Using interactive television to enhance authenticity in K-12 REALs: Two case studies

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Abstract: In this study, we examined two distributed learning environments that used interactive technology to enhance authenticity in Rich Environments for Active Learning (REALs). One case study used interactive television to connect a rural, an urban, and a suburban class together with community resources in a design education setting. In the second, interactive television was used to support a problem-based unit that connected students with internationally recognised experts in engineering. Specific findings from each study are reported, with recommendations for improving each educational model. The authors synthesise the findings from these two studies, finding that interactive television was a useful tool for breaking traditional classroom barriers. Interactive television allowed the instructors to connect students to authentic communities of practice. Implications for how others might use experts in the classroom, and for how we ought to conceptualise technology are explored.

Keywords:

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Biographical notes:

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1 Introduction

Many educators are increasingly acknowledging the social nature of nature of learning, favouring learning environments that situate learners in rich, complex, authentic contexts [1–3]. Grabinger’s model of Rich Environments for Active Learning (REALs) [4,5] synthesises much of the current work being done using technology to support student-centred learning, providing educators with a useful framework for understanding and designing student centred learning environments. Predicated on constructivist learning theory, Grabinger’s model of REALs examines many approaches to student centred learning, extracting principles for designing REALs [6–10].

Grabinger [5] suggests that technology might play an integral role in supporting the design, development, and implementation of REALs. Many educators have begun exploring the use of distance learning technologies to overcome traditional classroom barriers which inhibit the use of community resources in the classroom [11,12]. In doing so, it is hoped that learning might transcend the walls of the classroom, placing students in apprentice-like roles within authentic communities of practice [13,14]. Chen [15] suggests that interactive television which uses telephone wires to transmit real time audio and visual signals between distributed sites is one potentially powerful distance learning technology. For those attempting to form distributed communities of practice, interactive television is especially attractive because it can support rich interaction between learners, individually or in groups, with experts in real time.

Despite the potential for using distance learning technology to connect distributed communities of practice, most often, distance learning technologies have not supported innovative practices; rather, they have replicated traditional educational practices [16,17]. Finding that technology alone cannot be relied upon to change traditional educational practices is not surprising, given Clark’s classic assertion [18] that technology itself does not inherently enhance learning; it is the instructional strategies employed by the medium that is the integral factor in facilitating learning. However, because distance learning technologies afford the possibility of connecting people separated by time and distance, overcoming a major obstacle of fostering learning communities within traditional educational contexts, they still might be considered a potentially powerful tool in implementing REALs.

In this study, we examine two learning environments that use distance learning technologies to facilitate the design, development, and implementation of REALs. In both of these cases, interactive television, with its the ability to bring outside experts into the classroom and enable students to participate in broader communities of practice, was a catalyst in the design of a REAL. The availability of the technology and its unique affordances had a serious impact on both environments. This comparative case study outlines some of the issues that arose in these courses and suggests implications for how distance learning technology might be used to facilitate the design, development, and implementation of REALs.

Neither of the two instructional cases was designed to be an instantiation of Grabinger’s REAL [5]. The first case study was a case based design, and the second study was conceptualised as a collaborative problem-based learning environment [19,20]. By situating students in active problem solving on tackling authentic, real world tasks in collaborative groups, each case might be seen as an example of a REAL [21,22]. Therefore, both cases might be seen as naturalistic formative research studies of REALs.
Naturalistic formative research studies allow researchers to use naturally occurring cases to create or improve a design theory [23].

We will begin by examining the first case, Creating Your Own Future, a design course taught to multiple high schools via distance learning. We show how it relates to Grabinger’s work on REALs, and explore implications of how technology might help facilitate REALs. Our second case study evaluates a distance learning programme predicated on problem based learning theory, exploring the role technology played in it. In our conclusion, we explore implications for using technology to support REALs.

