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Vygotsky in Twenty-First-Century Research

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At the 2009 Ed-Media conference, a list of most often cited papers in Ed-Media 2004-2008 was revealed (Ochoa, Mendez & Duval, 2009). Vygotsky's theoretical work, originally published in Russia in the 1930s, came top of the list by a large margin. This paper examines why, and how this theory still can be relevant to twenty-first-century research. It is argued that an effective use of modern educational technologies calls for the use of advanced pedagogies. Vygotsky's theory provides a profound understanding of teaching and learning that reflects the complexity of social and cultural contexts in the modern learner. The most frequently used concepts of Vygotsky's theory are re-visited in relation to the research into new educational technologies. Additionally, the potential of some lesser known aspects of his theory, particularly in relation to educational technology, is explored. The inextricable connections between the Vygotskian approach and activity theory is discussed.

Introduction

Over the past three decades there has been an increased number of studies that address the role of cultural contexts and social influences in the use of computer technologies in teaching and learning. This coincides with a growing interest of educational researchers in Vygotsky's socio-cultural theory, which is widely renowned for its profound understanding of teaching and learning as embedded in the cultural context of children's everyday lives and inextricably linked to the way that children interact with other people. The recently presented statistics in relation to the most often cited work in Ed-Media 2004-2008 (Ochoa, Mendez & Duval, 2009) confirms this trend: Vygotsky's theoretical work, "Mind in Society", originally published in Russia in the 1930s, came top of the list by a large margin! This paper explores a variety of classical and modern theoretical constructs relevant to Vygotsky theory; it further discusses their implications for modern research, and to research into educational technology in particular such as computers, laptops, wireless connectivity, Interactive White Boards and mobile communication devices (ICT in education).

Who was Lev Vygotsky

Vygotsky's theoretical views were shaped by his own background and the social and intellectual context in which he lived and worked. A brief look into Vygotsky's educational background, as well as his professional interests and aspirations, will provide a 'biography of the ideas' (Kozulin, 1990) and give an insight into the uniqueness of his theoretical views and beliefs.

Lev Vygotsky (1896-1934) was born to a middle class family of a small town in Tsarist Russia. His father was a local 'enlightener' and a founder of the first public library in the town (Yaroshevsky, 1989). Vygotsky was educated by a private tutor, whose pedagogical technique was grounded in a form of Socratic dialogue (Wertsch, 1985) - teaching by engaging in extended critical inquiry and philosophical conversations with students. Undoubtedly, this kind of teaching influenced Vygotsky's further views on the role of social dialogue in learning. From young age Vygotsky had become known as a 'little professor' (Wertsch, 1985) showing extensive interests in and knowledge of theatre, literature, history, philosophy and languages. He was fluent in a number of languages such as German, French, English, and also read in Latin, Greek and Hebrew (Wertsch, 1985; Yaroshevsky, 1989).

Vygotsky started his career as a teacher during a time of dramatic revolutionary change in Russia when the newly formed government of workers was seeking a comprehensive system of education suitable for all classes in society. Vygotsky was inspired by the idea of creating a new education system and he took the challenge of

searching for its new theoretical base which provided the groundwork for his book on Educational Psychology, published in 1926 (Wertsch, 1985; Yaroshevsky, 1989). Vygotsky's innovative ideas on the culturally and historically mediated nature of the human mind, based on his extensive theoretical knowledge and everyday immersion in educational practice, resulted in his leading a research group which included such famous scholars as Luria and Leontiev and later became known as the Vygotskian school of psychology (Yaroshevsky, 1989).

Vygotsky's theory was not known in the English speaking world of educators until the 1960s when the first translation of his book, *Thought and Language*, was published in the USA (Vygotsky, 1962). There were several reasons for such a delay. Firstly, only a few of Vygotsky's scholarly works were published during his lifetime and these had been left as drafts. Secondly, and most importantly, shortly after Vygotsky's death, his theory was banned in the Soviet Union for twenty years, with publication of his work not being resumed until 1956 (Yaroshevsky, 1989).

