A Survey of Research Methods and Purposes in Mobile Learning

Anna Wingkvist, Linnaeus University, Sweden
Morgan Ericsson, Uppsala University, Sweden

ABSTRACT

In this paper, the authors present a survey of published research in mobile learning. The authors investigate 114 papers from mLearn 2005, 2007, and 2008, and classify them according to two dimensions: research method and research purpose. Research methods and purposes are important parts of how research is conducted. Opinions and approaches toward research differ greatly. The classified papers are evenly distributed among the research methods investigated, with one exception, there are few in basic research. In terms of research purpose, papers that describe research are well represented but there is a lack of papers targeting evaluation. Papers recounting both basic research and research evaluation are imperative, as they help a research field to mature and researchers to avoid repeating known pitfalls. This maturity, in turn, leads to better scalability and sustainability for future research efforts in the mobile learning community.

Keywords: Method, Mobile Learning, Purpose, Review, Survey

INTRODUCTION

Naismith et al., (2004) defines mobile learning as mobile technology that supports learning across locations, or learning that takes advantage of the opportunities offered by portable technologies. There has been a rapid growth in research, development, and deployment of mobile learning in recent years (Taylor et al., 2006). According to Kukulska-Hulme et al., (2009), this rapid growth has led to a number of significant activities in schools, workplaces, museums, cities, and rural areas around the world. There are, however, a number of issues identified that need further attention (Sharples et al., 2008). Research conducted into mobile learning is often small-scale and has seldom been developed into learning aids that are in wide use; hence we are faced with limitations of both scale and sustainability (Keegan, 2005). The field is compelled to evolve and find common ground in order to develop comprehensive principles and realistic visions, moving beyond specific implementations and branded technologies (Cobcroft et al., 2006). In addition, Traxler and Kukulska-Hulme (2005) conclude that few previous studies have been based on sound theory.

Mobile learning is still considered a young research field. The first research publications appeared in the late 1990s and the first international conference, the World Conference on
Mobile Learning (shortened to ‘mLearn’), was held in 2001. Vavoula and Sharples (2009) state that many of the influences on mobile learning research, and in turn frameworks, methods, and tools, have been borrowed from other research fields such as Technology-Enhanced Learning and Mobile Human-Computer Interaction. Influences from research fields such as Computer Supported Collaborative Work and E-learning can also be seen. Many researchers active in the field of mobile learning have backgrounds in Computer Science, Information Systems, and Media Technology. The body of researchers includes both academics and professionals (e.g., educators and software developers).

A young research field is often highly opportunistic and technology driven. A primary focus is set on producing solutions and less attention is given to research methods and the execution of the scientific process. As mobile learning matures it is necessary to examine how this line of research is being conducted. At the same time we need to understand the impact of the technology and comprehend the knowledge that is produced. This introduces challenges to all aspects of mobile learning research. Vavoula and Sharples (2009) state that as the understanding of mobile learning deepens, the “borrowed” frameworks, methods, and tools might no longer be adequate and need to be examined and evolved. They in turn propose a framework built on holistic and systematic evaluation divided into three levels of granularity (micro, meso, and macro) to guide data collection. Vavoula and Sharples (2009) also note that mixed methods are increasingly present in the design of evaluation for mobile learning. This can also be seen in terms of how the entire research process is conducted. Realizing and consciously being aware of the spectrum of research methods will, in the long term, allow us to influence the future direction of the research done in the field of mobile learning.

Emphasis on research methods and research purposes is important as these decide how research results are used and interpreted. Making methods and purposes explicit is also important because they help a research community to be built and allow this community to formally share results. Publications produced with explicit and sound method and purpose are outlets for knowledge transfer. For instance, Traxler (2007) specifies that the significant challenges for research in mobile learning lies in scalability and sustainability, and therefore frameworks, methods, and tools need to respond to these challenges. Hence, it is necessary to have a thorough understanding of the fit between the approach chosen and the goal of the research. Wingkvist and Ericsson (2009) suggest careful scaling according to pre-set specifications to increase the sustainability of research initiatives in mobile learning.

Discussing research methods and purposes is an integral and intricate part of scientific conduct. Initiators of this discussion were Wynekoop and Conger (1990), followed by Kjeldskov and Graham (2003), and later Jensen and Skov (2005). The classification schema presented within these papers demonstrates a usable and straightforward approach to enhance the discussion of research methods. In order to survey methods and purposes, the World Conference on Mobile Learning (mLearn) was selected as the data source for the publications accredited to mobile learning. The mLearn conference represents current practice conducted within mobile learning and highlights how research is carried out.

