CH 6: AN MLEARNING TOOLSET

Authors

David Parsons[1] (david@themindlab.com) and Kathryn MacCallum[2] (KMacCallum@eit.ac.nz)

1. The Mind Lab by Unitec, Auckland, New Zealand
2. Eastern Institute of Technology, Napier, New Zealand

Abstract

The development of effective mobile learning activities requires the careful selection of, and emphasis on, appropriate learning theory. However, operationalising the various principles of learning theories in mobile learning activity design can be challenging due to the dynamic changes in technology and learning environments taking place in education and the broad range of theories that can potentially be applied. This e-chapter introduces and discusses a set of resources (six evaluation rubrics, a Mobile Learning Activity Analyser tool and three worked examples) that have been created to help support educators in the development and evaluation of mobile learning activities. These resources will assist educators to align their activity designs with appropriate learning theories and principles.

Author Introduction

http://iamlearning.pressbooks.com/wp-content/uploads/sites/65654/2017/09/Ch-0-Introduction.mp4

An mLearning Toolset for Leveraging Learning Theory

DAVID PARSONS AND KATHRYN MACCALLUM

Introduction: Learning Theory from Socrates to Socrative

Theories about how effective teaching and learning takes place have been discussed for a very long time. The common structures of formal education, the lecture, the tutorial and the workshop, have been around at least as long as Socrates and the didactic plays, but it wasn't until public formal education began to become internationally widespread in the 19th century that the ground was laid for more recent developments in learning theory. As societies began to invest significant parts of their finances into education, they were increasingly interested in knowing how that investment might translate into socially beneficial outcomes. Academics, practitioners and researchers have thus been engaging with the mysteries of teaching and learning from myriad perspectives as educational structures, societies and economies have continued to evolve and constantly pose new questions about what we learn, why we learn, and how we learn. When mobile technologies are integrated into the theoretical mix, these questions become even more complex and challenging for educators to address.

Learning theories abound

One might ask why so many different learning theories have been developed over the last hundred years or so, and to what extent these are simply shaped by fashion rather than the actualities of learning. One answer to this question is the idea that as society develops and evolves it requires new learning theories to explain how learning best takes place in the given contemporary context (Harasim, 2012). Thus the industrial age gave us behavioural theories, the scientific age gave us cognitive theories, a more child-focused age gave us constructivist theories, a more social age gave us social learning theories, and a more divergent, interactive society gave us situated and distributed theories. Finally, an Internet connected age gives us new theories of connectivist digital teaching and learning. Does this mean, then, that these earlier learning theories become obsolete? Generally not. Instead, what these theories give us is layers of interpretation that join together what goes on inside the mind, what goes on in the learner's social context and what happens in the interaction between these two. Often these theories weave together and build upon each other. As society becomes more complex and connected, more aspects of teaching and learning need to be taken into account. Of course, there is an element of fashion in learning theory. Learning styles, for example, seem to have been a once fashionable theory that is no longer accepted by many (Pashler, McDaniel, Rohrer & Bjork, 2008), while early behavioral psychologists might have problems getting their studies through a contemporary ethics committee. For example, Piaget used his own children as data, Ebbinghaus used only himself, and Watson frightened a small child with a rat. Reactionary attitudes are also evident from some authors (e.g. Kirschner, Sweller & Clark, 2006) who choose to champion narrow instructivist principles based on simple cognitive models. Nevertheless, many different theories have stood the test of time, and in this resource we focus on six that we believe are highly relevant and often discussed in the context of mobile learning activities; behaviourism, constructivism, experiential learning, situated learning, communities of practice and connectivism.

From theories to metatheories

With the legacy of past theorising in research we are left with a range of choices about how we choose to think about how learning takes place and therefore how we might design learning experiences. How, then, can we choose the most appropriate learning theory or select an appropriate theoretical frame? This is, of course, not a new question and various people have put forward what might be called meta-theories; that is, frameworks for teaching and learning that acknowledge the multiplicity of theory that might apply to a given context. Examples of this would include activity theory (Peña-Ayala, Sossa & Méndez, 2014) and the conversational framework (Laurillard, 2013), both of which acknowledge the role of other theories as being components of these approaches. Labelling these as meta-theories (theories about theories) recognises that seeing how different theories can complement each other is an important feature of putting theory into practice. We take a similar approach in this chapter. We are not attempting to create any new theories, but we do adopt our own meta-theory, which draws from the works of many others and is primarily designed to be used as a practical tool for thinking about mobile learning activity design rather than any deeply analytical theoretical exploration.

The title of this introduction, 'from Socrates to Socrative', is intended to encapsulate the journey from the foundations of learning theory with the Socratic method to today's mobile learning tools, with Socrative (https://www.socrative.com) as an online student interaction tool being a typical example of how mobile technology enables new approaches to teaching and learning that were never before possible. Our challenge as educators is to consider how such radical changes in what can be done to foster learning can lead to changes in our own practice, supported by pedagogical perspectives and validated by established learning theories.

The components of this chapter

This e-chapter is centred around the provision of some resources that are intended to be useful to educators interested in the evaluation and/or creation of mobile learning activities.

We begin with a summary of the six Learning Theories for Mobile Learning that we subsequently use for the other material; behaviourism, constructivism, experiential learning, situated learning, communities of practice and connectivism. We then provide an introduction to the resources we have developed to help apply these learning theories to mobile activity design.

One of the main resources is a set of rubrics based on the six learning theories mentioned above and intended to help educators evaluate the theoretical underpinnings of mobile learning activities. This set of rubrics is somewhat traditional in that it is non-interactive and does not combine together features of different learning theories. We see this as primarily useful as an evaluation tool, which is simple to apply and gives direct feedback on how an existing mobile learning activity might operationalise specific theories.

The other main resource is an interactive software tool called the Mobile Learning Activity Analyser, written in a combination of HTML5 and JavaScript, enabling it to run easily on both mobile devices and larger screens. This tool provides a more integrated and interactive way of thinking about the role of learning theory in mobile learning, and we see this as being more useful as part of an iterative design process. Feedback from the tool can be used to guide an evolving mobile learning activity design. These resources are supported by some multimedia materials that explain how the tools can be used.

We provide three examples of how these tools can be applied. There are two examples of applying the rubrics to existing mobile learning activities and one example of applying the mobile learning analyser to the evolving design of a new mobile learning activity. The first example of using the rubric is augmenting the real world with mobile technology, an analysis of the well-known Ambient Wood project, while the second applies the rubric to mobile language learning within a personal learning environment using the Busuu language app (an earlier version of this analysis appeared in MacCallum & Parsons, 2016). The final example describes the process of using the analyser tool to refine the initial design of a mobile learning activity.

Six Learning Theories

Six Learning Theories for Mobile Learning

Before introducing the resources that were developed, we first provide a brief overview of each of the six learning theories that we have chosen to integrate into the chapter and the associated toolkit. In each case, we have only provided a very brief summary of each of these theories, and a passing mention of some of the major theorists. For each theory we have given some suggestions as to how it might be applied to mobile learning activities.

Behaviourism

ILLUSTRATIVE QUOTE

> "The ideal of behaviorism is to eliminate coercion: to apply controls by changing the environment in such a way as to reinforce the kind of behavior that benefits everyone."(Skinner, cited in Sobel, 1990)

OVERVIEW

Behaviourism is the oldest of learning theories. Mergel (1998) traces it back to Aristotle, who noted associations being made between events such as lightning and thunder. However, it was John Watson who actually coined the term 'behaviorism' in 1913. Conditioning of behaviour by external interactions is an impor-

tant part of behaviourist theory. In Pavlov's classical conditioning, stimulus leads to response, while in Skinner's instrumental conditioning, behaviour leads to reinforcement (Olsen & Hergenhahn, 2013). While such approaches might seem somewhat mechanistic, the concepts of rapid feedback embodied within them are important in helping learners to work at their own pace. The idea of positive reinforcement was outlined by Thorndike, who emphasised how 'satisfaction' could reinforce positive behaviours (Tapp, 1969), while Skinner (cited in Sobel, 1990) noted that the ideal of behaviorism is to change the environment to reinforce the kind of behavior that benefits everyone. Thalheimer (2013) describes how reinforcement of learning is related to Ebbinghaus' spacing effect, where learning is greater when studying is spread out over time.

