COLLABORATIVE HANDHELD GAMING IN EDUCATION

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Abstract

This project describes the trialling of a new form of cooperative learning strategy, in the form of a game known as EcoRangers. EcoRangers is a multi-player game, designed to run on handphones, written specifically for education. EcoRangers is one of the first, if not the world's first, instances of this totally new genre of pedagogical tools (ie, collaborative handheld educational games).

In its current iteration, EcoRangers is designed to help pupils practise skills of relevance to the Upper Secondary Social Studies syllabus, specifically through the pedagogical strategy known as the Structured Academic Controversy, in which learners debate an open-ended problem from a variety of perspectives.

The trialling was done in Fuchun Secondary School, among twenty Secondary Three pupils from the Express stream. These pupils were taken through two distinct fieldwork tasks in March and April 2004, with the game being introduced as part of a post-fieldwork activity.

Key definitions and review of literature

One of the primary theoretical constructs underpinning the research would be Pea's idea of 'distributed intelligence' (described in Perkins (1992)). To quote Perkins,

> people think and remember with the help of all sorts of physical aids, and we commonly construct new physical aids to help ourselves yet more. People think and remember socially, through interaction with other people, sharing information and perspectives and developing ideas … People sustain thinking through socially shared symbol systems – speech, writing, the technical argot of specialties, diagrams, scientific notations, and so on. (p. 133)

Perkins develops the idea further by elaborating on three ways in which intelligence can be distributed; namely physically (describing the gamut of student output from completion of traditional problem sets, to journals and portfolios, to simple programming and desktop publishing), socially (co-operative learning), and symbolically (for example, through diagrams & charts, mental maps, and role-play).

The germ of these insights was planted in Vygotsky's cultural-historical theory of activity, first formulated in the 1920s, in which the relationships between human agents and objects in their environment are mediated by culture, tools and symbols.

These same notions of "culture, tools and symbols" are implicit in Perkins's writings. Both Vygotsky and Perkins were remarkably prescient, considering that both had developed their ideas before the widespread adoption of the worldwide web

as a medium of information exchange and collaboration (let alone more contemporary technological developments such as the mobile internet).

Perkins's contemporary at Harvard – Putnam (1993) – brings to the present discussion the term 'social capital'. This refers to social networks which go beyond traditional familial ties and connect friends and strangers for mutual benefit. Social capital is therefore the basis of collaborative behaviour.

The basic unit of social capital is information, defined by Boeck (in press) as "material which is selected by individuals to be transformed by them into knowledge to solve a problem in the specific social domains to which they belong". In the study, the 'problems' in which the students found themselves are described through what Johnson and Johnson (1979) term 'Structured Academic Controversies'.

Defined as the "deliberate stimulation of intellectual conflict by creating a highly structured situation wherein one student's ideas, information, conclusions, theories, and opinions are incompatible with those of another, and the two seek to reach an agreement by engaging in Aristotlean 'deliberate discourse'" (Johnson, Johnson and Smith (1997)), such Academic Controversies permit investigations of the social distribution of intelligence, by building on traditional models of debate and encouraging participants to reach shared consensual values.

Such investigations exemplify Habermas's (1981) concept of 'communicative action' – defined as 'the use of language with an orientation to reaching understanding. Defined thus, Myerson (2001) explains that communicative action is shared action – such 'small-group engagement' is the 'process by which people come to an understanding about something'.

The study sought to apply the principles behind the design of Structured Academic Controversies to learning environments in which the protagonists were not necessarily co-located.

Background to the intervention

EcoRangers was originally commissioned as part of my doctoral research on the semiotics of adolescent understandings about their environment. In June 2003, I approached the School of InfoComm Technology at the Ngee Ann Polytechnic to investigate collaborative opportunities with regards to using handheld technologies in education. Later that same year, the polytechnic assigned Jason Wang as the programmer for the game. Jason's programming task would constitute his Final Year Project submission, in fulfilment of his diploma requirements.

Within six months, Jason had completed the first iteration of EcoRangers, and this was just in time to be trialled by some pupils of Fuchun Secondary, through the generous facilitation of the Principal - Mrs Chuah-Koh - and HOD (Humanities) – Mr Zainudin – in April this year.

