedded in QA and the high engagement factor.'

'Students were very engaged in the project even though technology was frustrating. They were very supportive of each other in giving clues about how to complete missions. It provided great extension opportunities for some students.'

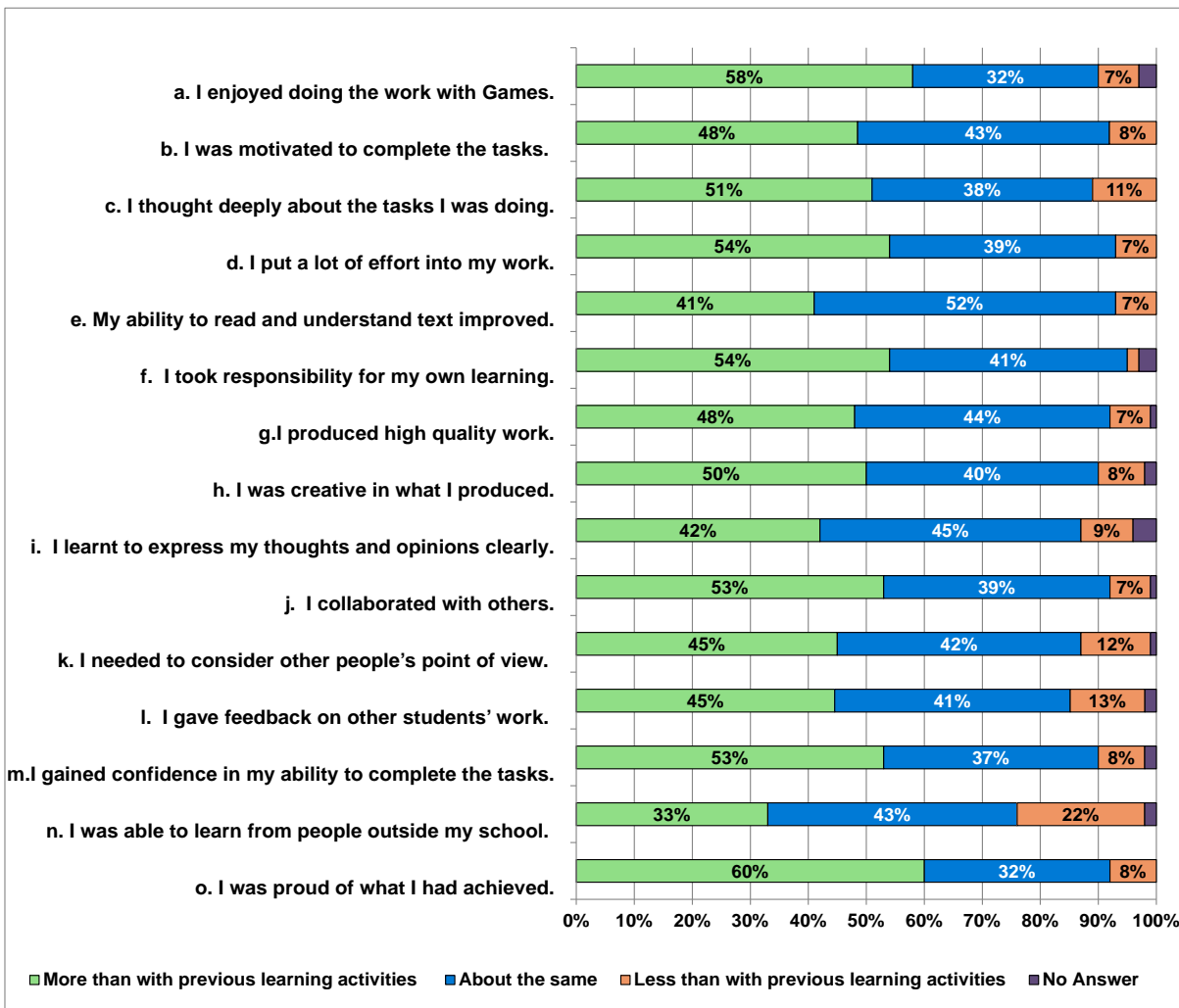
The Impact on Student Learning – Student Perspective

Students were asked in their surveys to think about the work that they had done using games and compare this with other lessons where games were not used. As indicated in Figure 6, in most areas, many indicated increased outcomes regarding the level and nature of their learning (selecting 'more than in classes where games were not used').

Although their responses often depended on the requirements of the project in which they were using the games, there were significant increases in the extent to which the students:

- Were proud of what they achieved (**60%**)
- Enjoyed doing the work (**58%**)
- Put a lot of effort into their work (**54%**)
- Took responsibility for their own learning (**54%**)
- Gained confidence in their ability to complete the tasks (**53%**)
- Collaborated with other students (**53%**)
- Thought more deeply about the tasks they were doing (**51%**)
- Collaborated with others (**51%**)
- Were creative in the work they produced (**50%**).