2 Creating your own future: course description

During spring semester of 1997, three high school classrooms joined for an interactive video class for one hour once a week. The ‘Creating Your Own Future’ course is designed to teach design and entrepreneurship within in a collaborative, problem-based framework. While the course met primarily over ITV, they also used the internet for posting class notes, resource gathering, and email communication. Two interactive television connections were made to expert practitioners in order to provide students with feedback to their work; one connection was to a panel of expert designers, and a second was to experts in their particular product area. Demographically, the schools were mixed; there was an urban school, a rural school, and a suburban school. Two of the classrooms were involved in block scheduling. Previously, the instructor had taught a similar class using texts and real clients, but she found that teaching the class via distance with these new technologies had a large impact on the class, dramatically changing the learning experience environment.

The design process taught was based on the work of Dr. Charles Burnette of the University of the Arts, Philadelphia. He and the instructor have been working together to forward K-12 design education over the past five years [24]. In the past, the course has been taught in a variety of instructional settings, including a children’s museum with student designed exhibits, a high school industrial design class, as well as a special summer course for students and faculty in technology courses.

Design education requires instructors to extend the learning environment beyond the classroom walls, which presents unique challenges to the instructor. Students need to have a real area/opportunity to design for; to design without a client -user in mind can make the design thinking ego-driven [25,26]. In creating quality design, designers need to view multiple perspectives before making decisions [27]. Providing novice designers feedback from experts in the area in which they are designing is another valuable tool for teaching design [28]. For example, if a group of students decided to provide car entertainment for children aged five and six, a toy developer would give them the most relevant feedback to their design. This precise kind of expertise is not often available in many communities. A part of designing for other people also means having access to those people in the environments in which they use the design [29]. Good design requires societal reflection and access to authentic feedback on how a design is received [25]. Finally, the holistic nature of design performance, the messiness of meshing values, standards and creativity make this kind of education even more needful of collaboration with systems beyond the school.

‘Creating Your Own Future’ was revamped, and offered to multiple schools using distance learning technologies in the hope that distance learning technologies might be
used to transcend some of the traditional barriers to design education. As usual in a classroom based course, the course was designed around a central design task which occurred within students’ communities and demanded them to negotiate multiple perspectives in their design process. They could not design something for themselves. The instructor established community liaisons with the local entrepreneurial volunteer organisation who would communicate with the students about connections and resources in the community. The Design for the ARTs website, (http://www.uarts.edu/~arts/dk12/index.html) instructor presentations, and the class website were the major resources designated for the course. The interactive sessions were designed to support just-in-time lectures, student presentations, design process discussions, and peer evaluations.

The course begins with values clarification as this grounds students’ individual and group decisions [30]. From there, students identify problems they want to design for. Students began a regular cycle of presenting progress and peer evaluation of not only of the products they developed, but also the design process that they had followed. A strong emphasis was placed on peer review, affording students opportunities to learn about the design process through critiquing. Not only did they expose their work to their peers, but they were also connected with professionals in the area for which they had developed their design. For example, a team developing a children’s toy connected to a toy manufacturer, and a team developing a website connected to an expert web developer. These ‘experts’ listened to students’ presentations of their work and reacted to the presentations, providing authentic feedback. Near the end of the course, two designers visited with students, helping them reflect on the entire design process. These connections were facilitated through interactive television and use of electronic mail.

Technology and the distributed nature of the course design played a key role in the design, development, and implementation of this course. The course instructor hoped that using interactive television, the web, and email would allow her to overcome some of the challenges in teaching this course in traditional settings, such as connecting students with multiple communities of practices distributed throughout the state. Several schools across the state had indicated a desire to have the course as part of their curriculum, but each school wanted to offer the course to different sets of students coming from diverse disciplines. Teaching a course with multiple communities and diverse goals was a challenge, and ultimately the course design was modified so as to capitalise on these diverse backgrounds. The instructor added more opportunities for cross group discussion, criticism, and evaluation. Similarly, in prior experiences the instructor had looked for authentic design problems and authentic feedback sources for learners for their design process. However, the search for experts from other communities of practice has often been unsatisfactory. The instructor hoped that the ITV delivery mechanism would afford student contact with the authentic experts. Thus, delivering ‘Creating Your Own Future’ via a distance was not a matter of transferring a course to a new medium; rather the course needed to be redesigned to capitalise on the advantages afforded by distance education.