Some Well-known Theorists: Ivan Pavlov, John Watson, Edward Thorndike, B.F. Skinner

KEY FEATURES OF BEHAVIOURISM

Key features	Explanation
1.An emphasis on producing observable and measurable outcomes in students	Learners should be told the explicit outcomes of the learning so that they can set expectations and can judge for themselves whether or not they have achieved the outcome of the lesson.
2. Testing learners to determine whether or not they have achieved the learning outcomes	Testing and assessment should be integrated into the learning sequence to check the learner's achievement level and to provide appropriate feedback. This can also include pre-assessment of students to determine where instruction should begin.
3. Appropriate sequencing of learning materials to promote learning	Learning materials must be sequenced appropriately to promote learning. The sequencing could take the form of simple to complex, known to unknown, or knowledge to application. There should be an emphasis on mastering early steps before progressing to more complex levels of performance.
4. Providing feedback to learners so they can monitor how they are doing and take corrective action if required	Learners must be provided with feedback so that they can monitor how they are doing and respond to that feedback to change their learning behaviour.
5. Providing reinforcement to positively impact performance (e.g. tangible rewards, informative feedback.)	Use of reinforcement to impact performance. This can take the form of tangible rewards and informative feedback. It may occur in a repeated process, with the reinforcement shaping the response until it is correctly executed.

Sources: Ertmer & Newby (1993), Ally (2004).

BEHAVIORISM IN MOBILE LEARNING ACTIVITIES

Behaviorist principles are commonly seen in mobile learning tools that enable quizzes, in-class polling, discussion, and question and answer, as well as for sequenced skills-based learning such as mobile assisted language learning. Reinforcement through immediate feedback is a core feature of these types of tools. Gamification can be used for positive reinforcement.

Constructivism

ILLUSTRATIVE QUOTE

> "The principle goal of education... should be creating men and women who are creative, inventive, and discoverers, who can be critical and verify, and not accept, everything they are offered." (Piaget, 1988)

OVERVIEW

Behaviourism might seem to be a rather passive process for the learner, simply responding to external stimuli. However, in the early 20th century a number of theorists looked at various ways that learners are able to construct their own knowledge. Constructivist theory asserts that learners actively construct or create their own subjective representations of objective reality, and link new information to prior knowledge. Frederic Bartlett first referred to the constructive nature of memory in 1932. Dewey (1933) stressed the value of outdoor education and hands-on, experiential learning, while Vygotsky (1978) emphasized the social role of learning, with the help of 'more knowledgeable others' (which might these days include digital sources) in the zone of proximal development. Other theorists also looked at the learner's interaction with their environment, for example Piaget, who stated that knowledge was built, not transferred (von Glaserfeld, 1982), and Bruner (1961), who believed that educational environments should provide the opportunity for discovery learning. These theorists are generally referred to as constructivists, since they focus on the learner being able to construct their own knowledge, though the term encompasses a number of different approaches. Dougiamas (1998) provides an

overview of several types of constructivism in the literature. One more recent variation is constructionism, developed by Piaget's student Seymour Papert, and focused on the physical construction of artefacts ('learning by doing') as a key component of constructing knowledge (Papert & Harel, 1991). Another varlant is social constructivism, which builds on 'social construction' (Berger & Luckmann,1966), around which debates are often philosophically dense. It has often been linked with technology enhanced learning and has affinity with some aspects of Communities of Practice (covered later).

Some Well-known Theorists: Lev Vygotsky, Jean Piaget, John Dewey, Jerome Bruner

KEY FEATURES OF CONSTRUCTIVISM

Key features	Explanation
1. Learning should be an active and meaningful process	Keeping learners active doing meaningful activities results in high-level processing, which facilitates the creation of personalized meaning. Asking learners to apply the information in a practical situation is an active process, and facilitates personal interpretation and relevance.
2. Learners should construct their own knowledge rather than accepting that given by the instructor	Knowledge construction is facilitated by good interactive instruction, since the students have to take the initiative to learn and to interact with other students and the instructor, and because the learning agenda is controlled by the student.
3. Collaborative and cooperative learning should be encouraged to facilitate constructivist learning	Working with other learners gives learners real-life experience of working in a group, and allows them to use their metacognitive skills. Learners will also be able to use the strengths of other learners, and to learn from others.
4. Learners should be given control of the learning process and time and opportunity to reflect	There should be a form of guided discovery where learners are allowed to make decision on learning goals, but with some guidance from the instructor. Learners should be given time and opportunity to reflect. When learning, students need the time to reflect and internalize the information.
5. Learning should be interactive to promote higher-level learning and social presence, and to help develop personal meaning	Learning is the development of new knowledge, skills, and attitudes as the learner interacts with information and the environment. Interaction is also critical to creating a sense of presence and a sense of community for online learners, and to promoting transformational learning. Learning should be made meaningful for learners. The learning materials should include examples that relate to students, so that they can make sense of the information. Assignments and projects should allow learners to choose meaningful activities to help them apply and personalize the information.

Source: Ally (2004)

CONSTRUCTIVISM IN MOBILE LEARNING ACTIVITIES

Mobile devices offer many opportunities for working with physical or conceptual materials to construct new artefacts and knowledge, such as tools for recording, mixing and disseminating various types of multimedia content. Mobile constructivist activities might include taking photos, recording videos and/or sound, editing and combining these artefacts with other media,

using mobile tools to create social media content or coding mobile apps.

Experiential learning

ILLUSTRATIVE QUOTE

> "The process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience" (Kolb, 1984, p.41)

OVERVIEW

Experiential learning is developed from many other learning theories, in particular Dewey's work on experience which emphasised that we do not learn from the experience itself, but from reflecting upon it (Beard & Wilson, 2013). The key aspect of this theory is that knowledge is created through the transformation of experience (Kolb & Kolb, 2009). Beard and Wilson (2013) state that experiential learning joins many other learning theories together into a unified whole and that the experience of the learner interacting with the external environment provides the most coherent theory of learning. A key concept in experiential learning is that there is some kind of cycle of concrete experience. There are various models for this, often based on 4 stages, for example Kolb's experiencing/noticing – interpreting/reflecting – generalising / judging – applying / testing, and the Shewart/Deming cycle of plan, do, reflect, act. Wilson (2012) notes that the experiences of learning can be both formal and informal.

Some Well-known Theorists: John Dewey, David Kolb, Kurt Lewin

KEY FEATURES OF EXPERIENTIAL LEARNING

Key features	Explanation
1. Experience is the foundation for learning	Experiential learning is spiral-like where students can learn from experience over and over again, so that experience reinforces and conceptualises learning.
2. Learning is the transformation of experience into knowledge, skill, attitudes, values and emotions	Learning is a process of transforming our experiences and internalising them to form our knowledge, skill, attitudes, values and emotions. Learning is best facilitated by a process that draws out the students' beliefs and ideas about a topic so that they can be examined, tested and integrated with new, more refined ideas.
3. Reflection is the means of transforming experience	The continued reflection upon earlier experiences is needed in order to add to and transform our experiences into deeper understanding and reinforce them into learning.
4. Learning takes place through a cycle of concrete experience, reflective observation, abstract conceptualization and active experimentation	A learner goes through all phases in the learning process – experiencing, reflecting, thinking, and acting – in a recursive process that is responsive to the learning situation and what is being learned. Immediate or concrete experiences are the basis for observations and reflections. These reflections are assimilated and distilled into abstract concepts from which new implications for action can be drawn. These implications can be actively tested and serve as guides in creating new experiences.
5. Knowledge is created through the transformation of experience	This theory overlaps and intersects with constructivist theories of learning whereby social knowledge is created and recreated in the personal knowledge of the learner. Education must be conceived as a continuing reconstruction of experience.