Figure 6: Student perceptions on their learning with games compared to their previous projects or work



Very few students selected 'less than in previous projects'. The exception was learning from 'people outside the school', This occurred mainly in Game Development, through the student development day with a game developer, but there were also opportunities for some students using Quest Atlantis, who appreciated the online interaction they were having with students from other schools and countries who were involved in the game.

Engagement and New Attitudes to Learning

When asked to list the 'best things' about using games in learning, well over 50% of students included 'it was fun' in their responses. But many added that because it is fun they are more motivated to learn and more likely to learn. For example:

'There are a lot of benefits from learning with games! When you learn with games you enjoy learning and have fun! This makes you motivated to learn more because it is something you enjoy!'

'You are having fun but you're still learning at the same time and sometimes have to work really hard and think a lot but other times

you don't even realise that you're learning anything because you're having so much fun'.

'I liked it because, not only was it fun it was also interesting and I learnt new things'.

'They are fun and creative to play I like them. It definitely does help you learn more'.

'It gets the students to improve their skill of learning in a way that is enjoyable to them!'

'I was in my element with my learning - I was interested in my work'.

Some made comparisons with the work that they were doing previously:

'I think they help me focus a bit more because they are a bit more fun than a teacher standing out the front and just talking'.

'It takes the boredom out of using pencils and paper'.

Independent Learning

Students also acknowledged that they were learning more independently:

'One of the best things was having a sense of independence and completing tasks in accordance to my ability'. Another added that it meant he 'didn't have to wait for other people to finish' before progressing further'.

This capacity to work independently was particularly highlighted by students in the Game Development Strand:

'We got to learn the skills we needed to use to create our game by ourselves. We also got to be creative and come up with our story for our game'.

'The teachers weren't telling us what to do. They let us ask our peers questions'.

'It was more creative than normal classes'.

'Learning how to make your own independent games is the best thing because you can go away with skills that you learn. You learn a lot and when you are finished you feel like you have achieved something'.

Those using Quest Atlantis also detailed the benefits of independent learning. For example:

'The best thing about using the game QA was that we were self-driven learners and completed the quests and worked in our own direction and way'.

Others in Quest Atlantis raised the benefits of being able to *'learn at your own pace'* and *'collaborate with other classmates and ask them for help'*. Some also talked of the value in knowing that their responses *'were not necessarily right or a wrong'*. For one student this meant that *'as there was no right or wrong answer'* she felt *'more free'* to express her opinions.

The Serious Games were most frequently used within a developed unit of work. Students would work independently or in groups on their game playing, which was often used as a starting point for a range of other activities that addressed specific learning needs and allowed students to extend their learning in areas of particular need.

Self Assessment

Students were also assessing their progress. In a class using Lure of the Labyrinth, for example, students worked through the various levels at their own pace, but were also self-evaluating their progress in developing their

maths skills. Rubrics were developed as a class, which led students towards writing their own goals, assessing themselves against the criteria and discussing the skills they were developing. They also worked with the teacher to develop graphic organisers which not only increased their incentive to achieve their goals but also meant that they were *'learning to identify and understand their learning'*. These students valued the opportunity to self-evaluate their progress: *'We need to visualise our thinking... it helps us to know how we are going'*. They also reinforced that *'it's OK to make a mistake – the more mistakes you make the more you learn and the better you become'*.

Collaboration

The opportunities for collaborative learning were seen by students, not only as *'fun'*, but also as beneficial to their learning. Over half of the students, across all strands, indicated that they were collaborating more in their Games-based Learning project, compared to previous projects.

In the Game Development projects, the teamwork needed to develop and then present their game at the showcase required *'lots of discussion and working cooperatively - we helped each other and worked together'*. This was particularly evident in one school (Case Study 6) where students, who only met *'formally'* once a week to work on their game, were communicating between sessions, via email, as they created, worked on and discussed the development of their game.

Students across the other strands also enjoyed collaborating via online spaces that were set up by teachers for students to discuss their progress and work together. In two classes using Serious Game, for example, a class blog provided the students with an avenue to share experiences, request and/or provide assistance and suggest new ways to approach the game. In one class, the teacher set up message board on which students could *'post'* (using *'Post Its'*) strategies they had used successfully, new ideas relating to the game or requests for assistance. These were then discussed as a class.