There was renewed interest in the ideas of Vygotsky in the latter part of the twentieth century as demonstrated by the rise in the number of new translations of his writing and the number of citations of his work (Wertsch & Tulviste 2005). Wertsch and Tulviste suggest that the major reason for this was the re-emergence in the West of the study of developmental psychological and the relevance of Vygotsky's studies to "the social origins of mental processes" (p. 60). Lev Vygotsky, 'Mozart of psychology' (Toulmin, 1978, in Wertsch, 1985), lived a short but productive life as a truly "revolutionary scientist" (Newman & Holzman, 1993). He had inspired many generations of educational theorists and practitioners.

Overview of the approach

Vygotskian psychology (Vygotsky, 1978) stated that the human mind is constructed through a subject's interactions with the world and is an attribute of the relationship between subject and object. Consciousness is neither reducible to behaviour nor separate from it, but instead is an attribute of the organisation of practical activity. It is the process that organises behaviour. Vygotsky also claimed that consciousness is not an attribute of any particular state or process, but is an attribute of the way in which states and processes such as attention and memory, are organised and functionally related both to behaviour and to each other. It was consciousness that established the connection between the various processes, it both creates them and transforms them. In particular the nature of a goal-directed activity transforms its user. He thus introduced the idea of externally mediated activity, actions that involve the use of external means to reach a goal. This led to the idea that mental processes could only be understood if we understand the tools and signs that mediate them.

Vygotskian theory was built upon the Piagetian idea of the child as an active learner (Piaget, 1959) but with the emphasis on the role of social interaction in learning and development. However, Vygotsky emphasised that children and adults are both active agents in the process of the child's development. "Development is, in this case, *co-constructed*." (Cole & Cole, 2001, p.37). For teaching it means that both the teacher and a student are seen as active agents in children's learning. The teacher's intervention in children's learning is necessary, but it is the quality of the teacher-learner interaction, which is seen as crucial in that learning (Tharp & Gallimore, 1988). This approach is associated with the term of *social constructivism* which emphasises the role of social interaction in development and learning. According to Vygotsky, 'good learning' occurs in the Zone of Proximal Development.

The Zone of Proximal Development

Perhaps the best known concept of Vygotskian theory is that of the zone of proximal or potential development (ZPD). Initially, it was elaborated for psychological testing at school. Vygotsky stated that testing should be based not only on the current level of a child's achievements but also (and mainly) on the child's potential development. He claimed that the actual level of development (level of independent performance) does not sufficiently describe development. Rather, it indicates what is already developed or achieved, it is a 'yesterday of development'. The level of assisted performance indicates what a person can achieve in the near future, what is developing (potential level, 'tomorrow of development', what a person 'can be'). Thus, the ZPD is the distance between what a person can do with and without help. It is defined as the difference between actual level of development as determined by independent problem solving and the higher level of potential development as determined through problem solving under guidance or in collaboration with more capable peers (Vygotsky, 1978). The term proximal (nearby) indicates that the assistance provided goes just slightly beyond the learners current competence complementing and building on their existing abilities (Cole & Cole, 2001).

Vygotsky spoke about ZPD by arguing that rather than having education dragging behind in sociological development it must anticipate it - it must "run ahead". This meant distinguishing between actual and potential development. Actual level is determined by tasks that a person is capable of solving by themselves and potential, the one at which the help of instruction is necessary. Vygotsky recognised that the distance between doing something independently and with the help of another indicated stages of development, which do not necessarily coincide in all people. In this way he regarded an instructor's 'teaching' of a student not just as a source of information to be assimilated but as a lever with which the student's thought, with its structural characteristics, is shifted from level to level (Yaroshevsky, 1989).

In other words, learning in the ZPD refers to performing a range of tasks that the person cannot yet handle alone but can accomplish with the help of instructors or more capable peers. As people engage in cooperative dialogues with more capable partners, they take the language and make it part of their private speech and use this speech to organise their independent performance in the same way. They acquire the methods of collaborative performance and use them in their independent performance later.