Source: Kolb & Kolb (2009), Conole, Dyke, Oliver & Seale (2004).

EXPERIENTIAL LEARNING IN MOBILE LEARNING ACTIVITIES

The portable, always-on nature of mobile devices means that they can be used to capture and curate experiences and materials for later reflection, and transformation of experience into knowledge. Devices can be used to gather evidence from an experience and subsequently to communicate, analyse and visualise the knowledge gained from that evidence. Mobile devices can provide a range of experimental tools (e.g. environment, location and orientation sensors) and related analytical applications.

Situated Cognition

ILLUSTRATIVE QUOTE

> "The activity in which knowledge is developed and deployed, it is now argued, is not separable from or ancillary to learning and cognition... Rather, it is an integral part of what is learned. Situations might be said to co-produce knowledge through activity." (Brown, Collins & Duguid,1989, p.32)

OVERVIEW

Situated cognition, who's best known theorist is John Seely Brown, focuses on how knowledge is embedded in the activity, context, and culture in which it was learned (Brown, Collins & Duguid, 1989). Learning is social and not isolated. Rather, people learn while interacting with each other through shared activities and through language as they discuss, share knowledge, and problem-solve during these tasks (a form of socio-cultural learning). The concept of situated cognition resonates well with experiential learning, but goes further to stress the integral nature of the situation in which the learning activity takes place, where the situation itself co-produces knowledge through activity (Brown, Collins & Duguid, 1989). We might also see some links with situated learning and distributed cognition (Henning, 2004).

Some Well-known Theorists: John Seely Brown, Allan Collins, Paul Duguid

KEY FEATURES OF SITUATED COGNITION

Key features	Explanation
1. Providing authentic contexts and activities that reflect the way the knowledge will be used in real-life	The context needs to be all embracing, to provide the purpose and motivation for learning, and to provide a sustained and complex learning environment that can be explored at length.
2. Providing access to expert performances and the modelling of processes	Authentic learning environments provide access to such expert thinking and performances, allowing students to observe the task before it is attempted and to access the modelling of processes.
3. Supporting collaborative construction of knowledge	Opportunities are provided for students to work in small groups or pairs. Such an arrangement allows students to 'put their heads together' on problems, and to fully articulate their progress as they go about the task.
4. Providing coaching and scaffolding at critical times	The role of the teacher is one of coaching and scaffolding – observing students, modelling, providing resources, offering hints and reminders, providing feedback, and so on – rather than a didactic one
5. Promoting reflection to enable abstractions to be formed	Students are required to reflect upon a broad base of knowledge to solve problems, and to predict, hypothesise, and experiment to produce a solution

Source: Herrington & Oliver (1995)

SITUATED COGNITION IN MOBILE LEARNING ACTIVITIES

The value of mobile devices in relation to situated cognition is that their portability enables them to be taken into different contexts. Expert performances and models of processes can be taken into the context of use, for example for just-in-time training for technical tasks. Learning activities can take place outside the classroom and across multiple spaces. Mobile device features such as location awareness, communication tools and sensors can be very valuable in applying knowledge to real life situations. Mobile tools can enhance the learning potentials of a given situation by providing tools to explore environments such as augmented reality and audio tours. Situations can also be simulated by using virtual reality tools.

Communities of Practice

ILLUSTRATIVE QUOTE

> "Communities of practice are formed by people who engage in a process of collective learning

> in a shared domain of human endeavour...who share a concern or a passion for something they do and learn how to do it better as they interact regularly." (Wenger, 2000).

OVERVIEW

Salomon and Perkins (1998) in exploring social learning, asserted that social systems can engage in learning as much as individuals. The importance of learning with others is central to a community of practice (Farnsworth, Kleanthous & Wenger-Trayner, 2016), which similarly emphasizes context and culture but also regards the authentic domain of the learning community as important. A community of practice is the simplest social unit that has the characteristics of a social learning system (Wenger, 2000). A process of social learning occurs when people who have a common interest in a subject or area collaborate over an extended period of time, sharing ideas and strategies, determine solutions, and build innovations. Learning can be, and often is, an incidental outcome that accompanies these social processes (Farnsworth, Kleanthous & Wenger-Trayner, 2016).

Some Well-known Theorists: C.S.Pierce, Jean Lave, Etienne Wenger

KEY FEATURES OF COMMUNITIES OF PRACTICE

Key features	Explanation
1. 'Practice' is the unifying feature of the community	Members of a CoP interact in the community to negotiate a joint enterprise, which defines significance, shapes practices, and develops into community standards of practice.
2. Member relationships are grounded in information exchange and knowledge creation	Mutual engagement describes relationships that are grounded in mutual interest, not just information exchange, networking, or interaction. Communities of practice support engagement in part by facilitating members to share their histories, of what they have done and what they have been
3. Membership ranges from novices to old timers (diversity)	Through legitimate peripheral participation, novices learn from mentors, and then eventually participate fully in the CoP. The experts and novices undertake various roles to communicate, contribute to and initiate ideas and joint projects.
4. Learning is shared, and may also occur effectively at the boundaries/ peripheries of the community	Learning also occurs at the boundaries, when learners may not be fully participating directly in a specific activity, but nevertheless participate on the periphery
5. Learning can be, and often is, an incidental outcome that accompanies these social processes	Members interact and engage mutually with one another; sharing ideas and stories, not necessarily when engaged in work. By this mutual engagement, knowledge is shared and enacted.

Source: Lai, Pratt, Anderson & Stigter (2006)

COMMUNITIES OF PRACTICE IN MOBILE LEARNING ACTIVITIES

A community of practice is a social learning system, which can usefully be supported by mobile devices. The rich set of messaging and social media tools that are available on mobile devices provide a range of options for learners in any context to collaborate and learn with their community.

Connectivism

ILLUSTRATIVE QUOTE

> "Learning... can reside outside of ourselves... is focused on connecting specialized information sets, and the connections that enable us to learn more are more important than our current state of knowing." (Siemens, 2004, para 21)

OVERVIEW

While most learning theories are grounded in 20th century thinking, in the 21st century we have seen the rise of new theories such as connectivism (Armatas, Spratt & Vincent, 2013), which has been proposed as 'a learning theory for the digital age.' The concept of connectivism is based on the idea that Internet technologies have created new opportunities for people to learn and share information across networks. Learners develop knowledge through peer networks and online, and these connections are more important than our current state of knowing (Siemens, 2004). Unlike other learning theories, connectivism does not address transferring, making or building knowledge. Rather, it is about how we grow or develop ourselves and our society in connected ways (Downes, 2012). Another perspective of connectivism is that rather than thinking about how technology influences learning, we should think about how learning influences technology, since social changes are greater than those occurring within technology (Kizito, 2016).

Some Well-known Theorists: George Siemens, Stephen Downes

KEY FEATURES OF CONNECTIVISM

Key features	Explanation
1. A stimulating and motivating learning activity that asks of and allows for learners to create artefacts in personal networks linked to other social networks	Learners should be able to cognitively interact and engage to create or modify artefacts, and engage deeply with others while reflecting on these artefacts.
2. A technologically- supported environment that supports meaningful dialogue and collaboration	The learner uses technological tools such as blogs, wikis and social networks to participate in learning. These tools engage with others to share and support learning.
3. Learners use diverse information sources offline and online, formal and informal	Learners learn how to navigate the networking terrain by identifying the right resource nodes (people or information).
4. Leveraging skills that are transferable across media, platforms and tools to expand students' learning networks	In a connectivist learning context, each learner should be assisted by a facilitator, peers, experts, and non-human support mechanisms to create and maintain a personal learning network (PLN) immersed in other networks.
5. Developing a dynamic, technology-based knowledge community and learning network wherein students critically evaluate and synthesize concepts, opinions and perspectives	Learner–content and learner–group interactions occur at a deeper level. The technological, social and conceptual grid is tightened as learners aggregate, make decisions, reflect, and build a coherent understanding of information collaboratively.