Students spoke of *'enjoying the challenges'* in the game. They were keen to persist with a problem till they found the solution, but they were also asking for assistance from their classmates when needed. Although they were working through their own game they saw themselves as *'part of a team'*. Their team mates were the first ones they would ask if they were *'stuck on something'*. This was done informally as they worked with each other in the classroom or it could be via the message board within the game, particularly when they were working at home on the game. *'We help each other because that way you can progress as a team'*. By explaining and discussing their answers with others, the students also felt they understood better. They also enjoyed the team tasks that were sometimes allocated *'because it helps when you are working together'*.

For the students using Quest Atlantis, connecting with and learning from others, both within and beyond the classroom, was seen as a valuable addition to their learning.

'I liked meeting and talking to the other people to gather information.'

'I could communicate with people that are in other schools.'

Knowledge and Skill building

Students listed a range of the specific knowledge and skills they had learnt through the games. Some also indicated why the games made this easier.

'It makes learning more fun than it is when we don't use games. I have learned more things about water and ph levels and stuff like that with Quest Atlantis.'

'Learning how to make your own independent games is the best thing because you can go away with skills that you can use for your own entertainment and learning.'

'You have to solve problems along the way so you learn more things about electricity, and how to control your own city.'

'Electric Box challenges your brain to solve each level and makes you think about what different strategies you can use.'

'You learn to solve problems learn to help others learn to make our own opinion.'

'I learn to read and understand properly, understand important parts and learn to answer the whole question.'

'I learned about how to keep water clean and how to test it and the activities got my brain working really hard to complete these tasks.'

'It encouraged us to think outside the box and to plan ahead.'

'Electricity taught us a lot about economics, and what makes a successful town.'

'We got to experience what it would be like to be a government. We learnt how to take care of our money.'

It requires you to think logically about what you are making.'

The Negatives

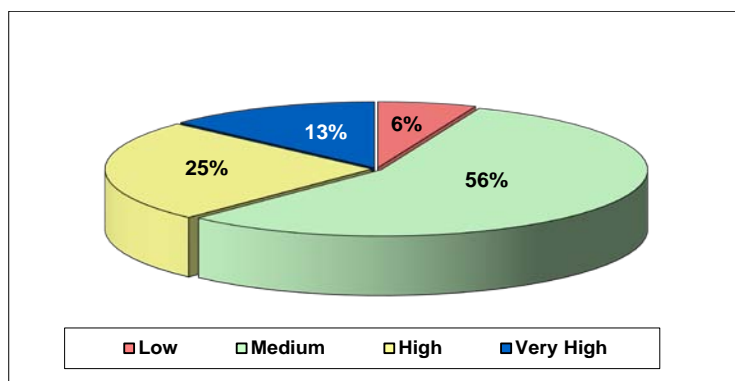
When asked to list the 'worst things' about using technology, many of the students did not respond. And some responded with a 'nothing'. However the most common response referred to the technical difficulties encountered, particularly in regard to Quest Atlantis which took a long time to load and would often 'freeze'. Also, a significant number of the students responding, indicated that they became '*bored*' when too much time was spent on the game although, in contrast, some students were concerned about the lack of time they had to play the game, given they only had access for a one hour session each week. A small number found the game '*difficult to play*' due to the amount of reading required.

The Principal Perspective

An interest in innovative teaching practice that engages students in their learning, the opportunity to build the capacity of their teachers and the teacher interest and enthusiasm in using games in learning were the main reasons cited by the Principals for participating in the Games-based Learning Trials.

The level of technology use and focus in their school prior to commencing in this project ranged between very high and low with most selecting medium.

Figure 7: Technology Use within school Prior to Games-based Learning



All felt that the Games-based Learning project implemented in their school aligned well with their school's Vision and Strategic Planning (53% to a large extent and 35% to a medium extent)

The factors that supported their school to participate effectively in the Games-based Learning trials included:

- The professional development provided for the teachers
- The energy and enthusiasm of the teachers involved
- Funding for teacher release and planning
- Funding for equipment
- Sharing of the learning with other staff to increase opportunities for school wide game based learning
- Opportunity for students to act as leaders and share their expertise
- Members of the school leadership team overseeing the trial
- Highly developed ICT skills of the staff
- A timetable structured to provide out of classroom time for ICT leader to work with other teachers and classes.

In response to the question 'What changes or developments in teaching and learning have resulted from your school's involvement in the Games-based Learning trials?' the Principals highlighted the increased skills and confidence of the staff involved but more frequently detailed the spread of learning and ideas across the remaining staff. This included:

Generation of interest and discussion around the role of games in learning

Expanded staff awareness of the range of applications for Games-based Learning

Teachers 'all on board' and actively seeking game based resources to support their inquiry units

Interest and discussion around the role of games in learning

Investigation of the application of Games-based Learning in a variety of curriculum areas

Greater breadth and depth of curriculum

Teachers more aware of student engagement through ICT

Teachers more eager to research ICT in classroom.