2.1 Attributes of a REAL

Grabinger and Dunlap [31] and Grabinger [32] set a initial framework for the particular elements of a REAL. Below is a chart demonstrating the most recent definitions of REALS [5], and comparing them to the designed instruction that was used in ‘Creating Your Own Future’ (Figure 1).
Because ‘Creating Your Own Future’ has the values, goals, and major features of a REAL, we believe it might be considered an application of a REAL. Because the course was not designed specifically to be an instantiation of a REAL, we approach this study as an example of naturalistic formative evaluation. Our reactions to the events of the course follow.

_Authenticity in REALs_

**Figure 1**  REALS – ‘Creating your own future’

**REALs qualities and attributes [5]**

- Encourage the growth of student responsibility, initiative, decision making, and intentional learning.

- Utilise dynamic, interdisciplinary, generative learning activities that promote high level thinking processes (i.e. analysis, synthesis, problem solving, experimentation, creativity, and examination of topics from multiple perspectives) to help students integrate new knowledge with old knowledge and thereby create rich and complex knowledge structures.

- Promote study and investigation within authentic (i.e., realistic, meaningful, relevant, complex, and information-rich) contexts.

- Cultivate communities of practice, i.e., knowledge building communities that utilise collaborative learning among students and teachers.

- Embed opportunities to reflect on the learning process as well as content acquired to promote both learning and metacognitive skill development.

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**The application in ‘Creating your own future’**

- Course was designed to supply students with ill-structured problem parameters. Students, identified the problem they wanted to tackle and made all key design decisions, such as which product to produce, what audience to produce for, and what specific procedures to follow.

- Design requires analysis, synthesis, creative thoughts, and the integration of multiple perspectives (self and potential users of designed entity). This design course was offered to schools as a course which might be embedded within a course offered at their school. Students came from graphic arts, technology, and an alternative school’s service learning project.

- Students were given an inquiry trigger- ‘You must design something that is needed by an age group other than your own’, making them address multiple perspectives in their design. Students then created and evaluated an original design project. All instructional activities were in support of the students’ problem solving process.

- Students engaged in collaborative design, working in teams on their projects. They participated in communities of practice that included experts in design and industry, veteran entrepreneurs, their peers, and the facilitating teacher.

- Reflection sections were built into the class time through guided exercises, discussions, and peer reviews. Peer teams reported their design prototypes and shared their decision making processes, allowing investigations into the design process.
Our chief goal was to determine how the media of ITV, internet access, and e-mail would effect student design learning in ‘Creating Your Own Future’. Specific questions included: Are there different types of learning going on in this situation compared with the same classroom activities undertaken earlier? Which instructional activities are best at adding instruction? Do students use e-mail and the internet for specific purposes? Does the internet get used for resource acquisition? Does the technology help or hinder the learning process?

2.2 Methodology

Reigeluth and Frick [23] suggest conducting observations, interviews, and document analysis when conducting naturalistic formative evaluations [33]. By using multiple data gathering techniques we hoped to reduce the chances of instructor and researcher bias, thus increasing the soundness of the data [34]. During the first phase of the research, we concentrated on less obtrusive techniques such as observation, journal writing, and document gathering. As a participant observer, the instructor noted her role and reaction as designer and instructor through informal journalising. Anecdotes and a simple evaluations were recorded. An outside evaluator visited 80% of the broadcast sessions, recorded observations, interviewed students and participating teachers, developed findings, and audited the instructor’s reports.

In the second phase of the research, we followed Merriam’s recommendations [35] and began employing more obtrusive, direct data gathering techniques such as interviewing as the need for more specific information and key themes emerged [35]. We continued our observations and journaling, and the researchers met to develop emerging issues. Two outside evaluators conducted interviews with students and cooperating teachers twice during the course. Interview findings were member checked via email [36]. A third, outside source oversaw the entire process, serving as a mentor and as a guide.

Throughout the course, artifacts were gathered as another data source. All teacher/student email communication, communication via distribution lists, student journals, and instructor journals were collected and analysed by both researchers to gain more understanding of students’ experience in this course and develop emerging issues. Student projects were analysed to evaluate students’ learning. The course syllabus and website were also analysed as a source of data.