The twenty pupils who trialled the game had earlier been split into five groups, with each group being taken to a different location in Singapore to conduct two distinct fieldwork tasks. First, they had to do an orienteering activity, and on a

subsequent day, having been familiarised on the prior visit with the neighbourhood, they participated in a field-based debate at the same location, in which they had to explore the area to gather photographic evidence to support or refute a given point-of-view. The students recorded these pieces of evidence pictorially, using the phones, and exchanged these pictures in real time while still in the field, physically separated from each other. Students used the evidence to explore given geographical issues regarding the bounded area, in the format of a Structured Academic Controversy.

Specifically, the field-based Structured Academic Controversy task comprised the following steps:

- Each team was made up of two pairs of students. Both teams were given forty-five minutes to explore a well-delineated area, with a view to gathering pictorial evidence to support a certain point-of-view. Pairs of students from the same team were encouraged to share their findings with each other, via multimedia messaging (MMS);
- For example, teams could have been tasked to investigate the extent to which a particular neighbourhood was meeting the needs of residents of public housing;
- After the initial time-period was over, both teams were given time to engage in a dialogue along the lines of a Structured Academic Controversy. This dialogue did not take place through face-to-face interaction, but through an exchange of text- and picture-messaging, allowing the nature of the discourse to be easily archived for subsequent analysis.

The trialling of the EcoRangers game itself was conducted back in the school, on an occasion subsequent to the field-based Structured Academic Controversy. Therefore, EcoRangers represents probably the first successful transposition of the tried and tested method of the Structured Academic Controversy to a multi-player handheld gaming environment. It achieves this by dividing the gameplay into various stages.

The stages, and how they are differentiated, are as follows (the terms 'host' and 'client' refer to one or other of the two players):

1. Exploring the environment
   At this stage of the game, both players explore the virtual environment, looking for nuggets of information to either support or refute their assigned perspective on the given topic of debate. At this stage of the game, neither player can send messages to each other.

2. Presenting host's initial perspective
   During this stage of the game, the host is allowed to present his or her initial perspectives on the given topic, by composing and sending messages to the client. The client, at this stage of the game, cannot reply, but can only receive the messages.

3. Presenting client's initial perspective
   During this stage of the game, the client is now allowed to present his or her initial perspectives on the given topic, by composing and sending messages to

the host. Just as the client was unable to reply during the previous stage, for this stage of the game, it is now the host who cannot reply, but can only receive the messages.

4. Debating the issue
   During this stage of the game, both players are able to send messages to each other. In this way, the debate progresses and their ideas and perspectives are refined, through careful analysis from both players.

5. Presenting host's reversed perspective
   This stage of the game (and the subsequent stage as well) are critical to the learning experience for both players, for this is when they are required to reverse perspectives. During this stage, the host is required to select and adopt the best arguments from the client, and now argue them as if they were his or her very own. The client cannot reply, but can only receive the messages.

6. Presenting client's reversed perspective
   It is now the turn of the client to reverse perspectives. At this stage of the game, the host cannot reply.

7. Consensus building
   At this final stage of the game, both players are able to send messages to each other, with the aim of building a consensus regarding the given topic of debate. Once the game has ended, both phones can then be given to the teacher for review of the quality of the messaging exchange that took place within the thirty minutes allotted.

Enhancing teaching and learning through collaborative gaming

As can be seen from the above description, one of the primary objectives of developing EcoRangers was to give pupils the opportunity to practise, with minimal supervision, the strategy known as Structured Academic Controversy.

Another very important objective of EcoRangers was to help pupils realise the importance of cooperative learning as a strategy for approaching open-ended problems.

A third objective of EcoRangers was to present pupils with authentic problems which necessitated an inquiry-based approach.

Finally, EcoRangers was designed as a vehicle for demonstrating how the various initiatives that have been introduced by the Ministry of Education over the past seven years might possibly be manifested in a coherent way.

The strategy of the Structured Academic Controversy is of great value to the Social Studies syllabus in its promotion of an appreciation of multiple perspectives. Traditionally, Structured Academic Controversies have demanded much time and planning on behalf of the teacher, as well as in terms of the logistics of organising a debate between an entire class. By distilling the strategy to its most fundamental

defining characteristics, EcoRangers permits learners to practise this valuable skill, at times and places of their own choosing.

With regards the objective of promoting cooperative learning, too often, pupils perceive the tasks and problems that they encounter as having clear-cut solutions to be approached in a binary ('win-lose') manner. By emphasising the value of sharing the data collected, as opposed to hoarding the information to themselves, pupils are subsequently able to appreciate that the sophistication and validity of their arguments often rest on a sharing of perspectives and information which they would not otherwise attain. Because EcoRangers is played via a wireless Bluetooth connection, players are not tethered either to each other or to a desk, and are free to move around during gameplay to suit their comfort level.