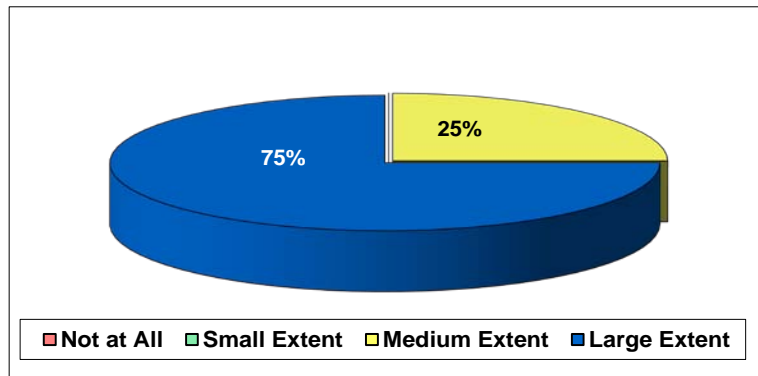
They also detailed the impact of the project on the students involved. These included:

- Students keenly interested in persisting with complex or new ideas.

- Self-directed learning for students
- Excellent development of high level thinking and communication skills in the students.
- An increase in student technology skills, reflective skills and language development
- Increased confidence and risk taking in students
- High levels of positive peer interaction
- Students keen to share their learnings
- Increased student confidence in their ability to work together to design and create a game and share it with others.
- Clear student engagement that is obvious to parents.

All responding principals are interested in implementing similar practices across their school in the future (75% to a large extent and 25% to a medium extent).

Figure 8: Principal Interest in using Games-based Learning in their school in the Future



Anticipated challenges included:

- Uncertainty about whether the time invested in the game and the project will have similar or greater benefit in terms of educational outcomes to the non - games approaches for covering the same skills
- Time management – acknowledgement that the teacher preparation for and involvement in their project was extensive, signalling that other teachers may also need this time to adopt Games-based Learning in their classrooms
- Ensuring that teachers are using the games for authentic applications in terms of the curriculum
- Being adequately prepared for an expanded use of games, with adequate technical infrastructure, equipment and support
- Ensuring that the parents are well informed about the rationale and the potential outcomes of using games in learning prior to extending their use across the school. The importance of doing this before commencing Games-based Learning was emphasised by one Principal who, in the early stages of the trial, had some parents expressing concern about the use of games in the classroom. With further explanation and observation of the benefits for their students they were both satisfied and very impressed.

Suggestions were also made in regard to what was needed to extend the activities in the future:

- Professional development for teachers
- Funding for teacher development and adequate technology resourcing to support the use of games in learning
- Further evidence of the cognitive impact of GBL on student learning
- Staff willingness to trial innovative practice
- A need to overcome the constraints of a secondary school timetable.

A final comment by one of the Principals highlighted the importance the school community placed on the trial and its outcomes

'It has been a very engaging project and other students have been 'watching' with eagerness. Parents have also been highly engaged with the progress of their child'.

Others added comments that reinforced the value of the project for their school and the prospect that the learnings from it would be built on:

'My staff is committed to the keeping our students at the leading edge in technology'

'This school can be isolated due to location and this links us up with other like-minded schools improves student and teacher engagement increases ICT skills'

'It has had a positive impact on the students and has opened a whole new perspective of what is possible. It has been a motivating experience for all involved'

'It has made us think differently about how we can personalize our programing with kids'.

'I would like to see program expanded so all children in a level are involved'

6. Circumstances Influencing Implementation, Outcomes and Sustainability

For the majority of the teachers involved in the trials, the use of online games in the classroom was relatively new. As detailed above, most now feel that Games-based Learning has enriched their teaching practice and changed the way their students learn.

The trials involved substantial support for the participating teachers in the form of funding for equipment and teacher release time and access to a range of professional development, expert advice from DEECD personnel and DEECD technical support where needed. Over the project period, teachers were also able to collaborate, discuss progress and share ideas and practical information via a Ning and through Web conferencing Sessions.