The rest of this paper is organized as follows; this introduction is followed by a presentation of eight well-established research methods and four research purposes. These provide the two dimensions of our survey, allowing us to review and discuss the results. We then present the classification and an interpretation of the results, and end the paper with our conclusions.

**RESEARCH METHODS**

In this section we present the eight research methods, including their strengths, weaknesses, and primary use in mobile learning research. The research methods are extracted from Wynekoop and Conger (1990) with supplementary input.
from references on research methods prominent in Information Systems (due to the first author’s background and main area of expertise). The methods considered are case studies, field studies, action research, experiment studies, survey research, applied research, basic research, and normative research. Research methods often overlap, so we emphasize the defining characteristics of each of the methods to show the classification of existing papers. The eight research methods are environment dependent, artificial, or environment independent (Benbasat, 1985). The first three methods, case studies, field studies, and action research are used in a natural (real) setting and are environment dependent, while experiments are carried out in a somewhat artificial setting. The remaining four (survey, applied, basic, and normative research) are all environment independent (but not artificial). This categorization of the eight methods is summarized in Table 1.

**Case Studies**

Case studies, according to Yin (2003), are an example of an empirical enquiry that investigates a contemporary phenomenon within its real life context, especially when the boundaries between phenomenon and context are not clear. From the researcher’s perspective the boundary from the phenomena is distinct as the researcher is a passive and independent outsider. Case studies are often intensive evaluations of small scale entities such as groups, organizations, individuals, systems, or tools. In general the data is collected by a combination of qualitative and quantitative methods such as observations, interviews, and questionnaires, with limited experimental or statistical control imposed. This often results in a complicated analysis, as data collected in a natural setting are by default very rich and sometimes conflicting or incoherent. On the other hand, case studies are particularly well suited for research focusing on describing and explaining a specific phenomenon and for developing hypothesis or theory. However, case studies can be very time consuming and the findings hard to generalize. In mobile learning, case studies could be used to provide rich data explaining phenomena involving the use of mobile devices in a specific context.

**Field Studies**

Field studies are characterized by taking place in a natural setting, allowing the researcher a flexible stance in respect to variables, the degree of and manipulation of the same. However, as control increases over variables the pragmatism decreases. Using a range of qualitative and quantitative approaches, data are often collected through observations and interviews, supporting the study of complex situated interactions and processes as addressed by Klein and Myers (1999). The phenomena are placed in a social and cultural context. The advantage is the corpus of data, realistically extracted and in a relatively short time period. The disadvantages are unknown biases, extensive data collection, and having no guarantee that the data are representative. In relation to mobile learning, field studies could be applied in current practice for either informing design or understanding the mobility of users, evaluating design or theory by conducting research in a realistic setting.

**Action Research**

Action research is particularly suited to application in an actual and natural setting; to study social and cultural phenomena. According to Baskerville and Myers (2004) the researcher actively participates in solving a problem while at the same time evaluating the results and making a knowledge contribution at large. For example, action research allows the introduction, transformation, evaluation, and extraction of theories. The advantage of being engaged in the activity is that it facilitates first-hand understanding and supports the learning process for all those involved. However, the disadvantage is that it can be very time consuming, and since the researcher takes part in the phenomena studied, retaining a critical stance can be hard. Even though the outcome is attached uniquely to the research conducted, it does offer a degree of external validity since others can interpret...
Table 1. Summary of research methods (adapted from Wynekoop and Conger, 1990)

<table>
<thead>
<tr>
<th>Method</th>
<th>Strengths</th>
<th>Weaknesses</th>
<th>Use</th>
</tr>
</thead>
</table>
| Environment dependent setting | Case studies                                   | Process understanding  
Demonstrate Causality  
Natural setting  
Rich data                                      | Costly, time demanding  
Limited generalizability  
No experimental control                  | Descriptions  
Explanations  
Generating hypothesis                  |
| Field studies                 | Natural setting  
Independent variables manipulation  
Replicable                      | Difficult data collection  
Unknown sample bias  
No experimental control  
No guarantee of independent variable variation | Studying current practice  
Evaluating new practice  
Post hoc study of processes and outcomes in practice  
Generating hypothesis                  |
| Action research               | First hand experience  
Applying theory to practice  
Close relationship with subjects         | Ethics consideration  
Researcher bias  
Time demanding  
Unknown generalizability             | Generating hypothesis/  
theory  
Testing theories/hypothesis                  |
| Artificial setting            | Experiment studies                             | Control of variables  
Replicable                                                                 | Controlled experiments  
Testing theory/product                  |
| Environment independent setting| Survey research                                | Relatively easy, low cost  
Can reduce sample bias                  | Collecting data from large samples  
Providing statistic picture  
Developing hypothesis  
Testing relationships between factors  
Descriptive data collection              |
| Applied research              | The goal is a product which may be evaluated   | Solution constrained  
May need further design to make product general | Product development  
Goal-oriented hypothesis testing  
Testing hypothesis/concepts              |
| Basic research                | No restrictions on solutions  
Solve new problems                      | Costly, time demanding  
May produce no solution  
Solution may not match known problems | Building theory  
Solving new problems                  |
| Normative research            | Insight into firsthand experience  
Basis for other forms of research          | Opinions may influence outcome                                           | Descriptions of practice  
Building frameworks  
Informing and teaching concepts          |
the theoretical contribution made. Nevertheless it can still be difficult to generalize upon. In relation to mobile learning, action research provides the perfect opportunity for a researcher to jointly collaborate with the “team”.