Third, with regards the use of authentic problem-based learning, an example of a possible topic which pupils might be presented with regarding the virutal gamespace of EcoRangers would be the extent to which limited government resources should be spent on developing major infrastructural projects (such as an airport) as opposed to the conservation of a wetlands habitat. Pupils would need to decide for themselves which pieces of information were relevant to the issue, as well as to prioritise between the search for more data and the consolidation of information already at hand. The technology enhances the teaching and learning experience because the pieces of data that the pupils collect in the virtual gamespace is easily customisable to the needs of learners of various profiles, as well as content interests.

Finally, with respect to addressing recent initiatives, the game allows for the ready infusion of messages of National Education and concepts in Economic Literacy, by its present focus on issues pertaining to the socio-economy of the virtual gamespace; players have to exercise both critical (analysis and prioritising) and creative (perspective-reversal) thinking skills as they work their way through the game; players are also encouraged to take considered risks during gameplay, with respect to the balance between available resources and potential discoveries. It is our belief that by pushing the pedagogical and technological envelope in so many of the above ways, EcoRangers reflects the very spirit of innovation and enterprise in education that we seek to foster in our students.

Documentation of experimentation and evaluation

EcoRangers was trialled during the week of 19 to 23 April 2004. On each day, two pairs of pupils were selected to play the game. Each pupil was given a Nokia 6600, and was tasked to play against the other member of the pair. As such, each pair played the game concurrently and independently from each other.

The number of messages exchanged was typically low. Several factors account for this apparent lack of demonstrable success of the trial. They are elaborated upon below.

This was the first field trial of EcoRangers. Due to constraints of the school calendar (most notably the mid-year examinations), the next opportunity for EcoRangers to be played by a similar number of pupils was in mid- to late-June, in another school. A very short time elapsed between the availability of a stable

iteration of the game, and the scheduled session in the computer lab (the pupils had been rostered months in advance, to facilitate planning and minimise clashes from the school's point-of-view). Thus, it was not possible to incorporate last minute suggestions and feedback into the iteration of the game that was given to the pupils to play. Specifically, suggestions as to the density of occurrence of the nuggets within the virtual gamespace, the difficulty of replenishing the avatar's energy levels, and the difficulty of navigating to different sub-regions of the gamespace, have since been improved in the current version of the game, with consequent increases in pupil interaction.

The small number of messages typically exchanged was also because of the limited amount of time available to each player to compose messages. This, in turn, was limited by the turn-based nature of the Structured Academic Controversy format. That is to say, within the thirty-minutes of gameplay that the current iteration of EcoRangers has, only a third of that time is available for messaging one's game-partner, and therefore it is not surprising that the most number of messages sent by any one player, during the trialling, was only four.

It is, of course, recognised that the above-mentioned durations are entirely arbitrary and are subject to the full control of the game designers. However, we initially chose to adopt the thirty-minute duration (including ten-minutes for messaging) because it was felt that thirty-minutes would be just at the limit of an adolescent's attention span with respect to playing a single game. Based on the experience of observing the twenty pupils in the trial, a case might be made for extending the total game duration in subsequent iterations of EcoRangers.

It is important also to stress that, despite the paucity of the number of messages exchanged, there were some instances which demonstrated that the pupils were trying their best to work their way through the various stages of the Structred Academic Controversy format. Given the above constraints and circumstances of the trialling, we find these examples especially encouraging.

Feedback was also sought from pupils after they played the game. Most of their concerns centred around the afore-mentioned difficulties. These difficulties relate not to structural problems of the game, but to relatively-easily-addressed superstructural issues (that is to say, increasing the density of nuggets of information, replenishing energy, and increasing opportunities for inter-regional navigation, are all easily addressed by tweaking the respective algorithms). We remain confident that the basic structure of EcoRangers is not only sound, but inherently flexible and adaptable to incorporation into other subjects and at other echelons of the formal education ladder as well.

Pupils were generous with their positive feedback. Typical comments were "the game gave me an understanding of topics taught in social studies and geography. For example, I learnt more about tourism and how to attract visitors to the country."; "the game helped me to see different points of view. It was also helpful in letting me understand social studies better."; and "I not only honed my debating skills, but also got the opportunity to apply geographical and social studies concepts that I had learned, to make my case stronger."

