The Design of Effective Mobile-Enabled Tasks for ESP Students: A Longitudinal Study

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ABSTRACT
This paper describes and reports on the findings of the Enactment phase of a longitudinal Design Based Research (DBR) study. Its aim was to develop effective design principles for learning materials for English for special purpose (ESP) students. The process of data collection and analysis over an eighteen-month period resulted in a conceptual model and design principles for a mobile-enabled language learning (MELL) solution. The study also generated a broader understanding of the context-embedded nature of ESP learning using mobile devices, specifically the role of particular components of the whole learning environment, ultimately contributing to real-life praxis of the Ecological Constructivist theoretical framework and the complementary approach of the DBR methodology. This paper focuses on the intervention design and development completed during the Enactment phase (Phase 2). The key outcome of this phase, namely the prototype of the mobile-enabled language learning eco-system (MELLES), encompassed eight ESP tasks accessible through a mobile-web portal that served as a gateway to the MELLES network. The design of the MELLES intervention and its constituent tasks are presented.

INTRODUCTION
This paper describes and reports on the findings of the Enactment phase, or Phase 2, of a three-phase longitudinal Design Based Research (DBR) study (Figure 1 below) aiming to develop effective design principles for learning materials for English for special purpose (ESP) students, enabled by means of mobile devices.
In keeping with DBR principles, the data collected and analyzed over an eighteen-month period resulted in a conceptual model and design principles for an emergent mobile-enabled language learning (MELL) solution. The focus of the study was to determine the characteristics of an effective, pedagogically-sound mobile-enabled language learning system for adult ESP students in a community college, using mobile devices to enhance their listening skills, while expanding their learning outside of the classroom.

**Figure 1. DBR study timeline with Enactment phase highlighted**

A broader understanding of the context-embedded nature of ESP learning using mobile devices, specifically the role of aspects of the whole learning environment, was also generated, ultimately contributing to real-life praxis of the Ecological Constructivist framework (Hoven, 2006, 2008; Hoven & Palalas, 2011; Palalas & Hoven, 2013) and the complementary principles of a DBR methodological approach. A more comprehensive overview of the design principles and theoretical model generated in the extended DBR study are reported in Palalas (2012). This paper focuses on the intervention design and development completed during the Enactment phase: the production phase that focused on the creation of the conceptual models as well as the detailed design and prototypes of the MELLES solution. This phase was chosen here as it produced the most illuminating data from participants in terms of their listening skill development and it yielded design principles. It also provided the most concrete examples of collaborative, co-created, context-embedded language learning.

The key outcome that emerged as a result of the Enactment phase was a prototype of what we called the Mobile-Enabled Language Learning Eco-System (MELLES), which encompassed eight ESP tasks accessible through a mobile-web portal serving as a gateway to the MELLES network. The interactions among learners, working both collaboratively and individually and in-class as well as in the environment outside of the classroom, is illustrated in Figure 2 below. Further details of these interactions will be provided in the Discussion section. As DBR involves a cyclic, non-linear, and iterative approach to conducting a research study, the structure of this paper diverges from a more traditional reporting sequence to reflect this. Consequently, the body of the paper begins with a description of the Background and pre-cursors to the initial phase of the formal study, followed by a summary of the findings and principles derived from the earlier...
pre-study stages and some background to mobile-enabled language learning in the context of CALL. An overview of the DBR methodological approach is then provided, situating the Enactment phase within the study as a whole.

Figure 2. MELLES—Key interacting components of the MELL Ecosystem (MELLES)

This overview includes a description of the Enactment phase of the study, the participants, and their contributions towards the design principles. The paper concludes with a presentation and discussion of the MELLES prototype emerging from this phase and its constituent tasks, as well as some insights into how these informed the design of the subsequent phases of the study.

BACKGROUND

The use of mobile devices in learning and particularly language learning is a relatively new practice in the broad field loosely termed computer-assisted language learning (CALL), having emerged just over a decade ago (Kukulska-Hulme & Shield, 2008). As new technologies have been integrated into language learning over the decades since CALL was first conceptualized as a field in its own right, numerous alternative terms have been suggested that might better describe or define the incorporation of these technologies that have been developed and quickly integrated into language learning and teaching. It is not particularly surprising, therefore, that the adoption of mobile devices has engendered similar confusion over terminology. While mobile assisted language learning (MALL) is a term that appears frequently in the field, for the purposes of this paper, mobile-enabled lan-
guage learning (MELL) will be used to describe that area of CALL in which hand-
held devices are employed as an enabler in the language learning process. MELL
is thus used here to evoke a focus on knowledge construction and co-construction,
skill development and performance support, in which learners engage with in-
structors, other people in their environment, prepared and spontaneously-created
content, and each other, across various times, locations, situations, and contexts.
It encompasses learning processes that may be formal or informal, incidental or
purposeful, spontaneous or planned. MELL is enabled and mediated by highly
portable devices that are always on, are capable of playing podcasts, recording
audio and visual recordings and images, and which afford networked connection
as well as communication. Consequently, MELL tasks have the capacity to be
embedded in the real world and to be associated with activities that are part of
learners’ daily lives.