Source: Kizito (2016)

CONNECTIVISM IN MOBILE LEARNING ACTIVITIES

Connectivist learners will share and communicate dynamic knowledge creation through networked interaction with machines and other people. The communication tools in mobile devices, coupled with the resources available through Internet connectivity, make connectivism an important theory for mobile learning. Mobile technology can help to provide the scaffolding for connectivist learning (Ozan & Kesim, 2013) and provide the channels for interacting with dynamic sources of data. From a connectivist perspective, the process of going through a mobile learning experience is more important than any content that may happen to be learned in the process.

The Analytical Tools

The analytical tools – mapping mobile learning theory to aspects of task design

The underpinning concept of this chapter is that an understanding of how some relevant learning theories are, or could be, used in a mobile learning activity can help us to make the most of mobile learning opportunities, either by selecting a suitable existing activity or by designing a new one. We have addressed the need to be able to assess the relationship between theory and design by creating some evaluation tools, based on some key features of behaviourism (Ertmer & Newby, 2013; Ally, 2004), constructivism (Ally, 2004), experiential learning (Conole, Dyke, Oliver & Seale 2004; Kolb & Kolb, 2009; Beard & Wilson, 2013) situated cognition (Brown, Collins & Duguid, 1989; Herrington & Oliver, 1995), communities of practice (Wenger, 2000; Lai, Pratt, Anderson & Stigter, 2006) and connectivism (Siemens, 2004; Armatas, Spratt & Vincent, 2013; Kizito, 2016).

The tools provided are a set of rubrics and an interactive analyser tool. Although we have suggested in this e-chapter that the rubric may be best suited to assessing an existing activity while the analyser might be more appropriate for designing a new activity, in fact either tool could be used for either purpose.

This section will first discuss the rubric and two examples of how they can be used to evaluate a learning activity, and then discuss

the analyser tool alongside an example of how it can be used to develop and improve a learning activity.

The Rubrics

The mobile learning activity rubrics each have 6 levels, where level zero indicates a complete absence of any evidence of this learning theory in a given activity, while level 5 indicates that the activity fully operationalises that particular learning theory. Levels 4 and 5 both indicate a design intent, whereas levels 1, 2 and 3 suggest that certain components of learning theories may be present but may not be an integral part of the learning design. Each rubric has synthesised and assimilated the major aspects of each identified criteria to embody the key aspects of each theory into a form that gives evaluative structure to observations (Brookhart, 2013).

See the Digital Extras section for a short video that provides an overview of how the rubrics work and can be used to evaluate a mobile learning activity.

Example 1: Augmenting the real world with mobile technology

The Ambient Wood Project was an innovative educational project involving primary school children using mobile technology to augment and explore a physical woodland environment (Dix, Finlay, Abowd & Beale, 2003). The following provides a discussion of how the six learning theories have been operationalised in this activity as well as the relative level to which these theories have been embedded within the design (this is the subjective evaluation of the authors and could be the subject of further valuable discussion). The theories are addressed in descending order of the extent to which they have been adopted within this activity.

EXPERIENTIAL LEARNING

The project centered around pairs of children equipped with a number of devices exploring and reflecting upon a physical environment that had been prepared with a WiFi network and

Radio Frequency (RF) location beacons. Exploring this environment was the foundation of the learning and this interaction was basis of the learning experience. This exploratory investigation allowed the children to build complex understandings of the rich ecological environment and lifecycles including the fragility of these habitats. The project was underpinned by experiential learning principles where the children were transforming their experience into knowledge. The children were allowed to explore and discover aspects about plants and animals living in the various habitats in the wood. The field trip was used to encourage learners to discover, reflect, hypothesize and experiment with biological processes taking place within a physical environment (Rogers, et. al., 2002). The project enabled learners to integrate their understanding and knowledge through a dialectic process of reflecting and acting. The learning took place through a cycle of concrete experience, reflective observation, abstract conceptualization and active experimentation within the environment and the experiences they had within the learning environment.

Based on this we have evaluated the case study at level 5 of the Experiential Learning rubric. "The mobile activity is **wholly designed** around a cycle of experience, observation, conceptualization, and experimentation, transformed through reflection into new knowledge" (Figure 6.1).

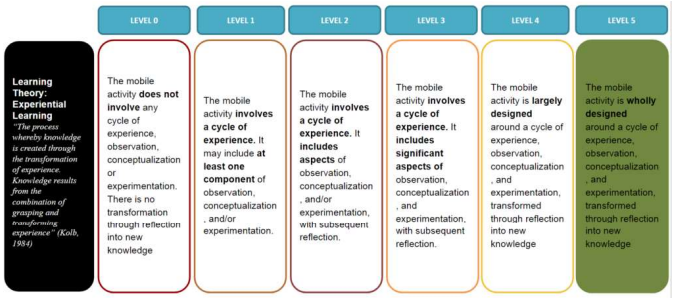

Figure 6.1: Assessment of Experiential Learning theory principles based on the rubric

SITUATED COGNITION

The learning was based on exploring a physical environment,

providng the authentic context and activities typical of situated cognition. The project enabled learners to integrate their understanding and knowledge through a dialectic process of reflecting and acting, and to do so in a playful way (Rogers et al., 2002). The students interacted with the environment at length and with others through shared activities and language. The expert is provided in the form of the additional information accessible via the RFID tags. However, the students learn from each other on how to use and engage with these tags. The teacher's role was largely one of support and coaching. The students learned through the exploration of the environment no longer dictated by the teacher. The data collection was used to help engage the learners in problem solving with developing and examining hypothesis on what the data would be able to tell them.

Based on this we have evaluated the case study at level 5 of the Situated Cognition rubric. "The mobile activity is **wholly designed** around an authentic context and activities that reflect real-life application and support collaborative knowledge construction through coaching, expert performances, process modelling and reflection" (Figure 6.2).

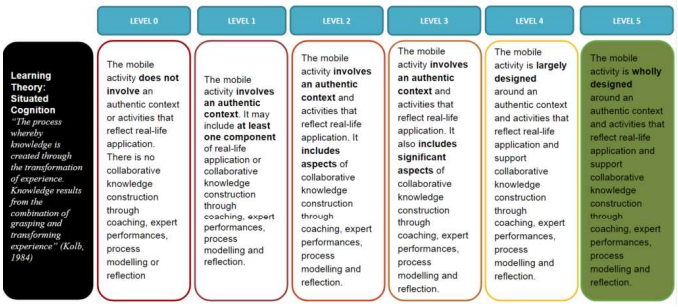

Figure 6.2: Assessment of Situated Cognition theory principles based on the rubric

CONSTRUCTIVISM

Underpinning this project was a rich set of located technologies which supported collaborative construction of knowledge. Learners were to work in groups to explore a real environment of the woodland. Learners were to learn from each other and collaborate with each other to gather data and learn about the

environment. Mobile devices, RF identification tags, movement sensors and multi-modal displays were used to trigger and present 'added' digital information which students could engage with to learn about their environments (Rogers et al., 2002). This enabled the learners to be guided in their learning, however they were still able to interact and further explore by using the mobile devices to look up more information about these points of interest.