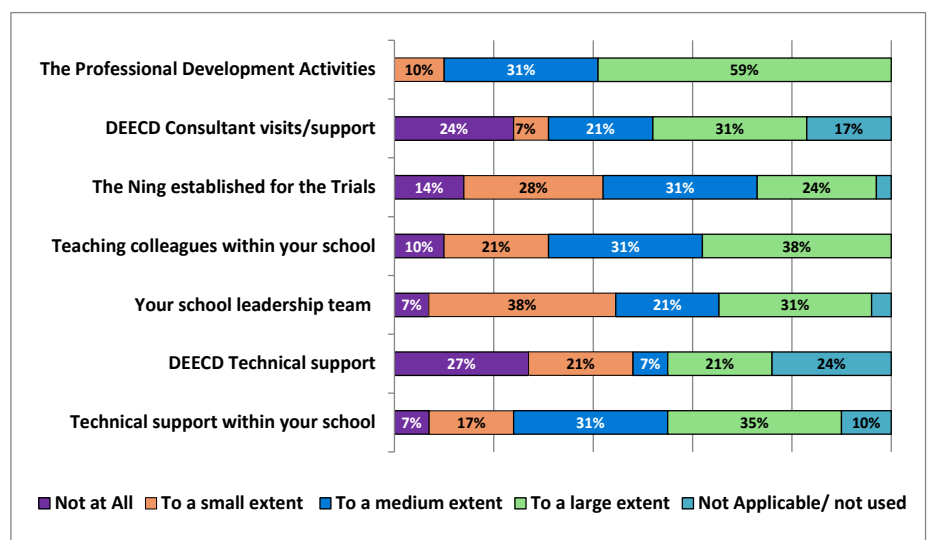
The extent to which these and other factors influenced the outcomes of the trials provides insight into factors that are most likely to support and sustain the successful implementation of Games-based Learning in the future.

Professional Development, Support and Sharing

Overview

The value of the various forms of support provided during the project is shown in the graph below. The graph includes teacher responses in regard to support at a system level and at the school level (principal, technical personnel and fellow teachers). Some teachers did not access the support, but the majority of those that did generally considered the support to be valuable (selecting to a large of medium extent). Areas with notable lower ratings included DEECD technical support, school leadership and the Ning. Further details on the value of the support were provided in the teacher survey and interview comments discussed below.

Figure 9: Value of the Support Provided



Professional Development

The professional development provided over the project was rated highly and appreciated by a strong majority of participants. It was specifically targeted to meet the specific needs of teachers within each game strand.

The Induction

The joint activities at their Induction Days *'excited'* and *'inspired'* the teachers, providing them with new ideas and resources. For example, they commenced the development of rubrics that would guide the structure of the learning and be used to assess the learning outcomes of their students. They were also involved in discussions and hands on activities relating to their game strand, which further highlighted the possibilities and assisted them to consolidate their project plans.

Those in the Serious Games trials, for example had the opportunity to explore and discuss a range of different games available, increasing their understanding of the potential of these games and assisting them in their decisions on which to use and how to integrate them more effectively into their curriculum. Both the facilitator of Quest Atlantis and a teacher who had used the game extensively in his classroom spent time with the teachers who had selected Quest Atlantis, explaining the requirements and discussing the ways in which it can most effectively be integrated into teaching and learning.

For those in the Game Development strand, their induction day was the first of three full days in which they had 'expert input' from industry game developers. This was considered highly valuable, providing insight into the nature of games and the processes involved in their development. The structure of the learning that took place in these sessions, as well as some of specific activities they participated in, also modelled strategies for introducing the concepts around Games Development to their students.

Further Professional Development

Opportunities for professional development continued across the three strands. Teachers in the Game Development strand completed two more full days with the Game Developer. Those using Quest Atlantis were required to attend the targeted online professional development sessions prior to using it in their classroom, while teachers in the Serious Games Strand were provided with a web conferencing session in which a University Professor with extensive expertise in Games-based Learning shared her research and knowledge with the teachers.

The professional development days conducted *'outside of their school environments'* were, as described by one teacher *'invaluable'*. In particular, the full day sessions for those in the Game Development strand contributed substantially to the success of these projects:

'The workshops that we attended were monumental in helping to guide the teaching for this program. They provided a solid foundation that we could use to build upon and we were able to model our sessions based on the journey that we took in the workshops'.

Teachers in one school referred to them as *'daunting'*, but *'incredibly valuable'*. As detailed in Case Study 5, they felt the thinking and discussion that stemmed from the range of activities was *'amazing'*. Without the professional development, they *'would never have understood'* the potential of Game Development in teaching and learning. They also came away very comfortable in their knowledge that the development of games literacy would be central to the students' learning, not the game itself.

Another teacher participating in these workshops had also found them both *'very helpful and inspiring'*, but she *'felt a bit isolated upon returning to school'* and would have appreciated a follow up visit *'just to see if we were on the right track'*. Also noted by several Game Development teachers, was the need for additional information and advice on the Game Development Software.

