Stakeholder Participation in Evolving Education Technology: An Exploratory Methodological Study

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Abstract
Innovation in educational technology can often be demonstrated to be both appropriate and useful. In many cases however, the innovation does not make it into the classroom. As the causes for this are not well understood, a collaborative story-sharing forum has established so that the use of technology can be studied against a variety of education theories and practices. The use of this forum between students in Canada, Colombia, Scotland, Chile and Spain is being studied as they undertake a variety of different learning activities. One exploratory study that is reported in this paper explores the use of Activity Theory as a means of gaining insight into the reality of the place, role and usage of technology in learning activities, and the role of users in the process of evolving deployable technology.

Keywords
Educational Technology, Activity Theory

Introduction
Innovation in the use of technology in education has been taking place steadily since the early trials using radio and phonographic records in the 1930's and 1940's. The widespread deployment of the Internet in the 1990's accelerated this innovation, resulting in many research and pilot deployment projects. Whilst some would argue that the innovation associated with the deployment of technology does not have any significant impact on learning when compared with more traditional methods [1], many innovative teaching situations that involve novel uses of technology have been accompanied with demonstrations of the utility of the approach. In reality, however, many innovations remain as pilot implementations and do not become widely deployed in mainstream education contexts. This phenomenon has been explored by Alona Forkosh-Baruch et al [2] where they contrast "Islands of Innovation" and "School Wide Implementations". They conclude that in many cases the innovative

deployment of technology is sustainable within very localised contexts, highly dependent on motivated individuals with specialist skills, and often do not scale for wider adoption. The value of the innovation is generally not in doubt, only the possibility of making it available for wider adoption. This is issue is also highlighted by Scott and Quick [3] using a couple of case studies of well accepted pilot innovations. They conclude that the perceived risk to innovation for educators and the education institutions must be reduced or masked in order to generate confidence in the adoption of novel technologies within educational practices.

This pattern of difficulty encountered when attempting to promote the adoption of innovative technology has also been experienced by researchers at the University of Dundee. A number of innovative systems have been developed, and the utility of the approaches demonstrated [4,5,6,7]. In practice, however, the systems developed in these studies, and in some cases, commercial functionally equivalent systems that followed, have not been adopted in the classroom.

At the same time, however, the need for innovation in the classroom is clear. The lives of young people involve technology in ways that were unimagined even a single generation ago. Not only is this changing the way that young people interact within society, there is evidence to suggest that the young people themselves are changing. These issues can be summaried as:

- Deep reflective thinking: Concerns raised by Prensky [8] and others that students who are constantly handling information in the form of short and easily accessed blocks seem to be losing the ability to think deeply about the meaning of the information, or to construct sequenced or coherent arguments. Whilst these concerns may be overstated, it is likely that the changes in information presentation and access will have as profound an effect on human behaviour as the the Gutenburg Bible did following it's publication in 1455
- Media Literacy: Young people are growing up in an informational age where the principle commercial commodity is information. Information is available in a wide variety of media, including, but not exclusively, text, pictures, photos, drawings, video, animations, speech and audio. These media are delivered via a variety of platforms including books, magazines, newspapers, telephones, personal digital assistants (PDAs), computers, games consoles, TV's, radios, CD's and DVDs etc. Many different people are producing and delivering information for a wide variety of reasons. Not only do the young people need to have skills in making and using media, they need to be able to understand the message being conveyed to them from others. [9, 10].
- Cross-cultural interaction: The appreciation and respect for cultures is becoming an essential attribute for citizens of global communities, if they are to maintain their chosen heterogeneous group, and their local, national, and global cultural memberships as well as their individual subjectivities.
- Online Experience: The nature of the communication and information access inevitably involves the use of the Internet and other remote communication technologies (mobile telephony, short messages, community TV, etc.). Turkle [11] and Joinson [12, 13] explore at length the new relationships and subjectivities that arise in these modalities of interaction.

Whilst these issues can be addressed in some measure by traditional means of education, there is clearly a role and need for innovation both in the teaching practices

and in the use of technology. The innovation must be built, however, on sound learning theories and practices. Central to these principles is the role of story telling and story sharing, and the role of activity in the process of learning.