**Experiment Studies**

Experiment studies are characterized by the researcher’s ability to control dependent variables, often by creating an artificial setting or situation. Being able to do this can be prohibitively difficult or even impossible and a researcher often resorts to quasi-experiment studies as presented by Denscombe (1998). These quasi-experiments usually take place in uncontrolled environments, variables from undetected sources are neither measured nor held constant, and these may produce misleading correlations between variables under study. Data can be collected depending on the style of the subsequent analysis desired. The major advantages of experiment studies are the opportunity to focus on specific phenomena of interest and a large degree of control in terms of manipulation of variables before and during the study through, for example, assignment of test subjects and exposure to different treatment variables. Also, well-designed and executed experiment studies are highly replicable and facilitate data collection. Disadvantages include limited connection to the real world and an unknown level of generalizability of the results outside of the specific setting. In mobile learning, experiment studies could, for example, facilitate general information being gathered about user needs and requirements, or of a phenomenon, and from this help us to develop an understanding of the current situation.

**Survey Research**

Survey research provides information from a defined population and the data, which is gathered directly through, for example, interviews, literature reviews and questionnaires, is assumed to be independent to the environment as stated by Fowler (2002). In essence, data from survey research is collected without the researcher’s intervention or stake other than the gathering of data and the presentation of the same. Data is most often analyzed quantitatively, but data from interview surveys can also be analyzed qualitatively. The advantages of surveys are that they facilitate large amounts of data to be gathered with relatively little effort, supporting broad generalization of results. Also a high level of control regarding sample subjects makes reduction of bias possible thus increasing validity. However, a disadvantage is that they suffer from providing only snapshots of studied phenomena and rely heavily on the subjective views of respondents. In respect to mobile learning, survey research could, for example, facilitate general information being gathered about user needs and requirements, or of a phenomenon, and from this help us to develop an understanding of the current situation.

**Applied Research**

Applied research is similar to prototyping and based on a trial-and-error practice relying on the expertise and reasoning of the researcher’s capabilities through intuition, experience, deduction, and induction. The outcome is known in terms of requirements, but not the method of obtaining the same as mentioned by Järvinen (2004). In line with this goal orientation, the advantage is that some kind of result is produced, which can in turn be evaluated against the preset goal. The disadvantages are that the initial goal may be very limited and not generalizable, and that appropriate solutions for accomplishing the desired outcome may not be produced at all. Applied research is relevant for mobile learning in relation to design and implementation of systems, interfaces and techniques, which meet certain requirements for performance, user interaction, user satisfaction, etc.

**Basic Research**

Basic research allows the researcher to study well-known problems to which methods or possible solutions are yet to be identified. The aim is to find out what is part of reality and often the researcher is concerned with the
development of a new theory (Järvinen, 2004). The approach is also trial-and-error based, riding on the competence of the researcher. The advantage is the directness of the research that is facilitated by the open choice of approaches and time, allowing a high level of creativity in the search for methods. The down side is that it can be very time consuming and there is no guarantee that a solution will eventually be produced. In relation to mobile learning, basic research may be applied to the development of theoretical frameworks for understanding fundamental principles, for example issues related to mobility or for identifying new problems related to learning while users are on the move.

Normative Research

Normative research is less rigorous in terms of research method per se, though usually addressing interesting phenomena from a pragmatic standpoint. This is done in order to stimulate and indicate directions for future research and, for example, covers writings of application descriptions, idea, concept, and suggestion development (Tolvanen, 1996). The narratives often seem intuitively correct but are not based on theory or research rigorously conducted, and are presented according to the style of a practitioner, i.e., giving a subjective view and focus on what worked in that particular situation. The advantage is that this kind of writing is more straightforward and often perceived as easier to formulate than presenting complex theoretical contributions. Drawbacks consist of limited theoretical foundation, weak methodological reflection, and low generalizability. However, such research that reaches the stage of publication often provides well-prepared arguments with considerable backing from other sources. For mobile learning, the papers describing general statements or designs, and procedures that worked well or did not prove successful, are representative.