We conducted a comprehensive language benchmarking study\(^1\) at George
Brown College and similar research in other community colleges between 2007
and 2009 (Palalas, 2009). This resulted in listening skills being identified as the
primary barrier for English as a second language (ESL) college learners seek-
ing employment and employers hiring and retaining immigrants as employees
(CIITE, 2004). These findings determined the need for a purpose-designed ESP
intervention.

In keeping with earlier research and development carried out in the area of
listening comprehension (Fischer, 1999; Hoven, 1997), the development of this
intervention began from the principle that instructional design is “the central con-
cern in any development process” (Fischer, 1999, p. 78). As Fischer (2007) also
advocated, “[t]racking student behavior . . . can play a central role in determining
the optimal balance of structured versus unstructured learning activities” (p. 417).
Together with the need for a purpose-designed intervention, students’ expressed a
need for expanded learning support outside of scheduled classroom hours lever-
ageing the affordances offered by the mobile devices defined above. Accordingly, a
Design-Based Research study was conceived. As elaborated further in the follow-
ing sections, DBR was chosen as the methodological approach for its capacity to
simultaneously guide the design of an appropriate intervention, track student and
instructor responses as well as their performance, improve the intervention, and
operationlize and refine a learning theory, which both explained the emerging
learning environment and generated new perspectives and directions on improve-
ments to the intervention.

Prior to the implementation of the main DBR study, a pilot hybrid ESP course
was designed, conducted, and evaluated. This hybrid English for Accounting
course incorporated innovative aural practice through a blend of in-class, online,
and mobile-enabled ESP learning. Traditional ESP content was delivered in class
and online, whereas listening skills were addressed with the help of mobile de-
vices. Audio and video content was created in-house and provided to students for
on-the-go retrieval and interaction. The one-semester course was piloted between
January and May 2009 with a group of twelve adult learners who were loaned
iPod Touch devices for the period of the study.
The level of students’ satisfaction with the mobile technology was measured using semi-structured interviews, surveys, and focus groups. All participants considered the mobile technology to be an effective ESP language learning tool, offering a flexible, portable, and convenient delivery format that matched their needs and demanding schedules (Palalas, 2011b). Consistent with findings reported in the mobile-assisted language learning (MALL) literature, learners seemed to appreciate the portability and convenience of mobile technologies, as well as the personalization and learning “across contexts and life transitions” (Kukulska-Hulme, 2012; Sharples, 2009). Participants also indicated that they preferred to use the inherent audio capabilities of mobile devices over text-based options. In addition, the pilot found that, of the four language skills, listening was best served via the mobile devices. It was also observed, however, that the audio podcasts developed for the pilot were not sufficiently engaging or interactive. Since the impact of the audio and video content was not exhaustively investigated in the pilot, nor was the actual learning adequately evaluated, further review of the course design and materials was necessary, as was a more extensive and detailed investigation of the overall learning environment. Critical to this investigation was how the inherent audio capability and portability of mobile devices could take aural-skills learning out of the classroom while still ensuring effective instruction. Issues of learner collaboration, co-creation of content and meaning-making, as well as MELL supports, also formed part of the subsequent study.

The DBR study was therefore structured in such a way as to investigate the design and development of a language learning instructional solution to address the problem of inadequate aural skills acquisition for college ESP students, in order for them to improve their academic performance and ultimately gain employment in their profession in Canada. Specifically, it focused on the use of mobile technology to expand learning beyond the physical and time restrictions of a classroom.