Storytelling in Learning

Humans are social creatures [14]. Gossiping and story telling is the means by which social interactions affect the balance of communities and societies [15]. Social interaction implies interaction with people within society. We learn from others and we share with others what we have learnt. We interact with others in various ways that influence our status and roles in social communities. Humans have more complex patterns of social interactions than any other species.

Read and Miller's work builds on that of Schank [16] who explored many aspects of story telling, considering it central to not only social interactions, but also as the essential organising mechanism of knowledge in memory. One aspect of this work is the idea that conversations often follow context specific "scripts", with associated "goals" and "plans", demonstrating and leading to "understanding". Whilst some of Schank's work has been criticised as being insufficiently supported by experimental data [17], it has catalysed a strong debate that has lead to renewed interest in the role of stories in human social interaction and in learning.

One further aspect of the various possible roles of storytelling as part of social interactions is that people live in societies that have specific cultures that govern the way that they live. Ember and Ember [18] defined culture as "the shared customs of a society, the learned behaviours, beliefs and attitudes that are characteristic of people in a particular society or population". Miller [19] reports substantial evidence showing that storytelling takes place in many different cultures and between people of all ages, in support of social interaction. The type of narrative may be highly culturally specific. Knowing the stories of another culture is a bridge into another culture. Scott [20], makes the point that storytelling does not automatically imply the use of words. Other forms of representation are possible, for example using pictures or images, symbols, objects or even mathematical equations.

Csikszentmihalyi and Rochberg-Halton [21] reported that photographs are the third most treasured possessions in the home of a modern western family after furniture and visual arts. When this is broken down by age, they were ranked sixteenth by children and teenagers, and ranked first by grandparents. In general, younger people are seeking to establish an identity, to understand their place in the world, and then to assert their individuality and their individual worth, by using images to capture humorous situations or everyday objects that were important to them.

The social implications of the ability to take pictures and make movies personally and non-professionally are explored by Chalfen in his book “Snapshot Versions of Life” [22]. He develops the notions of "Home Mode" photography, and explores the culture that they portray, encapsulating it in the term "Kodak Culture". He extends the work of Csikszentmihalyi & Rochberg-Halton [21] by including home movies as a means of recording significant events and objects from the world within which people exist. This basic need is finding new forms of expression in the current rise in popularity of blogs, personal online diaries.

Another aspect of human interaction, however, that has been explored by Dunbar [23, 24] and Emler [25] is that the vast majority of our conversation and interpersonal interaction is social, with perhaps only 7% being directly transactional. This has profound implications for on-line learning systems as they rarely provide social interaction forums alongside the transactional learning spaces. The failure to provide social spaces in online learning environments is presented as the explanation for poor engagement of students in the interactive aspects of on-line learning by Joinson and Buchanan [12]. In the context of technology supported education therefore, storytelling is a creative process that enables young people to express themselves (individually and collaboratively) by bringing together information into an engaging and coherent argument [26]. Stories are the basis for case based (and therefore reusable) memories [27] and are, therefore, essential for healthy cognitive development. Stories are also vehicles for meaningful social interactions and for learning. Learning through stories happens best when accompanied by socializing through stories.

Activity Theory

Central to the tenants of activity theory is the principle that learning arises from activity, rather than activity being enabled by new learning. Activity does not happen in a vacuum however, but in the context of collaborative learning, within a learning community, where all the associated parties have an interest in the activities leading to a productive outcome. Activity theory provides the means to consider the variety of factors that influence an activity. In the context of a collaborative story sharing learning environment therefore, a cycle of activities and reflection to reward achievements and isolate learning needs could be proposed.

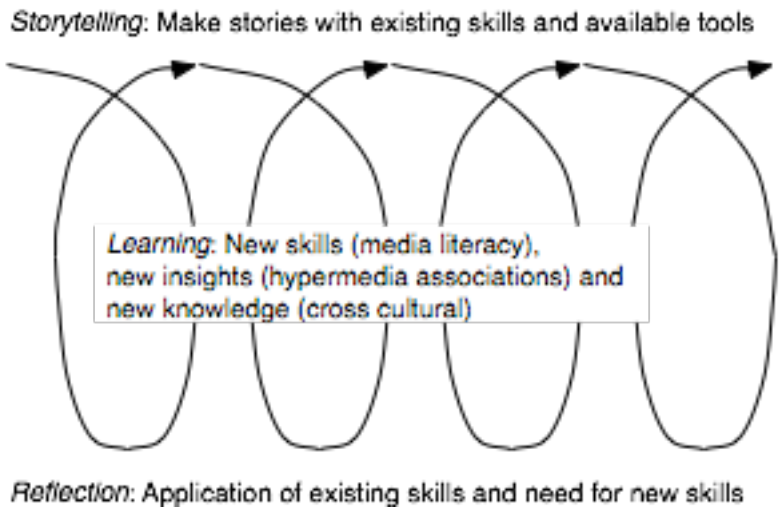

Figure 1: The storytelling, reflection and learning cycle underpinning the story sharing forum.