RESEARCH PURPOSES

In this section the research purpose is defined as the second dimension of the survey. The purpose of a research effort is closely linked to the research method used and vice versa, so these two notions make an excellent pair when attempting to classify mobile learning papers. The definitions of the four research purposes are inspired by Wynekoop and Conger (1990), although a slight refinement was made. The original categories were: Understanding/Describing, Engineering, Re-engineering, and Evaluating. We divided Understanding/Describing into two categories and merged Engineering and Re-engineering into one category called Developing. These changes were done first to differentiate between Understanding and Describing in order to sharpen the categorization with respect to these concepts, and secondly to merge the other two because mobile learning applications and frameworks have not been around long enough to fully use the categorization of re-engineering. As a result of this refinement the categories for research purposes are: Describing, Developing, Understanding, and Evaluating. These four research purposes are explained and defined here:

Describing refers to writings that describe the unit under study, such as features of the portrayed environment, the technical implementation, often represented in models at a low level of abstraction. Describing papers provide knowledge about the research in a straightforward manner with emphasis on actual results.

Developing refers to writings that define frameworks, be it technical or theoretical, and emphasis on development and the presentation of solutions. A typical example is when the aim is to develop a new conceptual model or a prototype, i.e., papers that basically provide first hand knowledge in uncharted territory.
Understanding refers to writings that seek to understand and make sense of conducted research, while trying to bridge the result into a theoretical frame, often presenting new constructs based on identifying and enhancing theory. These papers provide knowledge of a wider theoretical setting, often found in research that is in the process of rethinking something.

Evaluating refers to writings that evaluate the usefulness, benefits and shortcomings of the research, while hopefully giving pointers to other researchers. These papers can be seen as evaluating methods and purposes in practice and reflecting upon these, i.e., provide knowledge about lessons learned, which can give others a head start or at least the possibility to avoid pitfalls.

These four categories of purpose along with the research methods are used in the next section as a basis for classifying mobile learning research papers from three World Conferences on Mobile Learning, mLearn 2005, mLearn 2007, and mLearn 2008.

CLASSIFICATION OF MOBILE LEARNING RESEARCH

The proceedings of mLearn 2005 (van der Merwe & Brown, 2005), mLearn 2007 (Norman & Pearce, 2007) and mLearn 2008 (Traxler et al., 2008) were selected to get a picture of current practice in mobile learning. The proceedings of mLearn 2006 was omitted in this survey since it is neither available electronically nor in printed form.

Traxler (2007) notes that the mobile learning community was, at the time relevant to this survey, visible mainly through dedicated international conferences, of which mLearn is one of the main series, rather than through any journals (the International Journal of Mobile and Blended Learning was first published in Q1, 2009.) The mLearn conference series is renowned for including contributions from academics as well as practitioners. All 114 full papers from mLearn2005, mLearn 2007 and 2008 have been classified in this paper. The papers are numbered in the order they are printed in the conference proceedings with the first paper from mLearn 2005 as paper #1, the first paper from mLearn 2007 as paper #39, and the first paper from mLearn 2008 as paper #77 (cf. Appendix). The data set as defined by Robson (2002) is the set of papers from mLearn 2005, 2007, and 2008, which provides a solid and adequately representative basis for this survey. Each paper was peer reviewed, which indicated that the published papers are of good quality and of importance to the community. 114 such papers is a relevant and sufficiently large sample from which to draw conclusions.

Initially the first author reviewed all papers. Each paper was read thoroughly with a particular focus on identifying the purpose of the presented research as well as the method applied to accomplish the research. Many papers can be classified as having a number of purposes or methods, but the most coherent and dominant from each category were selected to classify the paper according to the two dimensions, respectively. Moreover, an international Master’s student repeated the same classification process. The results of the two classifications were compared and a final decision was made for each paper. This decision was then discussed and corroborated by the second author, who now also read all the papers. The complete survey result of the 114 papers is presented in Table 2, including the total share of each category as a percentage (%).

Table 2 shows that the most commonly used method within mobile learning research is the case study, with 22% (25 out of 114) of the papers. The second most common method is normative research, which 25% (28 out of 76 papers) used. Applied research and survey research are also commonly used; the former was used by 17% of the papers while the latter was used by 12%. In respect to the less generally used methods, field studies and experiment studies are more common, with 9%, respectively, while action research was used by only
4% of the papers. Only two papers were classified as basic research. The classification shows that environmental independent research (survey, basic, applied, and normative research) dominates and was used by 55% of the papers. 36% used environment dependent methods (case studies, field studies, and action research) and focused on studying real use in a natural setting. 9% of the papers use an artificial setting (experiment studies). In environmental independent research, normative research was the most common method, followed by applied research (44% and 30% respectively.) Case study dominated the environment dependent methods and was used by 61% of the papers. By definition, 100% of the artificial research used experiment research.