The key findings of the exploratory study and the resulting MELL pilot (Palalas, 2009; 2011a; 2011b), which re-emerged in the Informed Exploration phase and subsequently informed the Enactment phase of the study were: (1) the learner preparedness for MELL, (2) the theoretical construct distilled from the data analysis resulting in a refined theoretical framework, and (3) a shift from the focus on designing a learning object (micro) to an ecological (macro) perspective on the educational intervention in question. Some of the key preliminary design guidelines included designing language tasks that combine impromptu speech practice situated in a real-life context with individual rehearsed utterance practice at a flexible time and place, accommodating students’ schedules. The need for support from a language expert and by means of collaboration within a learning community was also identified. The respondents identified dynamic communicative tasks as vital for learning listening and emphasized that listening could not be learned in isolation but required the support of the other three language skills. Moreover, students recommended that the MELL tasks be integrated into a larger mobile module and that the modularized design would still allow them to complete tasks at a time and place of their choosing. The recognition that the city setting offered
a unique English speaking environment which afforded situated language learning, and that mobile devices could mediate the interaction with that context, led to our focus on real-life language situations and the role of the classroom setting as an augmentation of that practice. This was reflected in the participant feedback. The key findings from the Informed Exploration (Phase 1) (Palalas, 2012) were further refined through the Enactment and Evaluation phases to produce the final MELLES design principles.

**Mobile-Enabled Language Learning**

MELL draws on the attributes of enhanced mobility and flexibility of CALL applications and, building on characteristics of mobile technologies, offers learning that is potentially independent of location, time, and space. Mobile learning “can be spontaneous, personal, informal, contextual, portable, ubiquitous (available everywhere) and pervasive (so integrated with daily activities that it is hardly noticed)” (Kukulska-Hulme, 2005, p. 2). It potentially promotes continuity of learning by seamlessly connecting formal and informal learning, which is particularly beneficial for language learners who find themselves in a natural day-to-day English-speaking environment.

Literature in the area of mobile-enabled language learning provided some direction on the journey to discover whether and how mobile devices could be used to expand the scope of learning beyond the walls and timetables of the classroom. One of the first and more wide-ranging implementation of listening and speaking MELL activities was tested at Duke University (Belanger, 2005), where Spanish language students listened to audio information including glossaries, songs, narratives recorded by native speakers, and tutor feedback. They recorded responses during oral quizzes and oral assessment, and reviewed their vocabulary pronunciation. Students involved in this project gave positive evaluations of the feasibility and effectiveness of iPods for comprehension and pronunciation exercises. However, it seemed that listening skills had not yet been sufficiently addressed in MELL studies (Rosell-Aguilar, 2005). More recently, researchers demonstrated that mobile technologies were perceived as helpful and appropriate for language teaching and learning (Demouy & Kukulska-Hulme, 2010; Kukulska-Hulme & Shield, 2008) and that multimedia-enabled mobile devices were more accessible for students than computers (Minagah & Nezarat, 2012). It therefore seems timely to provide substantiation for assertions of pedagogical appropriateness by investigating actual learning and the conditions under which it occurs. Because of the scope of this undertaking and the necessity of viewing listening skill development longitudinally, Design-Based Research was chosen as an appropriate methodological approach for its capacity to encompass large amounts of data from a variety of sources and participants, as well as being responsive to the evolution of the context during the intervention. The DBR study and specifically Phase 2: the Enactment phase will be described in detail in the following section.
METHODOLOGY

This study aimed to enrich intervention theory (Plomp, 2009) by providing a framework to guide and constrain the design of similar educational interventions. The framework resulting from this study comprises a set of MELL eco-system guidelines, which, as the study demonstrated, generate positive learning outcomes. These interconnected principles create a framework that can inform future design of MELL listening instruction as well as provide an improved understanding of the praxis of mobile learning. The design principles encapsulate all the essential pedagogical elements of an effective MELLES intervention, including content, procedures, context, and actors (Palalas, 2012). They also incorporate the technical dimension of the system pertaining to the functionality, tools, and technological context required.

Design Based Research Overview

Design-based research, also known as educational design research, design experiments, formative research and development research (van den Akker, Gravemeijer, McKenney, & Nieveen, 2006) has evolved as a methodology for researching innovative educational designs in their naturalistic settings, since its first introduction to the field under the term “design experiments” by Brown (1992) and Collins (1992). The Design-Based Research Collective (2003, p. 8) subsequently identified four key areas in which DBR could improve educational practice:

1. exploring possibilities for creating novel learning and teaching environments,
2. developing theories of learning and instruction that are contextually based,
3. advancing and consolidating design knowledge, and
4. increasing our capacity for educational innovation

This approach was further reinforced more recently by Reeves, McKenney, and Harrington (2011) when they noted that “[t]here appears to be a fundamental disconnect between the conduct and reporting of educational research and serious improvement in educational outcomes…” (p. 56). They further elaborate on some of the reasons for this lack of improvement in educational interventions, using the term “education design research” for DBR. These include “(p)oor alignment between educationally relevant research and institutional reward systems” (p. 56), as well as two other barriers that impede the effect that educational research can have on practice. These barriers mainly derive from what they perceive as overly traditional views of what can be researched, and the place of alternative roles of the researcher and modes of research itself. In deploring the “sterility of the vast majority of educational research” today, they advocate DBR as having the capacity to provide “a direct link between research and practice” (p. 58).