In summary, whilst the case for innovation in education is clear, successful innovation should build on best-practice in terms of learning theories and practices. It cannot be claimed , however, that innovation in educational technology has not considered these

issues. It can only be asserted that despite these factors being taken into account, innovative technology is not making it's way into the classroom as it could.

For this reason, a new research initiative is being undertaken that has two distinctive characteristics.

- It attempts, firstly to understand the education infrastructure in order to address the issues that prevent worthwhile pilot projects from achieving wider adoption.
- It seeks to apply the insights gained by promoting the adoption of innovative technology enriched teaching practices within local, regional, national and international contexts.

This work attempts to address both the understanding of the factors that affect the uptake of educational technology, and the nature of the technology itself its suitability for use in education.

Background to the Study

In order to explore these issues, an online story sharing forum has been set up that provides school-age students with a platform to develop narratives in a variety of genres, including assynchronous chats, blogs, formal stories, and hypermedia based domain narratives. Students from Colombia, Canada, Scotland, Chile and Spain currently post material onto the forum and participate in videoconferences. These activities are mediated by school teachers, working in collaboration with researchers in the various countries. Central to the initiative has been the commitment to provide relatively simple technologies within a framework of innovation in teaching practices.

This forum provides a vehicle, therefore, to explore the factors that affect the adoption of innovative technologies, including the nature of the technologies themselves. A variety of qualitative analysis methods are being adopted within the framework of theories of human interaction. Actor Network Theory [29] is being applied to model the set of relationships that govern the deployment and use of technology within the school age education sector. In this way, the research intend to more completely understand the set of stakeholders (actors) that influence the deployment and ongoing use of technology. The temporal behaviour that informs the understanding being modeled within the Actor Network is being explored within the insights provided by Activity Theory.

One of the aspects that the education system seeks to promote is cross-cultural understanding within a framework of social and formal learning based interactions. A good test case for any collaborative, activity promoting, hypermedia story sharing system mediated by technology would, therefore be, to consider the value of such a system as an effective tool to mediate learning activity in this area. An example activity that has been chosen to explore this is the sharing of live music performances.

This in turn, should provide a test activity within a design exercise to explore the appropriateness of any given technology as being designed (as an ongoing process) for use by the students and its fit within the infrastructural realities of the school age educational context. This is a technology design activity.

Whilst Activity Theory is not a research methodology, it has been applied at a theoretical level to the designing of learning environments by Jonassen and Rohrer-

Murphy [30], where a framework is provided to help to expose the various factors in a systematic way that will be adopted in this exploratory study. The various aspects that the process suggests follow the example that have often been proposed where the factors of interest have been encapsulated in various diagramatic representations or models. These can be helpful in ensuring that core aspects of the activity are not forgotten or missed. Using this representation, two activities within this test case can be modeled: The performance as a means of learning, and the appropriateness of the technology to mediate this learning. In this sense, the performance is being employed as a test case to assist in the design of appropriate learning technology.