Learning in the ZPD awakens a variety of internal developmental processes that are able to operate only when people are interacting with more experienced people. These processes are happening externally, in between two minds and they are called inter-mental processes. The process when the adult and the instructor come to a shared understanding is called 'intersubjectivity' by contemporary psychologists. It is very important to achieve intersubjectivity to enable the next stage - internalisation - to occur. The processes then become internalised and turn into a part of the child's independent achievement; that is, they become intra-mental (within one mind). According to Vygotsky (1978), developmental processes do not coincide identically with learning processes. There is unity but not equivalence of learning and internal developmental processes: it presupposes that the one is converted into the other.

In summary, internalisation is the transformation of inter-mental, external processes into intra-mental, internal ones. Internalisation occurs through the means of language (the signal system). Learning is a necessary and universal aspect of the process of human development, which is culturally and socially determined and intentionally and systematically governed in society as "human learning presupposes a specific social process by which children grow into the intellectual life of those around them" (Vygotsky 1978, p. 88).

Post-Vygotskian Studies

Vygotsky's theory stimulated a wealth of research all over the world with a number of prominent leading theoretical perspectives today developed from his theory. The numerous concepts and approaches which are associated with Vygotsky's theory could perhaps be called "post-Vygotskian studies" (Daniels, 2001, p.69). Because of their shared background they have much in common; in their attempt to investigate the development of cognition in social, cultural and historical context they interrelate and complement each other. Among such newly emerged concepts are Barbara Rogoff's (1990) concepts of *cognitive apprenticeship* and *guided participation* based on the idea of the ZPD. They involve collaboration and shared understanding in everyday problem-solving activities. Adults or more skilled peers assist children in their development by guiding their participation in relevant activities, helping them to adapt their understanding to a new situation and structuring their problem-solving attempts (Rogoff, 1990, p.191). Another influential approach is known as *situated cognition* (Lave & Wenger, 1991, in Daniels, 2001) which views learning as engaging in problem solving in the course of participation in ongoing everyday activities. It concerns learning within the communities of practices in real life situations. The importance of learning in the community and the home is highlighted in the concept of the *households' funds of knowledge* (Moll & Greenberg, 1992). This approach aims at establishing cultural connections between what teachers and students do in classrooms and what students experience in the community. It focuses on the households' social histories, methods of thinking and learning and practical skills related to the community's everyday life in order to provide teachers with the knowledge of the culture and history of the students that are being taught. The concept of *distributed cognition* (Hatchins, 1995, in Daniels, 2001) looks at the phenomenon of cognition as being extended beyond the individuals: the information is processed between the individual and tools and artefacts provided by the culture, therefore the individual's abilities and achievements cannot be understood outside of the connections to the society and culture in which they are immersed (Salomon, 1993, in Daniels, 2001).

Vygotskian Psychology and Activity Theory

Over the past two decades in Western Europe and the US, Activity Theory has gained increasing popularity in application to the area of human-computer interaction (Engeström, 1996; Nardi, 1996). Recently, an increased number of researchers adopted various aspects of Activity Theory to the analysis of a wide range of educational technologies (for example, Lim & Hang, 2003; Karasavvidis, 2009; Murphy & Rodriguez-Manzanares, 2008; Scanlon & Issroff, 2005; Demiraslan & Koçak Usluel, 2008).

The popularity of Vygotskian psychology and Activity Theory (AT), perhaps can be explained by its broad view of human learning and behaviour and its well-structured categories for analysis. From an AT perspective, people are embedded in a socio-cultural context and their behaviour cannot be understood independently of it. Furthermore, they are not just surrounded by the context of their activities but actively interact with it and change it. Humans are continually changing their environment and creating artefacts or culturally meaningful products. This complex interaction of individuals with their surroundings has been called activity and is regarded as the fundamental unit of analysis. Activity, according to Leontiev, is not a reaction and not a totality of reactions but a system that has its own structure, internal transitions and transformations and its own development (Leontiev, 1978).