The devices were used to also take environmental readings like temperature and humidity, reflecting a typically constructivist mobile learning activity (Anand, Herrington & Agostinho, 2008). The students were engaged in active learning and used their devices to engage with high-level processing of information. The activities were wholly practical in nature and relied on the group to actively process and interpret the data and information gathered. The learning agenda was set by the students where they could choose what to explore and were encouraged to take the initiative to learn and to interact with the learning environment.

Knowledge was co-constructed by the engagement with the other learners, supplemented by the digital information provided by the instructor and by gather data via the mobile device. However, we might regard the activities as being too directed by the embedded tools to fully engage with constructivist learning and lacks the true attainment of higher-level learning and social presence, to help develop personal meaning.

Based on this we have evaluated the case study at level 4 of the Constructivism rubric. "The mobile activity is **largely designed** around (inter)active construction of knowledge by learners using collaboration and cooperation. Learners have control of the learning process and time and opportunity to reflect and develop personal meaning" (Figure 6.3).

COMMUNITIES OF PRACTICE

Social interaction and communities of practice were encouraged to a degree. Walkie Talkies were used by the children (novice) to communicate with a remote facilitator (expert), and used to answer questions posed by the remote facilitator. Additional information could also be received by the students via the

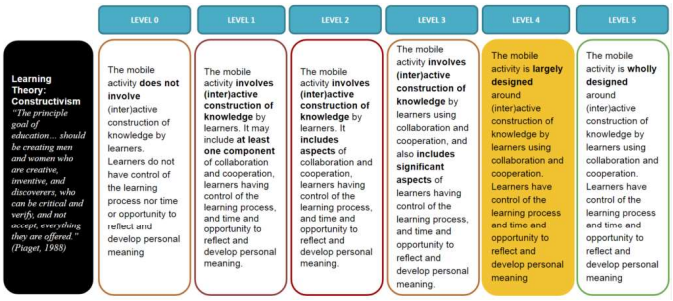

Figure 6.3: Assessment of Constructivism theory principles based on the rubric

mobile devices (Randell, Phelps & Rogers, 2003). They shared a domain and learned within it, but this community was short lived, confined to the scope of the activity. However the learning involved learners negotiating a joint enterprise with their own standards of practice and engagement, with some more taking a more peripheral participation within the learning activity.

Based on this we have evaluated the case study at level 3 of the Communities of Practice rubric. "The mobile activity **involves a diverse, unifying community of practice** and also includes **significant aspects** of shared learning accompanying a social process of information exchange and knowledge creation." (Figure 6.4).

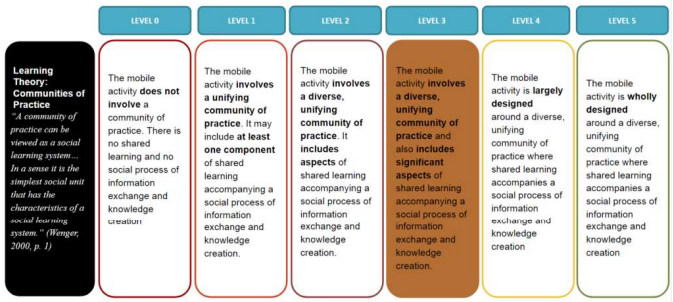

Figure 6.4: Assessment of Communities of Practice theory principles based on the rubric

CONNECTIVISM

The connectivism component was limited by the range of networked resources and tools that were available at the time of

the project, which pre-dated the publication of connectivist theory. Nevertheless, the technologically-supported environment that supported dialogue and collaboration supported some connectivist features.

Based on this we have evaluated the case study at level 2 of the Connectivism rubric. "The mobile activity **involves the creation and critical evaluation of artefacts** in learning networks, and **includes aspects** of using collaborative technologies, diverse information sources and transferable social media skills." (Figure 6.5).

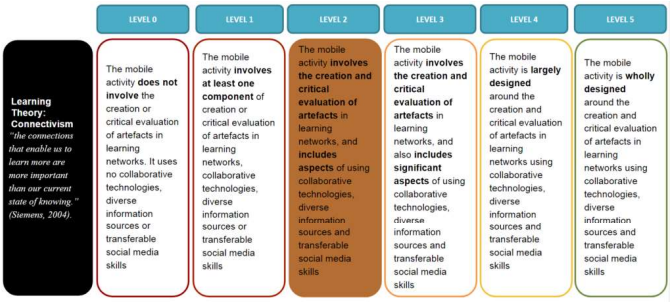

Figure 6.5: Assessment of connectivism theory principles based on the rubric

BEHAVIOURISM

Behaviourism is only conceptualised in this activity in the sense that there are some measurable learning outcomes. However, these aims are rather fluid as the experience of the activity itself is the primary focus. The activity also has some feedback with the teachers providing support and coaching as required and when sought by the students.

Based on this we have evaluated the case study at level 1 of the Behaviourism rubric. "The mobile activity **involves at least one component** of measurable outcomes, testing, sequenced materials, feedback or reinforcement." (Figure 6.6).

Based on this analysis it is evident that the project was underpinned, to different degrees, by the six learning theories; namely connectivism, experiential learning, constructivism, communities of practice, situated cognition and behaviourism,

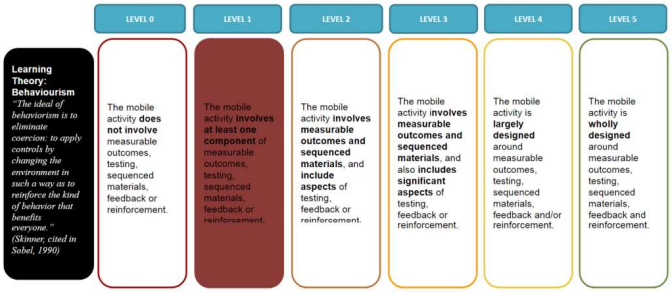

Figure 6.6: Assessment of behaviourism principles based on the rubric

with a core focus on situated, experiential learning. Behaviourism was the least operationalised of the theories.

Example 2: Mobile language learning apps within a personal learning environment

Mobile Assisted Language Learning (MALL) is a popular topic for mobile learning applications and has been the subject of extensive research (Viberg & Grönlund, 2013). Reasons for the popularity of MALL include personal mobility, personalised learning, social contact and collaboration (Kukulska-Hulme & Shield, 2008). Thus any exemplar chosen to explore MALL in practice should not only provide individual language experiences but support learning with others. With this in mind we have chosen the Busuu app as one example of many, because it combines both the conventional drill and practice of a multitude of language learning apps with a connectivist approach to social media and personal learning networks (Brick, 2011). Busuu is a mobile and web self-paced language learning application. The platform allows learners to practise their skills directly with other native speakers in a world-wide community of users. The application embeds interactive multimedia content with a social networking environment (Busuu, 2017). Ketyi (2013) notes that Busuu has an active and supportive community of learning, and its social networking features scored highly in a study by Liu et al (2013), while Gaved *et al* (2013) emphasised the impact of its feedback and progress indicators.

BEHAVIOURISM

As with most language learning applications, Busuu is heavily underpinned by behaviourist learning principles, with the core aspect of the app focusing on drill and practice of the repetitive language activities (Storz, Maillet, Brienne, Chotel & Dang, 2012). Learners are scaffolded within their learning, where a course is broken down into learning units. Language learning units enable learners to practice and reinforce their learning, underpinned by the formation of habits mainly through imitation and repetition (Mitchell, Myles & Marsden, 2013).

Badges are used to reinforce behaviour, show achievement (e.g. completing a learning unit or finishing a course) and encourage interaction in the community (e.g. correcting posts) (Álvarez Valencia, 2014). The use of the reward system is an example of continuous reinforcement and therefore further emphasises the behaviorist approach to learning.