2.3 Findings

The research design of this study requires that we offer no generalisable findings, and are cautious with the findings we make. Much of the data was collected through observation and journalising. Although the information was audited by an outside evaluator, both investigators were relatively new students to action research strategies.

2.3.1 The role of feedback from peers at a distance is different from the feedback received from classmates

Students exhibited feedback that was more rigorous and dealt not only with the product but also challenged the process of design that was used. Students reported that they felt freer to express their true reactions because they did not have to depend on their distant peers for social networks and could focus totally on the task at hand. An instructor journal entry highlights this thought. She writes,
“I just listened as they settled into the room and technology. I watched the community of learners develop over these weeks. These students, though miles apart, have a special relationship. I let a discussion on music events go on for five minutes today.”

The auditor made similar observations, noting

“The interactive sessions which feature one school engaging with another seem to be the richest. Students’ body language and expressions seem to enliven during school-to-school dialogues. One student commented that when they talk to students from other schools, they do not have to worry about social pressures; the focus is on learning.”

In reflection discussions, Susan, a 10th grade student, summed up this point we. She commented, “It’s so much easier to be honest about each other’s work at a distance. I can tell them what I truly think when I don’t have to think about who they know. I figure they feel the same and are being honest with me.”

2.3.2 Students’ motivation was increased by the knowledge that they would receive feedback from experts in the particular field they had chosen

Students chose both who would evaluate them and when this would occur. Both the instructor and the auditor noticed that students seemed very excited when discussing how their product would be evaluated by external experts. The instructor writes,

“Today the students who had the design of the toy met via ITV with the developer from a toy company. Its amazing to me that they faced him so bravely. He was appropriately honest and gentle. He asked for a video of the children using the product. They hadn’t believed me when I had suggested another test and recording reactions. The recommendations were also in the web based information they had access to, but this time they heard. Lesson learned. They even brought it up saving me an ‘I told you so’.”

Here, the instructor describes the value of having outside experts participate in the classroom community. She notes a high internal motivation in students who played an active role not only in determining their project, but also the means by which they should be evaluated. High internal motivation resulting from students choosing the type of assessment that makes sense to them is consistent with Keller’s [37] notion of relevance being an important component of internal motivation.

2.3.3 When teaching in this problem-case based learning environment, teachers need to be competent facilitators, guiding students on how to work in a student centred learning environment

The instructor found that old habits are too easy to fall into without guidance toward a new approach to learning. The students seemed unfamiliar with directing their own learning process. The auditor observed, ‘Students seem uncomfortable working in a project centred environment. Students do not seem to be identifying information needs and then choosing the appropriate resources to meet those needs.’ The instructor’s journal mirrored this concern, as she wrote,

“A scaffolding of skills necessary for a project-based designed instruction might produce less confusion. The students are having problems with the concept of usability testing of their services. I need to address this issue sooner or in a different way. Outside speakers might have been brought in too early.”
In follow up interviews, students were asked about this frustration, and they were in strong agreement that this type of learning was new for them. We were struck by how students’ perceived their frustration. Students did not attribute the difficulty that they were experiencing to the instructional methods employed on the course. Rather, they tended to lump them together, thinking of the distributed learning technology and the instructional methods as one and the same.

2.3.4 It cannot be assumed that students will utilise resources presented to them over the internet

Even though the students on this course were all accustomed to mining for information on the internet, they did not utilise course resources posted on the internet, even when they were directly linked to the website. Routinely, students would come to class without looking at the internet readings that were the basis of the day’s discussion, and few of them referred to the internet resources in conducting their project. In interviews, we asked students why they did not use the online resources more. Students commented that limited access to the internet was a major issue. Even though most of the students had over 30 minutes of web access per day, they usually chose to spend their time online engaged in other activities.

Not only was this pattern of behaviour true for using the web, but also for utilising email communication. Over half the students did not turn in their initial email reflection assignments. In interviews, students commented that they had a limited amount of time on the web, pressure from family members to share their computer, and computer requirements from other classes. In order to properly compose a reflection paper, students need a fairly large, uninterrupted block of time with access to email. Ten or 15 minutes between activities was not enough for some students. As a result, few students posed questions to the course list serve or privately to the instructor. Students need to have time set aside for this purpose and need to learn how to use email as intended.