In Figure 1 the papers are first divided by environment and secondly by method to show the number and percentage that cover each category. The most common purpose of the research was to describe the study (Describing), with 57% (65 of 114). This was followed by Developing and Understanding, 25% (29 of 114) and 15% (17 of 114), respectively. Only 3% (3 of 114) of the papers had Evaluating as their research purpose. Research with the purpose of describing most commonly used case study as the research method. This was used by 26% of the describing papers. The rest of the describing papers were almost equally distributed among experiment, survey, applied, and normative research (14%, 12%, 15%, and 14% respectively), while 7% of the papers used action research. The papers with a purpose of developing usually used applied or normative research, and 73% (i.e., 28% and 45% each) of all the developing papers used either of those two methods. 10% of the papers used case studies and 7% used field studies. The remaining 10% were equally divided between experiment study, basic research and survey research. The

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**Table 2. Classification of mobile learning research papers**

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Case studies</th>
<th>Field studies</th>
<th>Action research</th>
<th>Experiment studies</th>
<th>Survey research</th>
<th>Basic research</th>
<th>Applied research</th>
<th>Normative research</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Describing</td>
<td>7, 10, 24, 27, 39, 41, 44, 49, 60, 67, 70, 75, 78, 83, 88, 104, 108</td>
<td>21, 32, 40, 50, 66, 77, 97</td>
<td>8, 17, 87, 92, 109</td>
<td>6, 9, 23, 26, 54, 55, 65, 69, 111</td>
<td>12, 25, 34, 46, 76, 79, 91, 114</td>
<td>1, 3, 14, 35, 36, 43, 53, 62, 72, 94</td>
<td>11, 19, 30, 42, 47, 57, 61, 63, 71</td>
<td>57.02%</td>
<td></td>
</tr>
<tr>
<td>Developing</td>
<td>4, 29, 48</td>
<td>20, 95</td>
<td>51</td>
<td>107</td>
<td>5</td>
<td>37, 45, 58, 59, 64, 74, 84, 98</td>
<td>2, 13, 16, 18, 22, 28, 32, 46, 50</td>
<td>25.44%</td>
<td></td>
</tr>
<tr>
<td>Understanding</td>
<td>38, 93, 96, 105, 112</td>
<td>85</td>
<td>102</td>
<td>80, 86, 101, 103</td>
<td>73</td>
<td>15, 31, 33, 110, 113</td>
<td></td>
<td>14.91%</td>
<td></td>
</tr>
<tr>
<td>Evaluating</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.63%</td>
</tr>
<tr>
<td>Total (in %)</td>
<td>21.92%</td>
<td>8.77%</td>
<td>4.39%</td>
<td>8.77%</td>
<td>12.28%</td>
<td>1.76%</td>
<td>16.67%</td>
<td>24.56%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

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understanding papers were most commonly either case studies or normative research (30% each). 24% of the understanding papers used survey research. The remaining papers used field studies, action research, or basic research (6% each). The three evaluating papers were divided into using survey research, applied research, and normative research.

The case study research method was most commonly used for the purpose of describing, and 68% of the case study papers fall within this category. Similar results hold for field studies, action research, and experiment studies, where 70%, 83%, and 90% of the use of these methods is done with the purpose of describing. Applied and survey research are generally used for two purposes each, with applied research most commonly used for either describing or developing, with 53% and 42% respectively, while survey research is often used for either describing (57%) or understanding (29%). Normative research is done for the purpose of developing, describing or understanding (32%, 46%, and 18% respectively).

Within mobile learning there is a tendency towards research in an independent environment aiming at describing and developing. In the environmental dependent category, case study dominates with 41% (17 papers) and for all the 41 papers in that whole category, 29 papers have the purpose of describing. Understanding (and presenting theoretical frameworks) is the focus of seven papers (17%), which limits the body of knowledge for mobile learning. Of the 19 papers of applied research, 42% have the purpose of developing and understanding. Of the ten papers in the experiment category, 90% use this method for describing purposes. Of the ten papers that report field studies, seven papers use this method for describing purposes, while two papers use it for developing. The last paper uses experiment research for an understanding purpose. Applied and normative research is most commonly used for describing or developing. In the case of applied research, 52% of the papers utilizing this method are describing, while 42% are developing. In the case of normative research, 32% are describing, while 46% are developing. The two papers that used basic research used it for developing and understanding, respectively.