Activity theory adopts the basic tenet of Vygotsky's theory that tools occupy a mediating role in human reaction and interaction with the world. Tools therefore are social objects with certain modes of operation developed socially in the course of labour and are only possible because they correspond to the objectives of a practical action. Tools can be either external (physical, technical) such as artefacts, instruments and machines or internal (psychological) such as laws, signs, procedures, methods and language. Physical tools are designed to manipulate physical objects (e.g. hammer) while psychological tools are used by humans to influence other people or themselves (e.g. concepts, advertisements, calendars). Since psychological tools are included in the process of behaviour they alter the entire flow and structure of mental functions. Similarly the physical tool (including computers) alters the process of natural adaptation by determining the form of labour operations. A physical tool can be seen as an instrument of labour, a thing which is interposed between a person and the object of their labour and which 'serves as the conductor' of their activity.

Although tools expand our possibilities to manipulate and transform different objects they also have a limiting effect in that the object can only be manipulated within the limitation of the tool. His basic idea was of historically evolving object-oriented practical activity carried out by humans determining the genesis, structure and contents of the human mind. Vygotsky derived his original ideas from an analysis of the features of specifically human activity - work activity, productive activity carried on with tools, activity that is indigenously social i.e. developed under conditions of cooperation and sharing by people. He had isolated the two principal interrelated features basic to psychology. These were the 'instrumented' (tool mediated) structure of human activity and its incorporation into the system of interrelationships with other people. This means that the higher mental functions in humans originate only in the interaction of people with people. Vygotsky did not make a complete analysis of the specific concept of activity, but his theoretical approach pre-supposed the concept as one of its fundamental building blocks.

Human-computer interaction, activity, interactivity and pedagogy

Instead of the view of the computer and its human operator as equal parts in their interaction, which originates from the traditional Human-Computer Interaction (HCI) approach, Vygotsky's psychology and Activity Theory look at the way that the computer as a tool meshes into the user's real life activities thereby helping to improve their performance. It is essential to explore the processes where information technology intercedes in the practices of humans if these practices are to be enhanced by the ICT. A branch of psychology originated by Vygotsky in the beginning of this century provides a philosophical approach that opens new perspectives for constructing experimental research into this problem. Vygotskian psychology and activity theory take a broader view of the human mind as being the product of cultural and social forces (Vygotsky, 1978). From its perspective people are not a collection of cognitive processes but in a complex interaction with the world directed to the process of living. In this approach the main feature of the psyche is the active position of human beings toward the world in which they live. This world and its social context is referred to as 'objective reality' and consists of all the things (objects) which contribute to human existence such as events, happenings, interactions, etc. Humans are continually changing the objects and creating artefacts - tools. This complex interaction of individuals with their surrounding, called activity, is regarded as the fundamental unit of analysis of the human mind (Leontiev, 1978). Activity is motivated by the objects to be changed. Object orientedness

and mediation by tools is one of the most distinguishing characteristics of activity. Tools are seen as having extended human ability to achieve the goals of an activity, that is, to change objects in the world. This theory treats tools as a means of meeting real needs and achieving corresponding goals. This leads us to a different research approach, one with many more elements which emphasise the role of the computer as a tool embedded in human activity, both mental and physical.