In the closing interviews, the auditor ran several possible solutions to this problem past the students. Students agreed that a more concise, user-centred design of the site would help; the students felt as if the site was the teacher’s and not theirs. They also agreed that in order to properly use the web as a course resource, a large block of time to access the web is needed, and sufficient time to use the web was built in as a course requirement for future participation in the course.

2.3.5 The occasional interaction deficits experienced in the course was not an attribute of the medium but rather of the instructional strategy design

Students were highly interactive when discussion centred around their report of activities on the projects. The moment the instructor discussed an item that she felt would be helpful, the degree of interactions, during and immediately after the event dropped. The instructor’s journal entry from 11/4/97 illustrates this point. “Boy I lost them! One way communication, a.k.a. lecture seems to produce an immediate turn off. I can see the students on the screen and can see them fidget and look away. They do fine otherwise but not this way. Interaction. Interaction!!” The auditor made a similar observation in his research journal, “The more the instructor allows students to take over discussion and the less she ‘presents’ information to them, the better the sessions seem to go.” Indeed, when the instructor capitalised on some of the unique attributes of the technology, the ability to have learners
from widely different backgrounds and experiences share ideas and perspectives, the class seemed quite invigorated. In an end of the course reflection, the instructor commented that “this interactive television really keeps you honest . . . the moment you drift from their immediate learning needs to some sort of pre-packaged script, they’re gone.”

In the ‘Creating Your Own Future Experiences’, interactive television served as a tool to promote interaction, and to allow students to collaborate with experts from other communities of practice. It is worth noting that our findings are also consistent with Clark’s assertion that it is instructional methods, not media, that influence learning [18]. When used as a content delivery mechanism in this course, interactive television clearly had the affect of turning off learners. Thus, the Creating experience led us to agree with Grabinger’s assertion that

“a REAL is a set of instructional methods designed on the assumptions that media are tools for students and teachers to use and that the learning that occurs within the environment is founded on the activities and processes that encourage thinking and reasoning, not the media that deliver information [5].”

In other words, it was when the instructor used the technology to support the goals and methods of REALs, that the course became successful.

3 Second case study of a REAL: ‘A quest for speed’

Recently, we had occasion to act as evaluators of an interactive distance learning programme that sought to use community resources to create three authentic learning experiences for secondary students. In this programme, not only could students reach experts for feedback, but the developers of the instruction unit also had access to experts and authentic resources. In three separate trials of a REAL, students were asked to solve authentic complex scientific problems when given actual information from an international raceway and scientific concepts and formulas to use as tools. Students were asked to design the proper engine for the track by applying mathematical formulas, to design a tyre for the specific track applying the chemistry of polymers, and design safety equipment for racers, taking into consideration the reaction of the body to speed and movement.

This study explores the in vivo application of a Problem-Based programme by a teacher with students from several schools in a medium sized high school in a Midwestern state. The instruction involved feedback by authentic experts in the problem domain via Interactive television. Peer teams, from a distance, also saw the solutions presented from other sites. Students compared results, critiquing each other’s work. The connection to experts and peers at a distance was unique, and perhaps atypical of most implementations of in PBL.

Figure 2 illustrates how key components of the programme fit within Grabinger’s [5] description of a REAL.
The original study was to compare two classrooms in order to better understand the dynamics involved, but all of the classes were scheduled for the same time and days, so the study had to be narrowed. We developed the following research question: When given the Problem-Based Learning (PBL) instructional unit ‘Quest for Speed’, what are the effects on the teacher’s approach to using PBL, and what are the effects on students engaged in the problem-solving process?