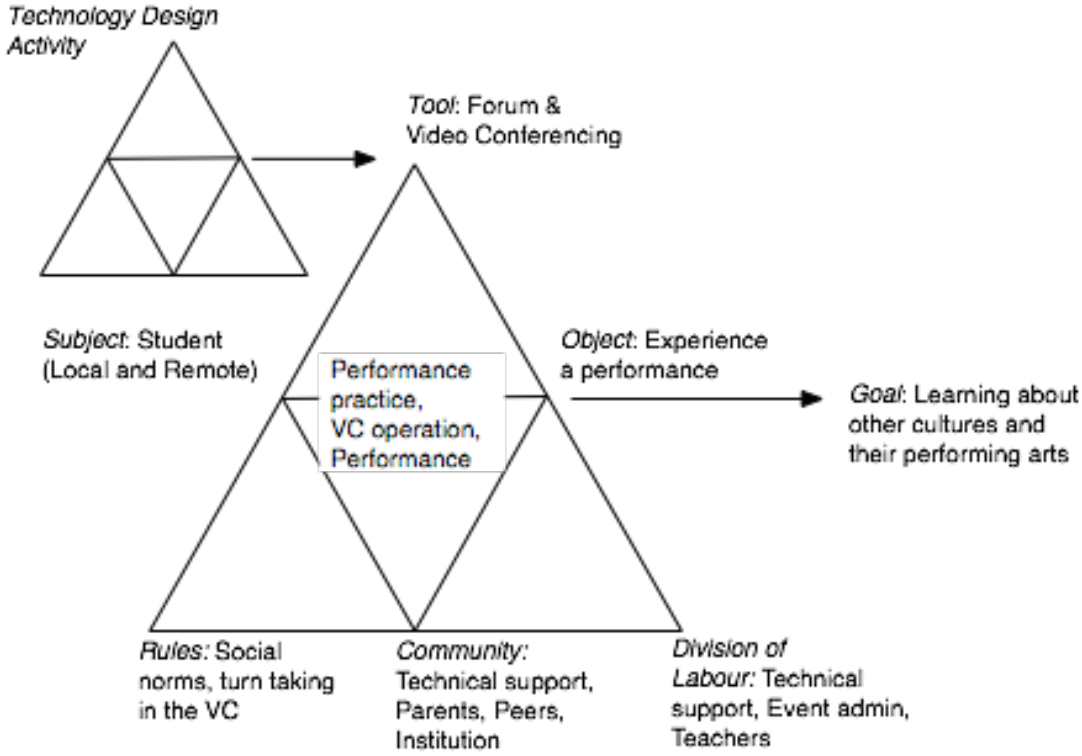

Figure 2: Performance as a learning activity model.

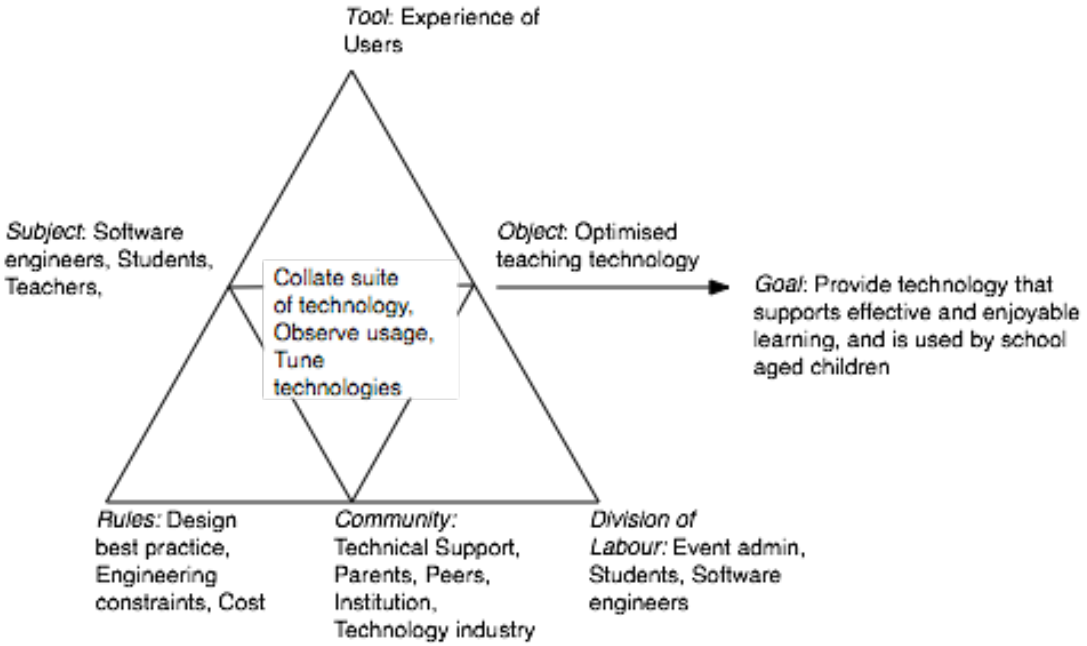

Figure 3: Educational Technology design activity model.