Based on this we can judge that this case study falls within level 5 of the Behaviourism rubric. "The mobile activity is **wholly designed** around measurable outcomes, testing, sequenced materials, feedback and reinforcement." (Figure 6.7).

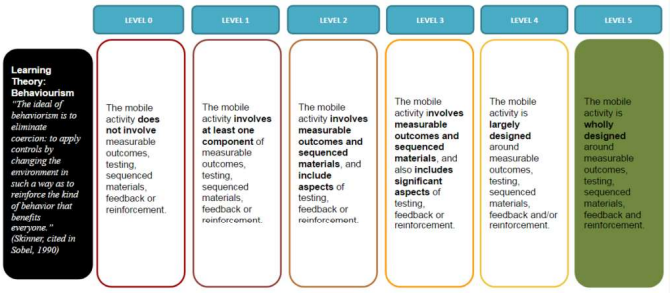

Figure 6.7: Assessment of Behaviourism learning principles based on the rubric

CONNECTIVISM

The use of social networks to connect with friends and others is an important focus of the app. Users sign up, send friendship invitations, and create groups to exchange text corrections, translations or simply to exchange some thoughts, as well as practice with native speakers of a specific language (Garcia, 2013). This interaction enables and supports meaningful dia-

logue and collaboration, a significant component of connectivist learning theory. The application provides the ability for users to network with other learners to discuss and share learning (Orsini-Jones, Brick & Pibworth, 2014). The features of the system enable a dynamic, technology-based knowledge community and learning network wherein students critically evaluate and synthesise concepts, opinions and perspectives.

Based on this we can judge that this case study falls within level 4 of the Connectivism rubric. "The mobile activity is **largely designed** around the creation and critical evaluation of artefacts in learning networks using collaborative technologies, diverse information sources and transferable social media skills" (Figure 6.8).

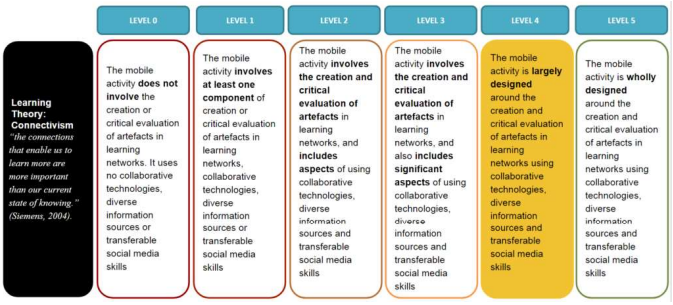

Figure 6.8: Assessment of connectivism theory principles based on the rubric

CONSTRUCTIVISM

In addition to reinforcing and encouraging positive behaviour, badges are used to encourage collaboration and interaction between users. Some of these collaborative activities include written exercises, audio recording, and chat. These collaborative and cooperative learning activities are an important driving factor for encouraging and facilitating constructivist learning. Also underpinning the constructivist paradigm is that learning is self-paced and learners can attempt the activities at their own pace.

The badges also reinforce gameplay (Álvarez Valencia, 2014). The game play extends the behaviourist approach to also include elements of constructivism. Users are able to compare and rank themselves based on the number of Busuu-berries

(the reward system used in Busuu) they have and with those of their friends. Learners are also able to challenge other users to complete learning units to obtain more berries. The gamification approach adopted in the application helps to "builds goal-orientation, collaboration, and competition into otherwise boring or hard activities" (Reinhardt & Chen, 2013 p 13). This approach helps make the learning more active and supports the transformation of the learning into a meaningful process.

Based on this we can assume that this case study falls within level 3 of the Constructivism rubric. "The mobile activity **involves (inter)active construction of knowledge** by learners using collaboration and cooperation, and also **includes significant aspects** of learners having control of the learning process, and time and opportunity to reflect and develop personal meaning." (Figure 6.9).

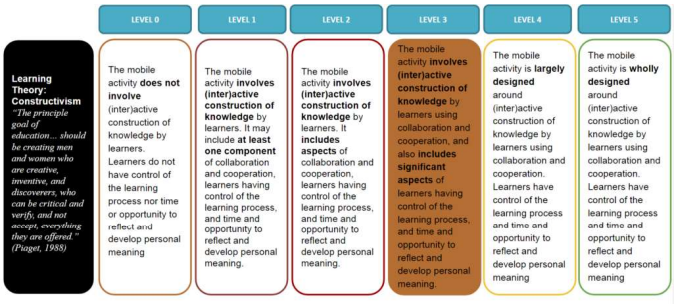

Figure 6.9: Assessment of Constructivism theory principles based on the rubric

COMMUNITIES OF PRACTICE

Another factor within the application is its strong domain-based learning community which is an important component of communities of practice (Wenger, 2000). Users are encouraged to engage with other learners, for example by peer-reviewing others' audio-recordings of dialogues. The audio recording facility allows learners to participate in a dialogue with others and more advanced learners are encouraged to support new learners so learners are encouraged to be both teacher and student. The social network allows people to correct other users' written work, making each user an expert in their own language (Garcia, 2013).

Based on this we can judge that this case study falls within level 3 of the Communities of Practice rubric. "The mobile activity **involves a diverse, unifying community of practice** and also includes **significant aspects** of shared learning accompanying a social process of information exchange and knowledge creation." (Figure 6.10).

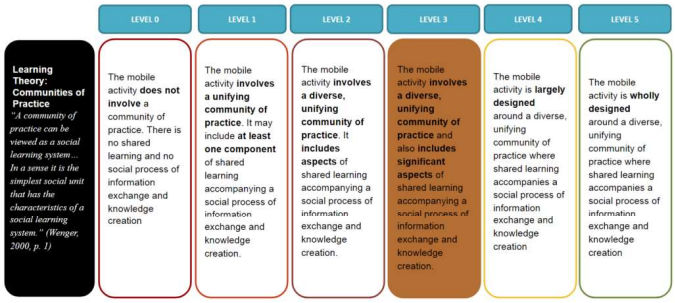

Figure 6.10: Assessment of Communities of Practice theory principles based on the rubric

SITUATED COGNITION

Busuu is used not used to help support a learner while engaging with their environment, however there is still a strong real-life application where learners are able to interact with native speakers to practice and develop their skills. Therefore, based on this, we can judge that this case study falls only within level 1 of the Situated Cognition rubric. "The mobile activity **involves an authentic context**. It may include **at least one component** of real-life application or collaborative knowledge construction through coaching, expert performances, process modelling and reflection." (Figure 6.11).

EXPERIENTIAL LEARNING

The mobile activity shows no evidence of any cycle of experience, observation, conceptualization or experimentation. There is simply not enough structure to the activities within Busuu to ensure that learners go through a reflective cycle of experience. They may do so, but only through their own agency. As a result, there is no transformation through reflection into new knowledge as a direct result of using the app. Again, this may well happen through learner agency but is not embedded into

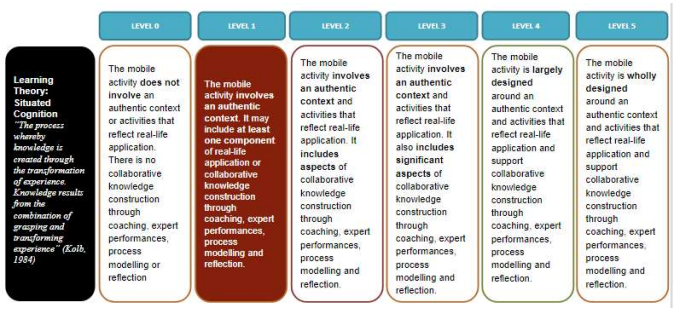

Figure 6.11: Assessment of Situated Cognition principles based on the rubric

the application design. Therefore, based on this, we can judge that this case study has no evidence of experiential learning as is assessed at level 0 of the Experiential Learning rubric. "The mobile activity **does not involve** any cycle of experience, observation, conceptualization or experimentation. There is no transformation through reflection into new knowledge." (Figure 6.12).