3.1 Methodology

Following the recommendations of naturalistic research, we triangulated our findings using document analysis, interview and observation. Reliability was also sought by using multiple informants and multiple evaluators working in isolation. All classroom materials

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Figure 2  REALS – ‘Quest for speed’

REALs qualities and attributes [5]
- Encourage the growth of student responsibility, initiative, decision making, and intentional learning.
- Utilise dynamic, interdisciplinary, generative learning activities that promote high level thinking processes (i.e., analysis, synthesis, problem solving, experimentation, creativity, and examination of topics from multiple perspectives) to help students integrate new knowledge with old knowledge and thereby create rich and complex knowledge structures.
- Promote study and investigation within authentic (i.e., realistic, meaningful, relevant, complex, and information-rich) contexts.
- Cultivate communities of practice, i.e., knowledge building communities that utilise collaborative learning among students and teachers.
- Embed opportunities to reflect on the learning process as well as content acquired to promote both learning and metacognitive skill development.

The application in ‘Quest for Speed’
- Programme was designed to supply students with problem parameters. Students were given tools and access to resources to complete the problem.
- Students were engaged in relatively rich problem solving tasks. Some of the tasks were more ill-defined than others, but all were complex tasks which required a team of students multiple class periods to complete. The problem tasks required students to synthesise and apply information gathered throughout the course.
- All the problems chosen were actual problems taken from the scientists at the speedway. Some of the problems were posed in their simplest condition; however, the experts confirmed that all of the problems were authentic.
- Students engaged in collaborative design, working in teams on their projects to design their solutions. By connecting to raceway officials, the students entered another community of practice.
- Reflection and debriefing sessions were included, but were somewhat less than ideal.

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were analyzed by the two researchers independently. The project coordinator, the lead teacher, the participating far site teachers, and several representative students were interviewed. A semi-structured interview schedule was used to allow important themes to emerge, yet also to allow the researchers opportunities to probe participants’ experiences. By using the triangulation of informants, time, and multiple sources, we believe these findings contain a good degree of reliability.

3.2 Findings

Four primary findings emerged from this study. They are presented below with supportive data.

3.2.1 Students presentation of problem solutions for feedback before internationally renowned authentic experts added value to this instruction and increased motivation for the students and teachers

PBL guidelines as presented in the literature [38–40] stress the importance of developing problems that reflect the authentic work of experts in the field. Expert involvement is suggested in order to pull students from novice status to expert knowledge [14,28] and to combat the problem of inert knowledge [41]. This particular instantiation of PBL involved interactive television (ITV) to connect to content experts as a source of feedback for the students. On 11/12/97, the evaluators noted the following conversation during the ITV exchange:

The programme has students from each site presenting their solution. Harvest School gives their presentation which goes well. The ‘experts’ give their feedback.

A mechanic comments, ‘Well, you guys in Harvest, see that car right behind us? You described its engine! Good job!’

Down low, beneath the desk, a student gives a ‘thumbs up’ sign to another student. A ‘yes’ came from some students in a whisper. During a subsequent interview with faculty, the instructor commented on motivation to implement the pilot.

Sam Snappy (Instructor): ‘Also we were to connect to a nationally famous organisation. That was magnetic . . . ’The conversation with students on effect of expert feedback session demonstrated no less motivation than the teacher’s.

Scott, a freshman student commented,

“I thought it would be pretty cool. I thought it was going to be in some room. I didn’t realise it was going to be right in the museum. I saw a lot of old drivers and members of pit crews just walking by. I thought it was pretty different. They were harder to talk to. I didn’t want to say a dumb thing. In class it’s no big deal.”

Autumn, a freshman student gave a similar reaction, ‘It was real life. You were seriously telling someone your opinion.’

3.2.2 Students in this course had opportunities to practice self-assessment and reflection skills by watching other students present their solutions to similar problems over ITV

Many constructivists and situated learning theorists advocate the benefits of presenting multiple problem solutions to learners in problem based learning environments [42,43]. This particular case was unique in that students from multiple classrooms developed
solutions to problem solutions simultaneously. As groups shared their perspectives on the problem solving process, students were afforded opportunities to see entirely different ways of framing problems and designing solutions. In many typical classrooms, students observed other groups designing solutions to their problems throughout the process. Observations and follow up interviews both indicated that students valued the opportunity to observe other solutions to their problems.