Online professional development was provided for those involved in Quest Atlantis. These compulsory professional development modules were, overall, considered very valuable but some comments indicated that undertaking the training as a group did not necessarily meet the needs of all participants. Although realising the need to *'foster a supportive learning environment for a variety of teacher ability levels'*, one teacher commented that, because she was *'a self-directed learner'*, the pace of the sessions seemed *'particularly slow and frustrating at times'*, adding that she could have *'run through the training modules much faster working solo'*. For some other teachers who were very new to this form of online learning, the professional development was seen as valuable but initially overwhelming, although with further exploration between sessions they soon found it *'a lot more user friendly'* than they thought it would be.

Web conferencing sessions provided further online opportunities for participants across all strands to discuss and share ideas and receive input from Games-based Learning *'experts'*. Although generally valued by those who attended them, there were some respondents who commented that online professional development, although convenient, was not as effective because, for example: *'There are many distractions within school (and outside of it) that limit the effectiveness of the online forms of communication'* They saw the face to face time as the most effective form of professional development.

DEECD Support

Many participants acknowledged the high level of communication and support they received from the DEECD Project Leader. Several survey comments also highlighted the value of the individual support she provided via phone and email, when specific participant or school needs and issues arose.

The input from the DEECD Innovation Leader was also considered most valuable. Although not able to visit all schools, those he was able to visit greatly appreciated the help and support they received:

'I found the face to face visit really helpful and useful'

'It was very worthwhile, it added to student enthusiasm having someone different, "an expert" in their eyes, coming to work with them. I also appreciated his input and expertise'

'It was most valuable in regards to supporting me in the implementation of GBL - helped me to make sure I was on the right track with assessment'

'It was a great motivating factor. It helped us to know that we were on the right track as well as helping us to narrow our focus and plan our next steps'

Ongoing Interaction and Support via the Ning

The Ning provided a forum for sharing ideas and gaining information. Both the DEECD Project Leader and Innovation Leader generated discussion and provided resources through the Ning. Over half of the participants found it a valuable to a medium or great extent. Some spoke of the value in hearing from others about their trial and they also appreciated the ideas that were shared and the sources of information provided.

The extent to which a range of participants were contributing to the Ning, however, was low and therefore it did not become as interactive as it might

otherwise have been, possibly accounting for the number who rated its value lower. One teacher, for example, commented that she was not using it as frequently in the end as *'there was little written regularly by the participants'*. Another, however, commented *'on looking back' I should have used the Ning more than I did'*.

It is noted, however, that the Conclusion Forum, which involved sharing experiences and ideas based on the learnings over the project period, renewed participant interest in continuing the Ning. It is now being seen as a way to retain the connection with others, enabling teachers to share ideas, new development and resources around Games-based Learning and other innovative teaching and learning practices.

Technical Support

A range of technical issues hindered some of the projects. These were typically dealt with at the school level, but DEECD technical assistance was also in place for schools in the project that required it.

The issues related to the technology infrastructure and equipment within the school, in particular the capacity of the server, restrictions in its use and the age and availability of computers.

Not all problems could be addressed over the project period:

'Inadequacies with the school network were the greatest blocker to the success of this program. A new network is on the way! Graphics cards on older machines also were not up to the demands of the program'.

We had major technical issues with running QA in MACS and we finally were able to have a site visit which helped. The platform was not ideal to run it on but it was OK.

One respondent commented that 'a lot of the websites we wanted to use were blocked (gaming sites, YouTube) and that made things difficult at times, so support in that area would have been good.'

However, in most schools the issues were eventually resolved, although this often delayed their commencement or altered the outcomes of their project.

'We were very happy with the prompt support from (the DEECD Technical support) - even though our issues were not completely resolved'.

'Getting the games installed was a nightmare. Still, we got there in the end!'

'Due to initial technical glitches, we had to start later than expected to allow time for the technicians to deal with the problems'.

At the end of the project, suggestions were made by some of the teachers in regard to what may have been helpful. Most common was from teachers in the Game Development strand, who highlighted the need for clearer guidance on the different software programs to select and some professional learning on using this software.

School Based Support

The support and encouragement from the principal and the fact that they allowed teachers to *'take a risk and have a go'* was for some of the teachers a key factor in the success of their project. Collegial support and interest from teachers at their school who were not involved was also appreciated and this was often the result of the Principal's willingness to highlight the activities and the outcomes with the whole staff.

In many of the schools, the projects were undertaken by a team of two or sometimes more teachers. This was seen as a significant contributor to their success, particularly as each brought different strengths to the project. In many cases the team included an ICT coordinator and a classroom teacher:

'I was lucky to be able to team teach this class for this trial. The most helpful thing was to have someone close to me also trying to figure things out. We could bounce ideas off each other and together we never felt like we were lacking in IT'.

'In so far as the technical side of things, I am thankful that my colleague had knowledge of which program to use. I think that without that I would have struggled to know exactly how I was going to get the students to actually create a game'.