In spite of the advantage (and the common sense) of looking at the computer as a tool which enhances human activity, it is still common to analyse the role of the computer technologies in their interaction with its user such as a teacher or student (Westin, 2009). This, in turn, leads to a particular view the role of computer technologies in enhancing teaching and learning. To judge on the effectiveness of a particular piece of technologies, educational researchers, and designers, turn towards studying the characteristics of that particular piece of technology. Obviously, it is important to study the characteristics of the 'tool', however, this approach does not guarantee a manufacturer (or a manager of the school who purchased it!) that the product will be successfully used by its consumers (such as teachers or lecturers, or students) in a real life setting such as a school or a tertiary institution. To this end, it is interesting to re-visit research reported by Engestrom and Escalante (1996), who vividly described a case of a vending machine named 'postal buddy' which was manufactured to substitute for a salesperson in the Post Office. It was anticipated that the 'postal buddy', which was designed to talk and interact with the customers, and offer them a variety of merchandise, would welcome the buyers, friendly communicate with them and therefore sell the products just as successfully as an experienced salesperson! It turned out to become a commercial failure, as the customers reflection was that they did not come to the Post Office to communicate but they just wanted to buy stamps, envelopes and greeting cards. The goal of the manufactures to enhance the interactivity between the human (buyer) and the computer (the postal buddy) failed to meet user's specific needs.

Activity theory provides us with a view of the ICT user, as an active entity in their real life setting, whose behaviour is driven by their needs and motivation. In their life, and at their work place, people perform a number of different activities to achieve goals and satisfy their needs. Interacting with a computer as an isolated act, obviously, is not a goal of high priority. People need to see the advantage of using ICT to achieve their real life goals and satisfy their existing needs in a more effective manner.

This approach can be extended to understanding recently emerged interactive technologies such as Interactive White Boards (IWBs) which are rapidly becoming a necessary attribute of a modern classroom. The view of ICT as a teaching tool is important in educational research as it urges a re-examination of the notion of interactivity. "Interactivity is a widely used term of great concern to researchers and practitioners in communication theory and human-computer interaction (Steuer 1992) and the idea of interactivity certainly appeals to the broad public, as indicated by the attention that the term has received over the last few years (Rafaeli, 1988)" (Roussou, Oliver & Slater, 2008, p.142). Although there is no agreement as to what interactivity (and interaction) mean in educational literature (Roussou et al, 2008; Kahveci, 2007), "researchers are in agreement that both terms are vital for teaching and learning one way or another" (Kahveci, 2007, p. 809).

Should interactivity be viewed as an attribute of the technology, or as an interaction between the student and the technology? Or does it belong to teachers' pedagogy and their interpretation of curricula? If we accept the "tools' based philosophy of technology" (Verenikina & Gould, 1998), the latter is the most productive, as it is the teacher who orchestrates the classroom learning environment by making everyday decisions on pedagogically appropriate interaction arrangements.

If the teacher's pedagogical goal is to use group work to enhance students' learning by bouncing their ideas against each other in a group of peers in order to 'co-construct' their views, then the teacher would look for an appropriate piece of technology to enhance this process. If the teacher's goal is to use a computer as a tutor (Taylor, 1980) then the notion of 'digital interactivity' (Westin, 2009) between the learner and the technology becomes appropriate. However, it is important to keep in mind the most recent findings which indicate that interactivity, in fact, can be limiting: "Current digital interactivity enables only reactive behavior of the user but not an active choice and interpretation" (Westin, 2009, p. 3).

It is no surprise that the research which asks the question whether IWBs can enhance interactivity in the classroom, or increase the students' academic achievements, does not always get a positive answer. For example, Moss and colleagues' (2007) recent statistical study of the relationship between IWB installation levels and pupil performance "failed to find any evidence that the increase in the installation of interactive whiteboards (IWBs) in London schools has increased pupil performance in Key Stage tests" (Moss et al., 2007, p.72). We cannot expect the tool substitute for a robust pedagogical approach. To be successful, the new

technologies call for the use of advanced pedagogies. “To a large extent the kinds of changes the technology fosters depend on what teachers think it is for... When use of the technological tools took precedence over a clear understanding of pedagogic purpose, the technology was not exploited in a way that would or could substantially enhance subject learning.” (Moss et al, 2007, pp. 6-7)

Activity theory model and ICT in education

A significant number of current studies into educational technologies consider Activity theory as a robust theoretical framework for research. “There is certainly no doubt that activity theory has significant influence in contemporary educational discourses and has become an influential tool for the analysis and transformation of practices” (Martin & Peim, 2009, p.131). The potential of activity theory is that, “...it affords a holistic description of an activity system in terms of its basic components and interrelations” (Karasavvidis, 2009, p. 438).