The instructors provided no guidance as to what criteria constituted high quality problem solutions. By sharing problem solutions, students seemed to developed understanding of which criteria constituted a quality problem solution. Many students used the presentation of solution time to reflect on what criteria constitute effective problem solutions. They compared their design solutions to other design solutions, and started to abstract criteria from those comparisons. Ideally, this kind of abstraction would have been better facilitated as an integral part of the learning experience [13].

The observer’s journal entry at Table 1 and follow up interview illustrate this process.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Observer’s journal entry and follow up interview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Journal entry</td>
<td>I watched the Harvest students’ rapt attention. No eye moved away. In subsequent interviews with students I was told the reason</td>
</tr>
<tr>
<td>Scott:</td>
<td>I was amazed. The other school had a great logo and formula. I think they worked on it a little more</td>
</tr>
<tr>
<td>Shelby:</td>
<td>I think their posters were better. That Vocational school knew what they were talking about. I don’t think we put as much time and effort into it</td>
</tr>
<tr>
<td>Jason:</td>
<td>I thought they were accurate</td>
</tr>
<tr>
<td>Brad:</td>
<td>I thought they were a lot more organised. I didn’t think they were going to go through all that trouble</td>
</tr>
<tr>
<td>Autumn:</td>
<td>They were good solutions and had a lot of thought put into them</td>
</tr>
</tbody>
</table>

In this case, we saw how technology was used in REALs to extend communities of practice beyond traditional classroom barriers. Not only was interactive television used to bring experts into the communities of practice, but also to allow students to engage in multiple, distributed communities of practice.

4 Findings and discussion

4.1 Effect on learning

Our experiences creating distributed REALs mediated by interactive television leads us to believe that technology, specifically interactive television, can have a large impact on the design and delivery of a REAL, ultimately impacting the instructional methods used. We found that interactive television afforded unique opportunities for collaboration and reflection. Perhaps most importantly, interactive television was a useful tool in supporting the formation of distributed communities of practice, which are key components of REALs. It allowed community partners from outside of schools to become actively involved in the learning process and learning community.
In both programmes, interactive television was used to facilitate interaction between students distributed across multiple environments. Students seemed to value and learn from hearing multiple problem solving solutions. In both cases, interacting with students from other learning communities played a central role. In ‘Creating Your Own Future’, students compared multiple problem solving strategies, as students were engaged in the problem solving task. In ‘Quest for Speed’, students were tackling more well defined problems, and had more opportunities to compare how each framed the problem, and the solutions each developed to that problem. Using comparison of students’ solutions as a reflection activity in PBL and design is not new [25,43,44]. However, we found that having this reflective activity occur between groups of very different learning communities resulted in a valuable learning experience for these learners. We also believe that because both cases used high school students, the advantages of this strategy may have been amplified. Many of these students had not been far outside of their communities, and adolescence is a period of identity formation. Thus, engaging with students from other backgrounds might have been especially motivating and valuable for these students.

4.2 Effect on partnership building

In these cases, we saw how authentic experts were invited to become active members of the learning environment, advising and creating the instruction. Outside experts helped define the parameters of the problems students tackled, they directed students to helpful resources, they gave students feedback on their problem solving process, and on the final solutions they created. Interactive television technology mediated this process, providing the classroom instructor opportunities to bring outside experts into the school. By providing feedback and participating in the problem definition and feedback processes, the experts functioned as subject matter experts, lending their expertise to the classroom teacher.

In her previous experiences working with community groups and schools as an educational consultant, the instructor was often amazed at the lack of true interaction between the groups. Often, partnering organisations were not invited to become actively involved in the learning environment, but rather were left to donate money or supplies; or perhaps provide a speaker for the classroom or a field trip. In these two cases, outside organisations became a very real part of the learning community and had a dramatic impact on the learning environment. Such organisation and school relationships might play a key role toward the authentic interaction required by REALs, and might be explored in further instantiation of REALs.

4.3 The role of interactive television

We found that interactive television played a major role in supporting the implementation of a REAL. Grabinger argues that

“to create REALs, teachers must involve their students, parents, administrators, and colleagues in planning and implementing strategies that encourage student responsibility, active knowledge construction, and generative learning activities on a large scale and in a variety of methods and forms [5].”