Others developed and worked on the project themselves but were typically given strong support from their leadership team and their technical support team. In contrast, a small number of teacher comments indicated that some of those involved felt *'isolated'* or believed there was a *'lack of interest'* at the school in relation to the work they were undertaking .

Embedding Games-based Learning in the Curriculum

The extent to which the teachers were able to embed the use of games in their curriculum influenced the extent to which the activities were valued by teachers, principals and parents. Although the teachers had applied to be involved, with broad ideas of their approach, the joint activities at the Induction Day inspired them with new ideas and resources. The planning of rubrics, for example, that would guide the structure of the learning and be used to assess the learning outcomes of their students was commenced and discussions and hands on activities for each strand highlighted the teaching and learning possibilities that helped them establish their approach.

Those using Serious Games were embedding the game into a unit of work. In one school for example it was central to a comprehensive unit on leadership and government which included a range of activities across different learning areas. In other classes the game chosen allowed them to focus on Maths, the environment or historical eras. Particularly evident across these projects was the extent to which teachers developed activities around the game that would enrich the learning outcomes for the students.

Similarly, Quest Atlantis formed the basis for the study of broad areas such as 'Space' and 'Endangered Species' but also opened opportunities for the development of a range for skills development in, for example, reading, writing, communication and problem solving.

Game Development involved students in the development and application of new ICT skills and understanding but also extended their problem solving and creative thinking skills. Showcasing their games at the end of the project provided new and very significant opportunities to develop skills and understanding around, for example, communicating for a purpose.

This capacity of the teachers involved to understand the scope of Games-based Learning, recognise and plan for a range of possible learning outcomes that could be generated through Games-based Learning and then implement these strategies successfully in their classrooms, resulted in a broad and rich range of learning outcomes for their students. It also reinforced that the value of the games extended well beyond being *'just a way to engage students in their learning'*.

7. The Future of Games-based Learning in Teaching Practice

Extending Games-based Learning in the Trial Schools

All responding teachers intend to continue using Games-based Learning in their teaching practice in the future. Some are already planning units for the coming year. Many plan to look at new ways to integrate games into their lessons or are looking at using games in different ways that will extend their students learning further.

As indicated in the comments below, many believe that the Games-based Learning Project provided them with new insight into effective teaching and learning and has changed the way they will teach in the future. For example:

'It has given me a platform for future direction of integrated curriculum. ie. using a game to drive experiences for students and then drawing on concepts from the game to teach the students'.

'I will continue to use games as a vehicle for continued exploration and discussion rather than playing games in brief sessions and moving on. Games that have a narrative context provide a motivating setting for learning through exploration'.

'My personal teaching style is probably more control and 'up front' driven. The use of games has shown me that students are quite capable of engaging with complex themes, issues and technology, and that games based applications are a great way to move towards more student centred and driven education'.

'Using a Serious Game has made me more aware of how quickly a tool such as this can change the teaching dynamic from a teacher led approach to a student driven model for the delivery of education'.

'I have noticed that now I reflect on my other classes and ask myself if I am giving my students content to learn or am I also teaching them to learn. I am now conscious of how I can integrate several skills into one class. I enjoy trying to think of ways that will encourage my students to think for themselves and not simply rely on the teacher for answers'.

'The GBL has been a fantastic eye opener for my own teaching. I am using more ICT in my teaching and will only look to increase my use in the future. The GBL has engaged the students more than anything I have tried to implement in the past and it has empowered them to take control and teach each other'.

Across all strands, teachers have new ideas for **using Games-based Learning in the future**. One teacher, for example, hopes to trial game development with an entire year level rather a smaller group of advanced learners. He is interested in seeing *'how the lexically dense nature of the text affects students with literacy weaknesses*. Others involved in game development also intend to continue, some using different software programs. A teacher using serious games feels she now has a clearer plan in regard to *'how to proceed step by step, outlining these steps with the students so that they maintain focus and are able to more effectively drive their own learning'*. She will also incorporate more graphic organisers and thinking tools in the planning and reflecting stages. Another teacher plans to collaborate with an

international school in Quest Atlantis, undertaking a global project and another is planning to incorporate gaming literacy into the literacy program at their school.

Extending Games-based Learning beyond the Trial Schools

Extending the very positive outcomes from the Games-based Learning Project beyond the trial schools requires consideration of the various factors that influenced success and the extent to which they can be replicated on a larger scale. The planned sharing of digital stories and case studies that were generated through the project period will assist in inspiring and informing teachers who are contemplating Games-based Learning, but more would be needed to achieve the types of outcomes that resulted from the trials.