Activity Theory (AT) allows us to conceptualise technology as a tool within a complex system of goal oriented activities at both the individual level of a teacher or a learner and at a broader level of an organisation such as school (Murphy & Rodriguez-Manzanares, 2008).

The model of AT developed by Engestrom (2001, as shown in Figure 1) enables researchers to systematically analyse “the whole configuration of events, activities, contents, and interpersonal processes taking place in the context that ICT is used” (Demiraslan & Koçak Usluel, 2008, p.460).

The model represents activity as a dynamic unity of several elements which interact with each other as an activity develops. The *subject* of activity can be either a teacher or a learner depending on the purposes of analysis. When considering a teacher’s activity the *object* of the activity can be seen as enhanced teaching using digital technologies as a pedagogical *tool*. Each teacher operates within a *community* which refers to the wider school community, and includes the students in the classrooms, other teachers in the school, administration staff and school leaders.

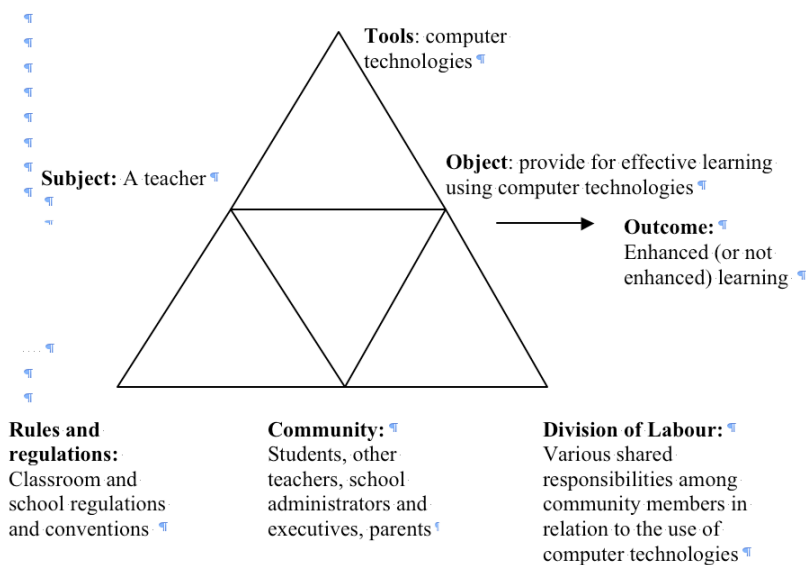


Figure 1. Activity system model: A teacher’s activity mediated by ICT within a school community (adapted from Engestrom, 2001)

The *tools* used by the teachers include technology, lesson materials, assessment and teaching functions. For the purposes of this study, we focus on tools of digital technologies and their use within pedagogical practices. The *object* of the activity here is enhanced teaching using newer communications technologies. *Rules* refer to classroom regulations and conventions (for example, expected student behaviour, promoted learning theories), as well as school technology and educational policies and regulations (for example, perceived demands, the regulations of accessibility, professional development). Rules can be implicit, for example, normative practices, social standards, or simply the way things are done. They can be either malleable or fixed, and are often a source of *tension* as they can afford, or constrain what is allowed within the Activity System.

The *division of labour* refers to the social reality of technology use such as the division of power between the subject (teacher) and the community (eg students in the classrooms); the implementation of the objectives of the use of technology items (and how the objectives change the nature of learning experiences through the integration of technology); the manifestation of the implicit and explicit objectives (beliefs) teachers have when teaching and learning with technology. The *outcome* of the activity system would be enhanced (or not enhanced) teaching and learning with technology in the classrooms.