As Reeves (2006) has also argued, the successful improvement of technology-assisted teaching and learning can only be achieved through a longitudinal, collaborative process of iterative testing, reflection, and refinement of problems,
solutions, methods, and design principles. DBR aims to do just this, by using the feedback and evidence collected from active student-participants and practitioners in the education instance being investigated, to progressively redesign appropriate educational interventions and revise the theory underpinning these. DBR, thus, aims to progressively improve learning and teaching by redesigning educational interventions and revising theory in response to feedback and evidence gathered from participants who are active students and practitioners in the educational situation under investigation. Similarly, Wang and Hannafin (2005, p. 7) define DBR as “[a] systematic but flexible methodology aimed to improve educational practices through iterative analysis, design, development, and implementation, based on collaboration among researchers and practitioners in real-world settings, and leading to contextually-sensitive design principles and theories.”

Drawing on these and other DBR researchers (Design-Based Research Collective, 2003; van den Akker et al., 2006; Bannan, 2009), the form of DBR in this study can be best described as an interventionist participative method, applied in a naturalistic setting, to improve educational practice through the design and refinement of innovative interventions and corresponding theory (design principles). The DBR process adopted here was organized following an established framework, namely the Integrative Learning Design Framework (IDLF) (Bannan, 2009) leading to the coordination of all research activities into the three phases: Informed Exploration, Enactment, and Evaluation: Local Impact. For reasons of time, and since this was a multi-phase longitudinal study, the last IDLF phase, Evaluation: Broad Impact was beyond the scope of the MELLES project. Necessitated by the nature of DBR and its naturalistic setting, the first three phases of the IDLF process were completed in overlapping, nonlinear cyclic fashion over a period of eighteen months. Figure 1 in the Introduction positioned the Enactment phase in the context of the complete MELLES study, discussed in detail below.

THE STUDY
Starting with the aforementioned preliminary principles derived from research literature and analysis of learning objects developed during the pilot phase, a set of design guidelines was generated based on the findings of Informed Exploration. These were then revisited as a result of the adoption of Ecological Constructivism as the theoretical framework for the study. Subsequently, through experimentation and collaboration and consultation with participants, the preliminary design principles were incorporated into the design of a new collection of solutions. Several conceptual models for listening tasks using mobile devices were created by Digital Design and Computer Programmer Analyst students at the college during the Enactment phase, addressed in more detail in the following section. The analysis and recurring discussions of these models resulted in the redefinition of the design and construction of the MELLES prototype accessible through the mobi-english mobi portal, which was then piloted with five groups of ESP students during the Evaluation phase.

Based on the findings of the intervention tests with students and practitioners,
the design principles were then further modified. As recommended by Plomp (2009), the final version of the MELLES design guidelines resulted from systematic reflection and documentation combined with rigorous data collection and analysis (Palalas, 2012). These design principles were formulated to guide ESP practitioners and are not “intended as recipes for success, but to help others select and apply the most appropriate substantive and procedural knowledge for specific design and development tasks in their own settings” (McKenney, Nieveen, & van den Akker, 2006, p.119).

Interviews, focus groups, meetings, and communication via email and the Wiggio project site were the techniques used to systematically collect feedback from practitioners and students. The interconnection between the three phases of the project and the associated data collection techniques are illustrated in Figure 3 below.

**Figure 3. Data collection methods and types of data**

The researchers’ observations and reflections were also incorporated in the data analysis. These included notes related to the characteristics of the MELL system, interconnections between its elements, and the impact of the context. Interview, focus group and survey questions (five-point Likert scale, dichotomous, ranking, multiple choice, and open-end questions) were formulated and then piloted to capture all aspects of respondents’ experience in designing and using the MELLES intervention. Students’ limited language proficiency was also considered and the member-checking technique was employed to validate the findings by confirming
with participants the intent of their statements offered during the interviews and focus groups.