The value of a performance as a learning activity should be evidenced by some interaction or statements by the participants that indicate that some interest and motivation has been generated and that some new skill or knowledge has been communicated and assimilated. The value of the performance as a means of validating an educational technology system could be evidenced in some positive statements by the users requesting further use of the system. This would be ample and sufficient as evidence for the appropriateness of the technology, as generally, educators and students will use innovative technologies within a research trial, but rarely proactively seek the use of the technology beyond the research study. In order to evaluate whether such evidence could be exposed by an Activity Theory based approach, an exploratory study was conducted involving students active in the story sharing forum.

Exploratory Study

In this exploratory study, two different cohorts of students were brought together in live online performance activity. This activity was mediated by two technological platforms: a simple web-based wiki/blog forum (using a ProjectForum server) for asynchronous collaboration and a web-based videoconferencing system (FlashMeeting) provided by the Open University in the UK. One cohort of students was based in the province of New Brunswick in Canada. This cohort consisted in a group of High School students geographically distributed across the province, studying Spanish at a distance. The other cohort was a group of High School students from the Rafael Uribe Uribe neighbourhood of Bogota in Colombia, attending the San Agustin school.

The live event was scheduled, following a discussion between the teachers of the respective cohorts, to take place on the 2nd November 2005. Preparations with the students commenced in mid October. The Canadian students agreed to study and

present the work of young local Canadian singer, Natasha St. Pier, and collaborated to compile material in a collective space in the forum, about the life and work of this singer for presentation to the Colombian students during the live event. In addition, students prepared some biographical information about themselves and some musical material to perform during the event. The musical material that was prepared and presented took the form of unaccompanied singing with roots in the French and Celtic Scottish folk genres.

The Colombian students in turn prepared some performances of a percussion band using instruments made from objects found in the local communities, such as containers, kitchen implements, car maintenance tools etc. The performance included some dance routines that contributed to the percussion performance.

During the event, both cohorts of students presented their various prepared materials, and had the opportunity to engage in some question and answer dialogues, directly student to student. The event lasted around one hour.

Observations

Within the framework of the aspects exposed by activity theory, the following observations can be made about the student performance activity.

- A performance activity took place that the students in the various locations could and did engage with. Following the event, students not only posted positive comments in the common forum area that would be read by the teachers, but also posted directly to other students. The comments by the students not only expressed appreciation for the quality of the performance, but also for the opportunity to experience new styles and genres of music and musical performance. At this level, the performances did constitute a cross-cultural learning experience.
- The tools did enable a performance based learning experience to take place, and did enhance the collaborative experience for the students. Whilst the distance education students in Canada usually employ a mix of synchronous and asynchronous tools, they don't use videoconferencing. Comments from the students indicate an appreciate of being able to "meet" in this way.
- The activity exposed many aspects of local culture that illustrated the different learning and performance contexts within which the students operate and exist. Aspects such as the wearing of school uniform, the size and compositions of the classes, the nature of the performances and the social interaction between peers. This aspect of the "rules" of performance activities has many rich facets to be explored in future work.
- The students prepared and performed within a community of effort and interest and were appreciated within a community. Preparation took place in class, at home, with peers and alone. These two aspect of community illustrate important learning experiences for the students as they reveal whole nets of dependencies.
- In principle, the goal of experiencing learning through performance was achieved, but subsequent reflection will draw out lessons to be applied in future performances to enhance the learning experiences. In this way, future goals can be set and motivation generated for future activities.

Following a similar pattern, the activity theory principles can be reviewed to explore the other main activity being explored, that of the usage of technology as a means of exposing design issues, using the performance activity as the tool.