Activity theory provides a framework for understanding the dynamic relationship between the elements of activity system. It allows us to examine the social tensions involved in the networks of human activity and how elements seemingly individual are interconnected (Yamagata-Lynch & Haudenschild, 2009). The analysis of tensions offers researchers the opportunity to explore potential barriers (Zevenbergen & Lerman, 2007) such as those anticipated to occur when ICT are introduced into an established school environment. Additionally, the view of contradictions as the driving force of change within an Activity System, provides a versatile tool to inquire into various aspects of educational technology use and its evolution over time.

Cases of Implementation

This section presents an overview of a number of research studies conducted in the Faculty of Education, University of Wollongong, which utilise Vygotsky's psychology and Activity theory in researching the use of ICT in various educational settings.

The use of ICT in teaching English for Specific Purposes (ESP) in a tertiary institution in Saudi Arabia

The study of Ibrahim Shaabi (2010) was focussed on the role of socio-cultural factors in the success of ICT integration in a tertiary institution in a Saudi Arabian context. The research which analysed the use of ICT in ESP teaching in an English Language Centre through the lens of the Activity theory model, demonstrated that the adoption of traditional social patterns in changing teaching environments is not efficient for the implementation of technology and that socio-cultural change in educational institutions is essential for smooth technology integration (Hayes, 2007; Hu & Webb, 2009). The implementation of technological change was not a simple matter of providing a set of new instructional resources to be added within traditional methods. The existing socio-cultural environment in the study of the ICT ESP context in a Saudi Arabian institution was found to be centralised, fixed and not easily adaptable to new elements. Consequently, the employment of ICT in such context was not fully supported at all the levels of the organisation. The Activity system analysis allowed the identification of significant contradictions between the decision making processes at the level of administration, the lack of coordination between the technical support team and individual teachers, as well as a lack of communication between the members of the teachers' community. Additionally, a restrictive policy of the use of the ICT such as the Internet, contradicted the pedagogical goals of ESP teachers. It was concluded that effective ICT integration requires a critical level of planning, coordination, and cultural adaptation.

The study of computer-mediated learning in a social constructivist environment

The doctoral study of Tony Stojkovski (2010) examined computer-supported learning in a socio-constructivist environment in an Australian high school classroom. The study is based in the pedagogical approach of social constructivism (Palincsar, 2005; Smagorinsky, 2007) where the communication with more knowledgeable members of society is the underlying premise of learning and development (Vygotsky, 1978). Learning is seeing as a process of social negotiation or collaboratively making sense of theories, mentoring, and joint knowledge construction. The study also drew on Vygotsky's ideas of the role of language in learning (Vygotsky, 1978).

The social constructivist approach to learning has been applied by Scardamalia and Bereiter (1994) in computer mediated (online) communication in a purposefully designed Computer Supported Intentional Learning Environment (CSILE). The study drew on the role of written language in enhancing both the understanding of the content and the development of higher order thinking in students (Scardamalia & Bereiter, 1994; Chan, Burtis, Scardamalia & Bereiter, 1992). The researchers found that written communication provided an opportunity for students to give elaborate explanations of their thoughts. However, communication in these studies was restricted to online interactions only. The study of Stojkovski (2010) extended this line of research by investigating learning and communication in a computer-mediated social constructivist environment that supported both oral and written communication in an authentic classroom setting. A computer-mediated socio-

constructivist environment (CMSCE) was created to incorporate writing in the process of exchanging of ideas and, as such, to enhance the co-construction of knowledge by drawing on the strength of written language as a powerful complementary learning tool to oral communication (Shy-Jong, 2007). Over a period of eight weeks the participants (nine Year 11 students) were required to complete a research project on a topic in an area of physical health, social drugs and physical activity. The students had to enter their work into their CMSCE page. This 'work in progress' was available to be viewed by all members of the class, and allowed the teacher and other students to provide feedback. The study allowed the capture of a significant number of episodes of social construction of knowledge among the participating students in their communication with the teacher and peers in both oral and written modes of communication.