In both cases, technology (to a greater or lesser extent) facilitated the problem definition process, the problem solving process, connections to authentic resources, and the feedback processes. It allowed instructional strategies to be employed that were not previously
possible. In the ‘Creating Your Own Future’ course, similar methods had been employed in the past, but with less success. In the ‘Quest for Speed’ programme, it was the availability of the technology that drove the decision to try and connect students to raceway experts. Thus, in both cases, the technology did not dictate which instructional strategies could be used, but it did make instructional strategies more feasible for implementation in actual K-12 settings [45]. Thus, the attributes of the technology, when used in a self-reflective manner scaffolded the instructors in designing learner centred environments.

In both cases, interactive television acted almost as a type of scaffolding for the instructor as she was teaching. When confronted with students who were reticent to take responsibility for their own learning, the ‘Creating Your Own Future’, the instructor was tempted to fall back on traditional, more didactic patterns of interaction. However, she found that the limitations of the interactive television technology actually prevented her from doing so. Interactive television was such an ineffective medium for lecturing that she was forced to find alternative strategies for scaffolding students. Similarly, in the initial ‘Quest for Speed’ programme, experts were essentially used ‘talking heads.’ They delivered presentations and fielded questions. Students grew visibly disinterested as the programme wore on. As a result, the ‘Quest for Speed’ team decided to change instructional strategies, and conceptualise the design the learning experience as a REAL for future programmes.

This notion that the technology can scaffold an instructor by not facilitating certain kinds of instructional strategies takes Clark’s notion of the instructional medium [18] and effectively, turns it on his head. In these two cases, we found interactive television to be an extremely poor presentation medium, but an excellent medium for facilitating interaction. In this way, the instructors were forced to reconceptualise the learning experience to better suit the tools they had available. Ultimately, the presence of the interactive distance learning technology drove the instructor to adopt (or adhere to) more learner centred strategies.

5 Implications for further study

Although ITV seems to hold promise in its ability to connect learners to experts thus extending communities of practice, the connectivity of ITV needs to be tested in more instantiations of REALs. Case studies exploring how to use distance learning technologies like ITV to situate learners in communities of practice might help build richer theory on how to design REALs. Furthermore, with the relatively high cost of ITV and other distance learning technologies, studies showing the viability of this technology on a broad scale and documenting learning gains experienced through these methods would be valuable for educators.

In the emerging paradigm of instruction [46] technology will increasingly be used to engage students in Rich Environments for Active Learning [5]. These two case studies suggest that technology can play a powerful role in supporting these environments, enabling very new types of learning environments to occur. In both cases, technology supported student participation in life beyond the classroom. The presence of these interactive technologies not only supports innovative instructional design, but it also can serve as a catalyst for change. In both of these case studies, it was the technologies, and the types of experiences that it afforded that prompted the instructional designers to move
toward a participatory model of learning. Ultimately, the introduction of this technology has changed some of these teachers’ practices. These findings suggest that perhaps technology can serve as a catalyst for pushing educators toward more student-centred forms of instruction.

References

3. Lave (1988). AUTHOR PLEASE SUPPLY FULL REFERENCE.
5. Grabinger, R.S., (1998) __________Portuguese address, unpublished)__.  
C.B. Johnson and K.D. Squire

21 Squire, Johnson and Bichelmeyer (1998) ‘Personalized independent learning systems’. Research Roundtable presented to the Annual Convention of the Association of Educational Communications and Technology, St. Louis, MO.

22 Johnson C.B. and Squire, K.D. (in submission).


26 Burnette (1995). AUTHOR PLEASE SUPPLY FULL REFERENCE.


29 Rubin (1995). AUTHOR PLEASE SUPPLY FULL REFERENCE.


38 Jonassen (1998). AUTHOR PLEASE SUPPLY FULL REFERENCE.


42 Savery and Duffy (1995). AUTHOR PLEASE SUPPLY FULL REFERENCE.


Bibliography


Authenticity in REALs


Burnette, C. Available online at: http://www.uarts.edu/~arts/dk12/index.html#

Burnette, C. personal communication.