- The videoconference took place, and the performances were shared. This is a highly significant result, particularly as this activity was promoted, organised and followed through by the teachers, not the researchers. Whilst it did follow earlier videoconferences that had been catalysed by the researchers on topics such as an exploration of the weather, in this case access to the technology as a means of mediating the performance activity was sought by the teachers. This is important as it suggests that the chosen suite of technology can be considered as having some properties that could make it suitable for use in this type of educational context. This can continued to be explored in detail.
- Technical issues did arise, such as chopping of the audio signal on occasions. These will form the subject of ongoing development activities by the development team. In addition, follow-up on operational aspects can take place with all the participants. This can be used to expose the set of stakeholders/actors that affect the technology and its use for modeling within an Actor-Network framework.
- Contextual information such as local technical and operational conditions were exposed that qualify the usage of technology. For example, the event took place in a community media training institution in Bogota rather than in the school for a variety of practical and technical reasons. The technical data gathered during the activity can be used to motivate changes in the technical infrastructures available in the school, and indeed is informing an initiative by the Bogota Department of Education to equip the San Agustin school with a new computer lab and Internet connection more appropriate to support this type of learning activity.
- Experiences such as this provide insights that inform the discussion within the community of interest, including insights for parents and educations. An example could be experiences and feedback concerning issues such as preservation of safety whilst on-line. This dialogue can take place with more concrete examples as a result of these exploratory activities.
- The activity gives concrete insights into the real effort and input required from those involved in supporting such an event from a technical and resource availability point of view. If future deployment of technology is going to become part of the portfolio of resources available to schools rather than being made available as “special events”, the manpower resources required from all actors will need to be appropriate. The activity theory approach to reflecting on the event will assist this dialogue to be properly informed.

Conclusion

This paper has explored the need to reconsider the design of educational technology in order to address the fact that much valuable and useful technology does not become adopted or used. There is little evidence that the educational technology that is deployed has been designed in a way that reflects a systematic and reflective dialogue involving all the actors with an interest or influence on the technology, based on concrete activities intended to promote learning. This paper has taken the proposal described by Jonassen and Roher-Murphy [30] and applied it in an exploratory study. The conclusion from this study is that the type of issues exposed by the thinking underlying activity theory will provide valuable insights that should lead to more effective and acceptable learning technologies. If this is coupled with a careful

analysis of the infrastructural issues that can be modeled within the thinking encapsulated within Actor-Network Theory, designers and developers of educational technology should be able to make significant progress in fitting technology to the reality of educational contexts as they exist to today, and to catalyse realistic and appropriate innovation.

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References

[1] Thomas L. Russell's, "The No Significant Difference Phenomenon: A Comparative Research Annotated Bibliography on Technology for Distance Education" (2001, IDECC, fifth edition)

[2] Alona Forkosh-Baruch, “Islands Of Innovation”And “School-Wide Implementations”: Two Patterns Of Ict-Based Pedagogical Innovations In Schools, Human Technology, Volume 1 (2), October 2005, 202-215

[3] Peter Scott, Kevin Quick, Heroic failures in disseminating novel e-learning technologies to corporate clients: a case study of interactive webcasting, Proceedings of the 4th International Symposium on Information and Communication Technologies, Cape Town, South Africa. Jan 3-6, 2005. ACM Press. ISBN 0-9544145-6-X

[4] P. Mederly, M. Kravcik, A. Bebjak, N. Hine, I. Gordon, W. Beattie, J.L. Arnott, A. Arato and F.P. Seiler, (1997) “A TCP/IP Daemon that Allows Inter-application Communication across the Internet”, in the proceedings of Ed-Media/Ed-Telecom 97, World Conference on Educational Multimedia/Hypermedia and Telecommunications, Calgary, Canada, 14th -19th June.

[5] N. Hine, G. Harper, W. Beattie and J. Arnott, (1998) “The LEARN-ED Distance Teaching System - Results of Use by Disabled Students”, in the proceedings of the RESNA ‘98 Annual Conference, Minneapolis, Minnesota, U.S.A., 26th -30th June.

[6] J. Martins Ferreira, G.R. Alves, R. Costa, N.A. Hine, (2002) "Collaborative Learning in a Web-accessible Workbench," Proceedings of the 8th International Workshop on Groupware (CRIWG'02), La Serena, Chile, September

[7] S. Joel, J. L. Arnott, N. Hine, S. Ingvarsson, R. Rentoul and S. Schofield, (2004) "A framework for analysing interactivity in a remote access field exploration system", in: IEEE International Conference on Systems, Man & Cybernetics, The Hague, The Netherlands, 10-13 October

[8] Prensky, M. (2001) Digital Natives, Digital Immigrants, On the Horizon, NCB University Press, Vol. 9 No. 5

[9] Meyrowitz, J. (1998). Multiple media literacies. Journal of Communication 48: 96 – 108

[10] Frechette J.D., (2002) Developing Media Literacy in Cyberspace: pedagogy and critical learning for the 21st century classroom, Praeger Publishers

[11] Turkle, S. (1997): Life on the Screen: Identity in the Age of the Internet. New York: Simon & Schuster

[12] Joinson, A., & Buchanan, T. (2001). Doing educational research on the Internet. In C. R. Wolfe (Ed.). Learning and Teaching on the World Wide Web (pp. 221-242). San Diego: Academic Press.