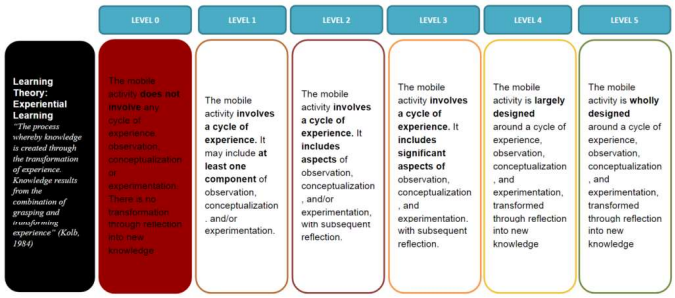

Figure 6.12: Assessment of Experiential Learning theory principles based on the rubric

Our analysis suggests that the application mainly leverages the principles of four learning theories; behaviourism, constructivism, connectivism and communities of practice, but is most strongly behaviorist and connectivist. Situated learning is only marginally linked with this activity and there is no evidence of experiential learning intrinsic to the activity.

The Analyser Tool

The Mobile Learning Activity Design Analyser is a web based tool

that provides an interactive feedback mechanism for mobile learning activity design. Unlike the rubrics, it does not focus on individual learning theories. Rather it takes various features from the six theories and proves a series of statements about these. The user can select the level of presence of each of these statements in a particular design. The tool uses these responses to analyse the theoretical content of the design and gives feedback as to how it might be improved. The tool can be used multiple times to help refine an activity design.

It should be noted that the tool we have developed was influenced by the approach of the Mobile Learning Toolkit for Educators (Burden and Kearney, 2017) based on the iPAC framework. However, the basis of their approach is the three principal constructs of personalisation, authenticity and collaboration, while ours focuses more on specific aspects of a broader set of learning theories. Further, the output from the Mobile Learning Toolkit for Educators is a polar chart, but no specific recommendations for further development are provided. Thus we see our work as significantly different in focus.

See the Digital Extras section for a short video that provides an overview of how the Digital Analyzer works and can be used to evaluate a mobile learning activity.

INITIAL DESIGN

In this mobile learning activity, individual learners will be guided by a mobile learning app to several outdoor locations using the GPS sensors on their mobile devices. At each location they will be asked by the mobile learning app to answer a multiple choice question about that particular destination. For this example we assume that these destinations are local sites of historical interest, so a multiple choice question might ask something like 'in what year was this foundation stone laid?' At the end of the activity each learner will receive their overall score and feedback of the correct answers.

ANALYSING THE DESIGN

If we apply the mobile learning analyser to this design, we might assess it at the levels shown in the following example. We will

show each step in the 6 step analysis process and indicate our responses to each of the statements (note that there is a degree of subjective judgement in the process, so you might think differently). Each step comprise four statements, and the current design is evaluated against each statement using a 5 point slider that ranges from 0 (not at all) to 4 (this is the primary content).

The first four statements are as follows (Figure 6.13). We have assessed the design as being relatively high in terms of measurable and observable outcomes, and testing whether those outcomes have been achieved. However, there is less facility for feedback allowing learners to take corrective action or positive reinforcement, since feedback occurs at the end.

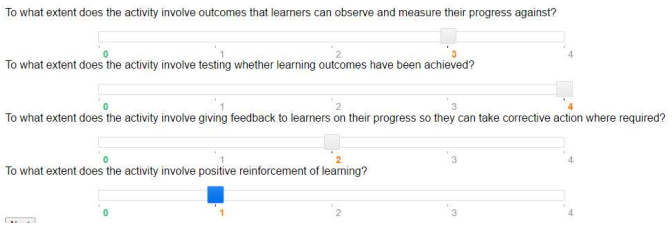

Figure 6.13: First set of questions within the Analyser Tool

Looking at the next four statements (Figure 6.14), although the activity is sequenced there is no meaningful process in that sequence, simply a series of questions at the same kind of level. Learners have no control of the learning process, and while there may be some opportunities for reflection and construction of their own learning these are very limited within the constraints of the activity.

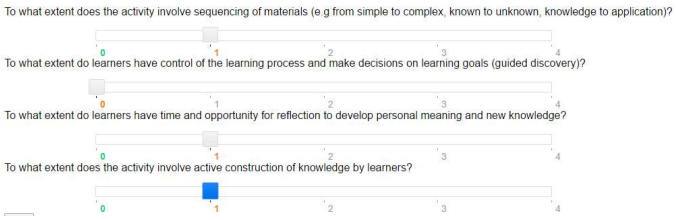

Figure 6.14: Second set of questions within the Analyser Tool

The activity design performs particularly poorly against the next four questions (Figure 6.15) since it is an individual activity and

there is no collaboration, either directly with others or through collaborative Technologies. There are some small elements of experience and observation but no defined cycle, and there is no opportunity for conceptualisation or experimentation.

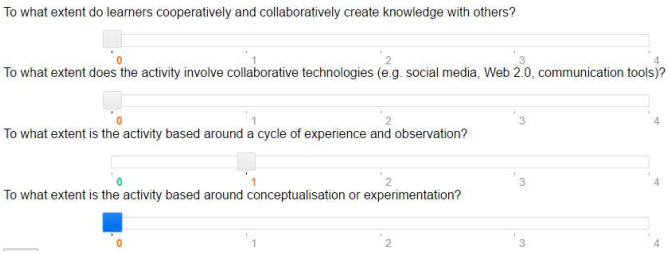

Figure 6.15: Third set of questions within the Analyser Tool

For the next four questions (Figure 6.16) the learning activity certainly does involve an authentic context, and there is at least the potential for a degree of real life application, depending on the particular context. However there is no coaching, expert performance or modelling evident in the design.

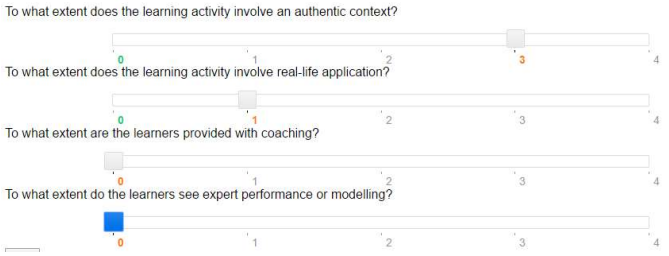

Figure 6.16: Fourth set of questions within the Analyser Tool

The design also performs poorly against the next set of questions (Figure 6.17), since there is no social community or shared learning involved in the process.

In the final set of questions (Figure 6.18) the application again performs rather poorly. There are no social media skills or created artefacts. It is possible that the information sources in the activity could be somewhat diverse, but this would depend on the choice of locations.

The chart (Figure 6.19) generated by the tool suggests that the

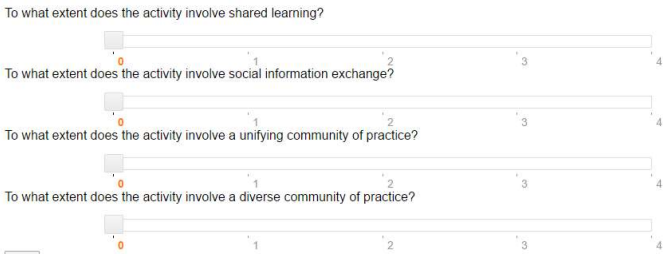

Figure 6.17: Fifth set of questions within the Analyser Tool

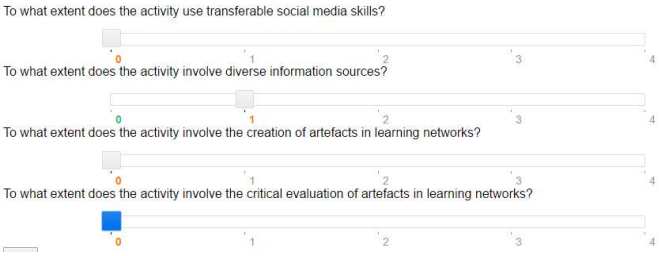

Figure 6.18: Sixth set of questions within the Analyser Tool

overall degree of learning theory in the proposed design is rather limited, so there may be some opportunities to rethink the design to provide a more effective learning experience.