DISCUSSION

This section presents an analysis of the results of the classification presented in the previous section. Generally, the research conducted is either close to one situation in particular, gathering empirical data, or on a normative level presenting ways to utilize the essence of mobile learning in an abstract sense. These two represent opposite ends of the spectrum given method choice and purpose and out of the 114 papers considered in this survey, 79 papers fall into either of these (69%). This suggests a need for a broader scope in terms of the methods and purposes of mobile learning research to help the

Figure 1. Papers divided by environment (left) and method (right) in percentage
field to mature and also help other researchers to avoid repeating known pitfalls. This maturity, in turn, will lead to better scalability and sustainability for future research efforts in the mobile learning community.

Mobile learning is evidently an interdisciplinary field with ties to, for example, Computer Science, something that might explain the emphasis on applied research and data gathering. Methods used in related fields, e.g., Information Systems and Software Engineering are also noticeable within mobile learning, for example in action research, case studies, and field studies. A difference compared to these related disciplines is how few papers are found in artificial environments and experiment studies in this review. From the 114 papers, only ten presented some kind of experiment studies. In some related fields, experiments are more common, for example Kjeldskov and Graham (2003) show that experiment studies are the second most common research method used in Mobile Human-Computer Interaction. This divergence may be a result of the difficulty of emulating aspects of mobile learning, such as mobility and the dynamics of context changes in an experimental setting. Field study, on the other hand, offers an ideal opportunity for the study of rich real-world cases. Mobile learning is applicable and well understood in a natural and environment dependent setting. The use of research methods such as case study and action research aids and strengthens the result when studies are conducted. Mobile learning researchers could learn from other disciplines that have struggled with the study of similar phenomena often depending on the degree of involvement from the researcher. Experimental studies and the use of control groups are subsequently essential.

The prevalence of gathering empirical data and research that is conducted to describe a phenomenon shows a strong connection to real-world cases. Much of the research conducted is done to describe how the real world works and is often presented as the result of a small-scale study where a population used mobile learning technology. This data is presented, not interpreted, and offered as a description of the process. At the other end there is the normative research that is also done with the purpose to describe and develop. Many of the papers that fall into this category present either a description of a current situation or a future situation describing what may happen or how something should be developed. These papers are based on some evidence and are generally visionary. Between these two, basic research and evaluating research would be expected, but have not been found. Of the papers reviewed, 5 fall into either of these categories, none in both.

There is a distinct lack of evaluation and basic research among the papers reviewed. The one paper we found in basic research is mirrored in the survey of Jensen and Skov (2005) that also only found one such paper in relation to their field (Children’s Technology Design). Many of the papers include an attempt at reflection. This is often not the main purpose and almost always leads to the evaluation from an end-user perspective. There is little reflection by revisiting results, or evaluation of the effort compared to other efforts. This is a problem. In a similar manner, much of the research is done to describe, not understand or evaluate. This may indicate a lack of maturity and a lack of clear definitions. There is still a need to describe how it works in order to define it. There is a need to bridge the gap between descriptive small-scale research and normative visionary research, by evaluating and trying to understand. This is where knowledge is produced and theories are formed.

One reason for the lack of evaluating and basic research might be the speed with which mobile technologies are developed and improved upon. A generation of mobile devices is short-lived, which may result in many technical aspects being lost when a new generation is introduced or many studies feeling outdated and old, which in turn may affect evaluations and reflections. This may direct us towards simply stating facts or presenting visionary plans. However, without proper focus on the research process, including methods and purposes, it is hard for research in mobile learning to transfer.
already obtained knowledge as the starting point for new efforts.

One way to describe the papers reviewed is to consider some of them as standing on the frontiers looking into the future and others working hard to keep up with current development. A challenge for mobile learning research would be to stop, turn around, and reflect over the results once again. This is the way to reach the visionary future, which is predicted by looking ahead and avoiding already known pitfalls. Also, a head start is given if research is built upon previous research instead of the wheel being reinvented every time a new mobile learning initiative gets under way.

Given this review it must be stated that research methods and a classification of research according to defined methods is not an exact science. Some definitions can be considered vague or even overlapping with other methods. To make issues even more complicated, few papers contain a discussion of the exact methods used, so in many cases it is down to a judgment call. With the overlapping and vague methods it was sometimes hard to pick one, and only one, method. For example, is a study conducted in a natural setting but with all variables fixed a field study or an experiment?

Further along these lines, it should be acknowledged that the survey presented in this paper has some limitations. It can for example be questioned if the research papers presented at a conference, although marketed central to the field, is really representative of the research and activities that are conducted within the field? Furthermore, it is not always easy to compress the research to fit the page limitations or topics of interest at a conference. Notwithstanding these constraints, the conference series selected for this review provides papers from a wide range of researchers and research projects. The authors read each paper several times, and carefully discussed the method and the purpose before it was classified. The purposes and methods matrix, as classification tool, has been used for a number of similar reviews. Further, the results of the classification in this paper show a clear trend that is difficult to attribute to vague method definitions. Based on these observations, the authors of this paper are confident that the research conducted is of value, even with the limitations placed on it.