The study of contradictions in the use of the Interactive Whiteboard (IWB) in literacy teaching

A project that studied the implementation and the use of IWBs in literacy teaching in an Australian primary school, explored how interactive learning technology represented in the IWB mediates literacy teaching from the perspective of an Activity System (Kervin & Jones, 2009; Verenikina, Wrona, Jones & Kervin, 2010). Activity Theory allowed the researchers to holistically explore the different factors that influence the use of technology as a tool within literacy teaching: the individual beliefs and motivation, the interactions within the class and school community, the rules and regulations of technology use and the rules and traditions in an organisation. The analysis of teaching literacy activity indicated that the subject brings biases and beliefs to the literacy experience, which influences views regarding the ability of technology to mediate successful literacy outcomes. In addition, the subject's underlying pedagogical beliefs influence how the tool will be used to mediate the literacy experience. That is, for personal or pragmatic reasons teachers may employ pedagogical practices that vary in their level of interactivity, which consequently impact upon how a technological tool will be used in the literacy session.

The study explored the rules of the literacy Activity System. It was found that the rules embedded in IWBs technology do not necessarily encourage pedagogical practices which employ interactivity. For example, in the study, the IWB software would only allow one student at a time to engage with the board. Thus, although the technology was by definition interactive, the interactivity did not support the features of interactive learning, which was confusing for the teachers. The rules that make up the curriculum were influential in determining both how technology could mediate practice, and which types of practices teachers employed. For instance, explicit or implicit rules found within the curriculum motivated teachers to use pedagogical styles, which varied in their degree of interactivity. That is, if the achievement of a specific learning outcome does not require a highly interactive teaching style there is little reason for an educator to use highly interactive tools or methods.

It was found that the division of labour between the teacher and students within the classroom limited or dictated the type of pedagogical and technological interactivity that was used. For instance, it was more pragmatic for a teacher to employ a less interactive practice when explaining general information to a whole class. However, deep interactive learning that focuses on the co-construction of knowledge, collaborative working practices and discovery problem solving, required everyone to have a shared role in activity. Overall, the results suggested that technology alone is not the remedy to a quality education system rather that technology is useful relative to its need in achieving a learning outcome. It re-examined the importance of pedagogy by arguing that interactive technology will not necessarily result in deep and interactive student learning.

Technology support in learning of children with Autism Spectrum Disorders

The current study of the use of technologies in learning of children with Autism Spectrum Disorders (ASD) identified the need for a holistic approach to address the problem (Tanner, Dixon & Verenikina, 2010). The analysis of the literature demonstrated that commonly the students with ASD eagerly engage in working with technology as the clear rule-based systems used by digital and visual technology make them highly suitable for such individuals. It has been found in clinical trials that the use of predictable, routine, systems-oriented visual technologies can help support the learning of students with ASD (Tanner et al., 2010). However, the researchers express caution about the generalisation of such findings to the applied setting of the classroom and suggest that there may be some barriers that classroom teachers might face if applying these research findings to their teaching practice.

Because of the emphasis on a strictly controlled single subject multiple baseline methodology, there is little data as to how digital technologies can improve learning in group situations in classroom settings which is the most

common educational placement for students with ASD. There is little research that addresses teacher competency in digital technologies and students with ASD. The research project undertakes an investigation of the use of technologies in children with autism spectrum disorders in a natural educational settings and examine the implementation of the technology from the perspective of classroom teachers as they orchestrate the learning environment in their classroom in collaboration with the school administration, fellow teachers and the students.

Conclusion

In his recent paper in the *Computers & Education Journal*, Karasavvidis (2009) refers to a number of studies which demonstrated that “for the most part teachers used technology to enhance traditional practices rather than transforming them” (p.436). It was suggested that, thus, the mere availability of technology did not result in any substantial change in terms of teaching practices. Indeed, new technologies call for advanced pedagogies to ensure their effective use. The theory of Vygotsky, which has gained an increased popularity in the past three decades, provides a rich, comprehensive and well established framework for an advanced pedagogy of this kind. A number of prominent leading theoretical perspectives which stemmed from the theory of Vygotsky provide a wealth of ideas and approaches to support and substantiate such pedagogy.

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