Developing Teacher Understanding and Confidence

The professional development required for both Quest Atlantis and Game Development was substantial. It is a requirement of Quest Atlantis and was considered important for Games Development in order to assist teachers understand the scope and depth of learning that can be generated through the activities. Quest Atlantis training is accessible to those teachers wishing to use the game in their classroom in the future. But for those taking on Game Development, the professional development undertaken by the Game Development trial teachers is not easily replicable, even though the teachers involved believed it strongly influenced the outcomes of their trial. Ways to pass on the ideas from this professional development need to be considered.

Encouraging the trial teachers across the three strands to continue sharing their knowledge and ideas and their documented plans and strategies (via the Ultranet, FUSE or dedicated blogs, or face to face activities) could support and build on a growing interest in and understanding of Games-based Learning. Teacher visits to schools that were using the Games-based Learning might also be possible within clusters of schools.

Increasing Technology Support

Setting up the Games provided challenges in some schools, although in most cases these were addressed over the trial period. Documenting and making available the requirements for schools who are taking on Games-based Learning would enable both teachers and their ICT support teams to understand and better prepare for the technical requirements of the games.

Generating School Community Support

Most Principals and participating teachers felt that the project had raised the interest of other staff members in the school, who were seeing the potential of Games-based Learning across other learning areas. Parental interest and support was generally positive, although in some schools Principals and teachers reported that concerns were being expressed by some. Most Principals now recognise the importance of better informing parents about the rationale for Games-based Learning and providing them with strong evidence of the learning outcomes that were being generated through these games.

Recommendations

Based on the findings from this evaluation, the following recommendations are suggested in order to generate further interest and action in regard to Games-based Learning:

Raising awareness and showcasing the activities stemming from the Games-based Learning trials through:

- Publication of the digital stories and case studies on relevant DEECD websites
- Inclusion of Games-based Learning Sessions, led by selected teachers from the trials in conferences, networking activities and other relevant forums
- Distributing information on the Games-based Learning trials to Regional Managers and Consultants
- Raising the profile of Games-based Learning in relevant Principal Forums
- Distributing information on the Games-based Learning trials to institutions involved in Teacher Education.

Informing and supporting those interested in using Games-based Learning through:

- Continuation of the Ning – looking at ways to encourage further input from the trial schools, particularly as they develop new ideas for implementing games in their classrooms, and also ways to attract further interest and input from a broader range of teachers
- Conduct of professional development (online or face to face) for teachers interested in specific Games-based Learning strands. This could be conducted by teachers involved in the trials. Game developers might also contribute to sessions on Game Development
- Documenting and making available the successful strategies and requirements for effective integration of each Games-based Learning strand, including sample unit plans and equipment required
- Encouraging teacher visits to schools that were using the Games-based Learning
- Providing principals with advice and information that will assist them to gain support for Games-based Learning from their school community.

Increasing Technology Support through:

- Documenting and publicising the specific Technical Requirements for implementing the different Games-based Learning strands
- Providing a central contact for gaining technical information, advice, and assistance related to Games-based Learning.

8. Conclusion

The Games-based Learning Project has been implemented very successfully across a wide range of schools. It has resulted in significant changes to the way teachers teach and the way students learn. In addition, it has provided insight into factors that have influenced the extent and nature of these changes and what is required to build on and extend the learning across a broader range of schools in the future.

As one teacher highlighted, the impact of the trials can be seen not only in the student learning outcomes that were generated through the project but also in the way teachers will rethink the structure and management of learning in their classrooms in the future. She is *'absolutely thrilled with the outcomes and the future direction of learning'* that this Games Based Project has created.

Importantly, there is now a cohort of teachers who are equipped and very keen to continue the use of Games-based Learning in their classroom and share their ongoing learnings with other teachers in their schools. There is also scope and sufficient enthusiasm across the trial teachers to further extend this new knowledge and understanding, through online collaborative learning spaces, support networks, and conferences, so that a broader range of teachers across all levels will have the confidence to try Games-based Learning in their classroom. As indicated in the comment below, informing and supporting teachers can lead to significant change:

'I went into this trial quite hesitantly as I really didn't know what I was in for! I am not a major game player, not a programmer, not an ICT 'geek', but the entire process has been extremely valuable and rewarding. I have connected and engaged with my students in a completely different way and have built relationships with those kids who would have been labeled 'difficult' to teach. It has been really rewarding - and fun!'

Appendix 1 – case studies

CASE STUDY 1: Fitzroy North Primary School

CASE STUDY 2: Epping Views Primary School

CASE STUDY 3: North Geelong Secondary College

CASE STUDY 4: Deepdene Primary School

CASE STUDY 5: Meredith Primary School

CASE STUDY 6: Athol Road Primary School

CASE STUDY 7: Boneo Primary School