Acknowledgements

This project would not have been possible without the complete commitment and co-operation of two institutions.

First, I would like to thank the School of InfoComm Technologies of the Ngee Ann Polytechic. Specifically, we are very grateful to the School's Director – Ms Angela Wee – for nominating final-year student Jason Wang to be the programmer for EcoRangers.

Second, the staff and students of Fuchun Secondary School have been extremely supportive of this project. My thanks go to them as well.

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Appendix – Transcripts from the trialling of the game

Date:	19 Apr

Topic: "The most urgent need that this area has, is for a health care programme that works."
Beng Kit (0010); Kartini (0013)

0010	0013
Rubbish all over the park	Rats are found in farms
There are not many shops in the park	Flies are spreading dieases
There are many pests at the industrial park	There are plenty of hospital
This city is unhygenic	

Date:	19 Apr

Topic: "This area would benefit greatly from the immediate construction of a large international airport."
Andre (0037); Zufarhan (0300)

0037	0300
There are many snatch theives so it's not that safe for tourist.	
Locals know more about other countries because of tourists.	I like the point where you said that locals learn from other tourist
	There are many people dying of HIV. Many people don't want to come.
Percentage of people who engage in tourism is increasing.	The hawkers increase the price of their local food because of tourists
So we have to build a new airport.	The airport is fifteen hours away

Date:	20 Apr

Topic: "This area would benefit greatly from the immediate construction of a large international airport."
Rafina (0010); Asri (0013)

0010	0013
This place has a lot of crime	The tourists help the people a lot
This place is not good	There are a lot of houses here

Date: 20 Apr

Topic: "This area has no choice but to start developing immediately its mineral resources."
Peck Sin (0037); Wei Lian (0300)

0037	0300
Uranium is deep underground	Water polution causes fish to die

Date: 21 Apr

Topic: "The most urgent need that this area has, is for a health care programme that works."
Theeban (0010); Hisyam (0013)

0010	0013
	Drains were clotted with rubbish which could affect the health
They also need medical facilities to help them prevent the AIDS disease	
I think they realy need medical facilities because there are a lot of mosquitoes that spread malaria	

Date: 21 Apr

Topic: "This area would benefit greatly from the immediate construction of a large international airport."
Samantha (0037); Elwalid (0300)

0037	0300
It is suitable to make an airport for the local and tourist	Don't build an airport here!! Because there are endangered species and theft!!
People here mostly die of HIV/AIDS	They have learnt about each others' way of life so that makes them cultural.
Local people learn more about other countries now	It's not good to build an airport here as there is theft, lead poisoning and people here are workers and are uneducated.
	Lead poisoning, endangered species, snatch theft is very common.

Date: 22 Apr

Topic: "Nature has not been kind to the citizens of this area."
Intan (0010); Sairam (0013)

0010	0013
Nature has not been kind to the citizen because some of the disasters may have killed many people!	I do believe that nature has not been kind to the citizen as there have been earthquakes
	In a sense nature is kind
	After the earthquake tourists prefer to visit the hot spring areas

Date: 22 Apr

Topic: "This area would benefit greatly from the immediate construction of a large international airport."
Jianle (0037); Jingyi (0300)

0037	0300
The airport wil help to increase tourism and economic growth.	The airport causes air pollution and the money needed is large
Then the pay may not be so good because the city is polluted and has high crime rate so no tourists will come to the city so the airport is useless when no one is using it.	
A foreign company wants to build a theme park, so there will not be enough land to build airport.	Theme park so useless and cannot help in the economy of the country. The airport can also help to increase the tourists visiting the country and help the increase of money earned
	People want to have high pay so the airport can help to increase the pay

Date: 23 Apr

Topic: "The construction of a theme park would benefit the citizens of this area, more than the development of ecotourism."
Qiwei (0010); Genevieve (0013)

0010	0013
This evironment is quite good	Good? In what sense? Wouldn't an eco park bore the tourists?
	Many tourists...usually people who go on holiday would surely play,who wants to visit eco parks..

Date: 23 Apr

Topic: "This area would benefit greatly from the immediate construction of a large international airport."
Rongwei (0037); Tungsiang (0300)

0037	0300
Building an airport at the city will allow people to reach there easily	
	We conclude that is a waste of money and space
	I don't think that citizens will benefit . by building an international airport . we can use the sum of money for other purposes like for education . so don't waste that sum of money