[13] Joinson, A. (2003). Understanding the psychology of internet behaviour: Virtual worlds, real lives. Great Britain: Palgrave Macmillan

[14] Read, S.J. and Miller, L.C. (1995) Stories are fundamental to meaning and memory: for social creatures could it be otherwise?, in Wyer, R.S. (Ed.) Knowledge and Memory: The Real Story, pp.139-152. Hillsdale, New Jersey, USA: Lawrence Erlbaum Associates, Publishers.

[15] Emler, N. (2001) Gossiping, in W.P. Robinson and H. Giles (Eds.) The New Handbook of Language and Social Psychology, pp.317-340. Chichester, England, UK: John Wiley and Sons Ltd.

[16] Schank, R.C. (1990) Tell me a story: a new look at real and artificial memory. New York, New York, USA: Scribner's, Macmillan Publishing Company.

[17] Brewer, W.F. (1995) To assert that essentially all human knowledge and memory is represented in terms of stories is certainly wrong, in Wyer, R.S. (Ed.): Knowledge and Memory: The Real Story, pp.109-119. Hillsdale, New Jersey, USA: Lawrence Erlbaum Associates, Publishers.

[18] Segall, M.H., Dasen, P.R., Berry, J.W. and Poortinga, Y.H. (1999) Human Behaviour in Global Perspective: An Introduction to Cross-Cultural Psychology. Needham Heights, MA, USA: Allyn & Bacon.

[19] Miller, P.J. (1995) Personal storytelling in everyday life: Social and cultural perspectives, in Wyer, R.S. (Ed.) Knowledge and Memory: The Real Story, pp.177-184. Hillsdale, New Jersey, USA: Lawrence Erlbaum Associates, Publishers.

[20] Scott, L.M. (1995) Representation and narrative: A commentary on Schank and Abelson's "Knowledge and Memory, in Wyer, R.S. (Ed.) Knowledge and Memory: The Real Story, pp.165-176. Hillsdale, New Jersey, USA: Lawrence Erlbaum Associates, Publishers.

[21] Csikszentmihalyi, M. and Rochberg-Halton, E. (1981) The meaning of things: domestic symbols and the self. Cambridge, England, UK: Cambridge University Press.

[22] Chalfen, R. (1987) Snapshot versions of life. Bowling Green, Ohio, USA: The Popular Press.

[23] Dunbar, R.I.M. (1996) Grooming, Gossip and the Evolution of Language. Chatham, Kent, England, UK: Mackays of Chatham plc.

[24] Dunbar, R.I.M., Marriott, A. and Duncan, N.D.C. (1997) Human conversational behaviour, Human Nature, Vol.8, No.3, pp.231-246.

[25] Emler, N. (1994) Gossip, reputation, and social adaptation, in R.F.Goodman and A. Ben-Ze'ev (Eds.) "Good Gossip", pp.117-138. Wichita, Kansas, USA: University Press of Kansas.

[26] Bruner, J. (1986). Actual minds, possible worlds. Cambridge, MA: Harvard University Press.

[27] Schank, R.C. and Abelson, R.P. (1995) Knowledge and memory: The real story, in Wyer, R.S. (Ed.) Knowledge and Memory: The Real Story, pp.1-85. Hillsdale, New Jersey, USA: Lawrence Erlbaum Associates, Publishers.

[28] Mercer, N (2000) Words and Minds: How we use language to think together London: Routledge.

[29] Law, J. (1992), Notes on the Theory of Actor-Network: Ordering Strategy and Heterogeneity, in Systems Practice v. 5. no. 4 pp. 379-393

[30] Jonassen, D. H. and Rohrer –Murphy (1999), Activity Theory as a Framework for Designing Constructivist Learning Environments, Educational Technology Research & Development, Vol 42, No. 1