The feedback provided by the analysis tool is shown below (Figure 6.20).

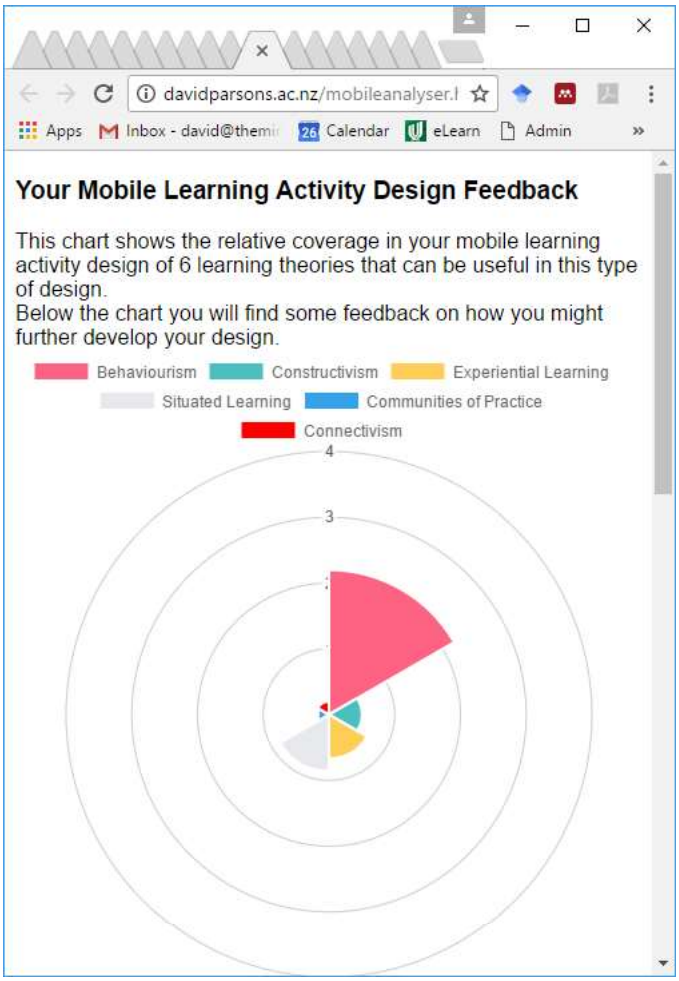

Figure 6.19: Final screen showing the radar chart indicating how each learning theory is operationalised within the study

The scores for each learning theory are as follows:

Communities of Practice with a score of 0.17

Connectivism with a score of 0.20

Constructivism with a score of 0.50

Experiential Learning with a score of 0.67

Situated Learning with a score of 0.86

Behaviourism with a score of 2.20

The theory best covered in your design is behaviourism with a score of 2.20

The theory least covered in your design is Communities of Practice with a score of 0.17

You might consider including further aspects of **Behaviourism** in your design;

- Including measurable outcomes that learners can observe and measure their progress against
- Testing whether learning outcomes have been achieved
- Sequencing materials (e.g from simple to complex, known to unknown, knowledge to application)
- Giving feedback to learners on their progress so they can take corrective action where required
- Providing positive reinforcement of learning.

You might consider including further aspects of **Communities Of Practice** in your design;

- Providing activities that involve shared learning
- Providing activities that involve social information exchange
- Involving learners in a unifying community of practice
- Involving learners in a diverse community of practice
- Enabling learners to actively construct their own knowledge
- Enabling learners to cooperatively and collaboratively create knowledge with others

Figure 6.20: Final screen showing the scores for each learning theory and how they could be improved.

REDESIGNING THE ACTIVITY

As seen in Figure 6.20, the tool provides the user with some advice as to how the design could be improved. This focuses on two areas; where is the activity strongest in terms of learning theory, therefore what is already reasonably well established and could be further developed? Also, what area is least covered? Perhaps considering this might bring a new and interest-

ing dimension to the activity design. In this case behaviourism was the theory with the best coverage and communities of practice the least, so with this in mind let us consider redesigning the activity by taking on board some of the advice.

Looking at the suggestions made, it would be helpful if we were to incorporate a better sequence of materials, integrating ongoing feedback that would enable users to take corrective action and also to receive positive reinforcement of learning. One way of doing this might be to ensure that the sequence of locations that the user is taken through creates a kind of narrative that will build, perhaps, a social, fictional, historical, economic or political story. Feedback on multiple choice questions should be immediate and there should be positive reinforcement such as gamification components (badges, leaderboards etc.) Also, the sequence of learning should progress, so we might start with simple multiple choice questions, move to more discursive questions, or provide greater challenges such as giving clues to something that should be photographed and described.

To include components of a community of practice, learners need to be engaged with other learners. This need not be in a physical context but could be sharing discoveries in an online community so, for example, if learners are attempting to answer clues to find and describe locations their photographs and descriptions could be shared on social media to enable learners to actively construct knowledge and do so collaboratively with others. The activity should enable new locations, journeys, narratives and challenges to be co-created by the learners.

These are just a few suggestions about how the advice from the analyser tool might be used to develop and enhance an initial mobile design, and of course the tool could be used multiple times until the activity designer is satisfied with their design.

Conclusion

Mobile learning is no different from any other type of technology supported learning, where careful foregrounding of appropriate learning theories over choice of tools is important to ensure that effective learning is likely to occur. It is, clear that

there are a number of current theories and approaches that are strongly aligned to the unique affordances of mobile technology (see for example Ozan & Kesim (2013) and Herrington & Herrington (2007)). This e-chapter covers how current mobile learning theory can be mapped to aspects of task design. The tools covered in this chapter each explain how these tools can be used to develop a toolkit to guide educators in designing effective mobile learning activities. The resources enable a detailed explanation of how this toolkit can be used by educators, as either an analytical or a design tool, explained through examples of different mobile learning activities.

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Digital Extras - Design Rubrics

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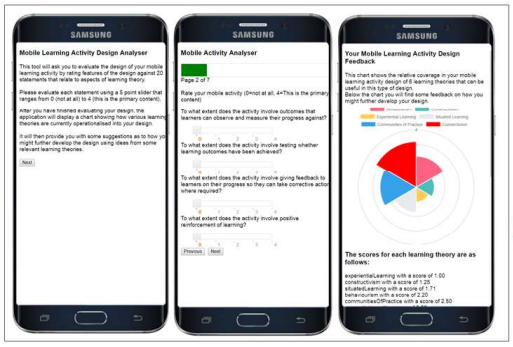
Mobile Learning Activity Design Rubrics

Digital Extras - The Digital Analyzer

Click on the image or text below to access the Mobile Learning Activity Design Analyser



Mobile Learning Activity Design Analyser

http://davidparsons.ac.nz/mobilealyser.html

Mobile Learning Activity Design Analyser

The following video gives an overview of how the Digital Analyzer tool works, and can be used to develop and evaluate a mobile learning activity:
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Citation

Parsons, D., & MacCallum, K. (2017). An mLearning toolset for leveraging learning theory. In R. Power, M. Ally, D. Cristol, & A. Palalas (Eds.), *IAmLearning: Mobilizing and supporting educator practice.* [e-Book]. International Association for Mobile Learning. https://iamlearning.pressbooks.com/part/ch-6-an-mlearning-toolset/

ISBN: 978-1-7751408-0-1