CONCLUSION

Research methods and research purposes are an integral and intricate part of how people conduct research. In this paper we present a two dimensional matrix where we compare research methods and research purposes from 114 papers. The first dimension consists of eight research methods: case study, field study, action research, experiment, survey, applied research, basic research, and normative research. The second dimension consists of four research purposes: Describing, Developing, Understanding, and Evaluating. The 114 papers we investigated represent a broad selection within current practices in mobile learning.

Our classification shows an even distribution in respect to research methods, with only basic research being under-represented. In terms of research purposes, describing is the most frequent, and is used within more than half of the papers, followed by one-fourth of developing papers, and one-seventh understanding. Evaluating, on the other hand, is represented only within about one-fortieth of the total number of papers we have investigated. Our survey reveals that there is a clear lack of papers utilizing basic research in terms of research method and evaluating as a research purpose. This indicates a void that could be filled with publications specifying lessons that were learned, describing benefits as well as shortcoming of research already conducted. In a young and evolving research field it is necessary to try new research methods, which in turn can greatly improve the diversity of the research published. Mobile learning is an excellent example of an evolving field where researchers apply various methods to solve their problems. Our survey shows exactly that, and our findings further present a number of opportunities for future research. We suggest
that researchers revisit and evaluate their research methods. This can lead to evolution and presentation of new frameworks, methods, and tools. This holistic approach and systematic description is important not only for method and purpose in research but also for improving the overall system development process that mobile learning research is faced with.

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Anna Wingkvist earned her PhD in Computer Science in 2009 from Växjö University, Växjö, Sweden. Currently, she is an Assistant Professor at the School of Computer Science, Physics and Mathematics, Linnaeus University, Växjö, Sweden. Her scientific interests and publications are mainly in the mobile learning domain with a focal point from an information systems development perspective, methodological and research methods reasoning, and project management. She has also been involved in utilizing podcasts in higher education as a learning tool.

Morgan Ericsson received his PhD in Computer Science in 2008 from Växjö University, Växjö, Sweden. He is currently a Post-doctoral Fellow at the Department of Information Technology, Uppsala University, Sweden. His research interests are on how to best use technology to enhance learning and education, with a special focus on connected, mobile devices and personal learning. Software plays a major part in this research, and he has been involved in the creation of programming models and software development frameworks to aid developers working with Internet services and mobile devices.
APPENDIX: FULL PAPERS

mLearn 2005

1. Ally, M. et al., An Intelligent Agent for Adapting and Delivering Electronic Course Materials to Mobile Learners
2. Angarita, M. et al., Educagaming PCs and QUICKPDA eBooks: A New Model for Surpassing Fragmentation in Mobile eHealth
3. Arias, R. & Pasch, G., XML saves the day: Porting a Rich-Media Collection to a Mobile Platform in Three Weeks Flat
5. Barker, A. et al., A Proposed Theoretical Model for mLearning Adoption in Developing Countries
7. Burke, M. et al., Utilizing Wireless Learning Pocket-PCs to Promote Collaboration in Field-based Courses
8. Corlett, D. et al., Interactive Logbook: a Mobile Portfolio and Personal Development Planning Tool
10. Divitini, M. & Marken, E., Blending Mobile and Ambient Technologies to Support Mobility in Practice Based Education: the Case of Teacher Education
11. Edwards, R., Your Learners are Increasingly Mobile, is Your Learning?
12. Facer, K. et al., Challenges and Opportunities: Making Mobile Learning a Reality in Schools
13. Feist, M. et al., Adaptive Heterogeneous Learning Systems
14. Katz, H. & Worsham, S., Streaming mLearning Objects via Data Resolution
15. Keegan, D., The Incorporation of Mobile Learning into Mainstream Education and Training
16. Landers, P., Meta Learning: Experiences from the Inclusion of mLearning in a standards-Based and Corporate-Wide Learning Content Management Framework
17. Laouris, Y. & Anastasiou, H., The Introduction of IT in the lives of Children as a service to Global peace: Experience from a Nation-Wide Experiment Introducing IT in the Lives of Children: Fifteen Years Later
18. Laouris, Y. & Eteokleous, N., We need an Educationally Relevant Definition of Mobile Learning
19. Louw, W., Taking the Distance Out of Distance Education through the means of mLearning
20. Leach, J. et al., 4D Technologies: Appropriating Handheld Computers to Serve the Needs of Teachers and Learners in Rural African Settings
21. Matilla, P. & Fordell, T., MOOP – Using mLearning Environment in Primary Schools
22. McMillan, J., Seven Reasons Why mLearning Doesn’t Work
24. Ng’ambi, D., Mobile Dynamic Frequently Asked Questions (m-DFAQ) for Students and Learning Support
25. Nonyongo, E., Effectiveness of SMS Communication Between University and Students
28. Sharples, M. et al., Towards a Theory of Mobile Learning

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30. Smyth, G., *Wireless Technologies Bridging the Digital Divide in Education*

31. Stead, G., *Moving Mobile into the Mainstream*

32. Swan, K. et al., *Teaching and Learning with Mobile Computing Devices: Closing the Gap*


34. Treadwell, I., *The Usability of PDAs for Assessment of Practical Performance*

35. Veith, P. & Pawlowski, J., *Conception and Development of Reusable and Modular Mobile Content*


37. West, P. et al., *Content Exposure of Slide Show Presentations for Selective Download and Annotation via Mobile Devices*

38. Wishart, J. et al., *Using Personal Digital Assistants (PDAs) with Internet Access to Support Initial Teacher Training in the UK*

**mLearn 2007**

39. Ally, M. et al., *Use of Mobile Learning Technology to Train ESL Adults*

40. Arrigo, M. et al., *A Collaborative Mlearning Environment*


43. Cochrane, T., *Moving Mobile Mainstream: Using Communities of Practice to Develop Educational Technology Literacy in Tertiary Academics*

44. Cooney G. & Keogh, K., *Use of Mobile Phones for Language Learning and Assessment for Learning, A Pilot Project*

45. Elson, B. et al., *Blueprint for an Adaptive Training - Virtual Learning Environment (Adapt-VLE) for the Training of Dentists*

46. Goerke, V. & Oliver, B., *Defining the Handheld Computer for a First Year University Student: Is it a ‘Handy’ Accessory or an Essential Learning Tool?*

47. GreenJ., *Using Mobile Technologies for Open and Distance Learning Community Development*


49. Hartnell-Young, E., *Making the Connections: Theory and Practice of Mobile Learning in Schools*

50. Hawkins, G. et al., *21st Century Assessment for 21st Century Learners*

51. Hwang, W. et al., *A Study on Ubiquitous Computer Supported Collaborative Learning with Hybrid Mobile Discussion Forum*

52. Kolesnikova, S., *Learning Resource Authoring Techniques in Mobile Platform*

53. Kukulska-Hulme, A., *Self-Service Education: Smartphones as a Catalyst for Informal Collective and Individual Learning*


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61. Ng, W. & Nicholas, H., *Ubiquitous Learning With Handheld Computers in Schools*

62. Nussbaum, M. et al., *Comparative Study of Peer Learning Mediated by Interconnected PCs and PDAs*

63. Kress, G. & Pachler, N., *Thinking About the ‘M-‘ in Mobile Learning*

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65. Petrova, K., *Student Revising for a Test using SMS*

66. Shao, Y. et al., *Designing a Mobile Group Blog to Support Cultural Learning*

67. Song, Y. & Fox, R., *Educational Affordances of Handheld Devices: Undergraduate Student Perceptions*


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71. Taylor, C., *Hunting Mobile Literacies: Listening To the Experiences of Students*


73. Traxler, J., *Flux Within Change*

74. Jianhua, W. & Jing, L., *Research of Device Adapting Based On MAS in Field of Mobile Learning*

75. Clark, S. et al., *Short Podcasts: The Impact On Learning and Teaching*

76. Anarki, F., *Assessment of Mlearning A Case Study: Assumption University of Thailand*

**mLearn 2008**

77. Anastopoulou, A. et al., *Learning 21st Century Science in Context with Mobile Technologies*

78. Arrigo, M. et al., *Some Considerations on a Mobile Learning Experience in a Secondary School*

79. Attewell, J., *Towards Sustainable Large Scale Implementation of Mobile Learning: the Mobile Learning Network (MoLENET)*


81. Botha, A. et al., *MobilED: A Tool by Any Other Name...*

82. Botha, A. & Ford, M., *“Digital Life Skills” for the Young and Mobile “Digital Citizens”*

83. Botha, A. et al., *Improving Cross-cultural Awareness and Communication through Mobile Technologies*

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96. Hartnell-Young, E., Mobile Phones for Learning in Mainstream Schooling: Resistance and Change
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112. van den Berg, M et al., MobilED: A Step Backwards to Look Ahead
113. Vavoula, G. & Sharples, M., Challenges in Evaluating Mobile Learning
114. Woodgate, D. et al., Mobile Learning in Context: School Science Data Collection as Legitimate Peripheral Participation