The resulting mixed data were systematically analyzed to enable the constant flow of input into the DBR process and consequently the design of the intervention was regularly updated (main refinements at four data analysis milestones combined with some agile design modifications). All qualitative data were coded and analyzed using the NVivo9 Qualitative Data Analysis System, allowing the analysis to remain grounded in the data. To ensure exhaustive and rigorous data analysis, all data sources including text, images, and audio (transcribed) were integrated into NVivo9. Subsequently, codes were assigned to phrases and sentences through repetitive thematic analysis guided by the main research question. Pre-coding, the initial analysis through Descriptive Coding, and then multiple cycles of Focused Coding (Saldaña, 2009) eventually resulted in a hierarchy of themes encompassing two super categories (Pedagogy and Technology) with major themes (such as PEDAGOGIC PROCEDURE) further divided into subcodes. Table 1 below provides the gist of the Evaluation findings encapsulated as a list of the most frequent themes identifying the essential features and components of the desired MELLES design. Although this coding scheme and the themes did not emerge in its current format until the final summative analysis, its consecutive versions provided dynamic guidance for the intervention design.

Table 1. Evaluation qualitative findings—Main themes (modified from Palalas, 2012, p. 186)

<table>
<thead>
<tr>
<th>Codes (NVivo Nodes)</th>
<th>Ref Freq Total</th>
<th>Rel. Freq Total (n=109)</th>
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<tbody>
<tr>
<td>PEDAGOGY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEDAGOGIC PROCEDURE - How</td>
<td>482</td>
<td></td>
</tr>
<tr>
<td>Grouping</td>
<td></td>
<td></td>
</tr>
<tr>
<td>group work</td>
<td>178</td>
<td>33%</td>
</tr>
<tr>
<td>collaboration and peer support</td>
<td>133</td>
<td>41%</td>
</tr>
<tr>
<td>interaction and communication</td>
<td>37</td>
<td>34%</td>
</tr>
<tr>
<td>share learner-generated artefacts</td>
<td>20</td>
<td>18%</td>
</tr>
<tr>
<td>individual practice</td>
<td>31</td>
<td>28%</td>
</tr>
<tr>
<td>pair work</td>
<td>14</td>
<td>13%</td>
</tr>
<tr>
<td>Motivation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>motivating factors</td>
<td>69</td>
<td>32%</td>
</tr>
<tr>
<td>fun-enjoyment</td>
<td>39</td>
<td>36%</td>
</tr>
<tr>
<td>Activity</td>
<td>Total</td>
<td>Percentage</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>-------</td>
<td>------------</td>
</tr>
<tr>
<td>Scaffolding - help from teacher</td>
<td>61</td>
<td>56%</td>
</tr>
<tr>
<td>Feedback</td>
<td>51</td>
<td>15%</td>
</tr>
<tr>
<td>Need for feedback</td>
<td>19</td>
<td>17%</td>
</tr>
<tr>
<td>Classmate feedback</td>
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<td>17%</td>
</tr>
<tr>
<td>Teacher feedback</td>
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<tr>
<td>Listening practice</td>
<td>38</td>
<td>35%</td>
</tr>
<tr>
<td>Recording own voice</td>
<td>35</td>
<td>32%</td>
</tr>
<tr>
<td>Pre and post activities</td>
<td>34</td>
<td>31%</td>
</tr>
<tr>
<td>Integrated skills</td>
<td>16</td>
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</tr>
<tr>
<td>Need for integrated skills</td>
<td>7</td>
<td>6%</td>
</tr>
<tr>
<td>Speaking supports listening</td>
<td>9</td>
<td>8%</td>
</tr>
<tr>
<td>CONTENT - What</td>
<td>259</td>
<td></td>
</tr>
<tr>
<td>Authentic speech</td>
<td>58</td>
<td>27%</td>
</tr>
<tr>
<td>Need for authentic speech</td>
<td>51</td>
<td>47%</td>
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<tr>
<td>Accents</td>
<td>7</td>
<td>6%</td>
</tr>
<tr>
<td>Vocabulary</td>
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<td>31%</td>
</tr>
<tr>
<td>Directions &amp; explanations</td>
<td>29</td>
<td>27%</td>
</tr>
<tr>
<td>Communication skills</td>
<td>22</td>
<td>20%</td>
</tr>
<tr>
<td>Support materials &amp; resource</td>
<td>24</td>
<td>22%</td>
</tr>
<tr>
<td>Socio-cultural knowledge</td>
<td>24</td>
<td>22%</td>
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<tr>
<td>Pronunciation</td>
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<td>16%</td>
</tr>
<tr>
<td>Relevance - work &amp; program related</td>
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<td>14%</td>
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<tr>
<td>Listening skills</td>
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<td>Listening skills - general</td>
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<tr>
<td>Listening comprehension</td>
<td>9</td>
<td>8%</td>
</tr>
<tr>
<td>Task length</td>
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<td>6%</td>
</tr>
<tr>
<td>Variety of topics</td>
<td>7</td>
<td>6%</td>
</tr>
<tr>
<td>CONTEXT - When and Where</td>
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<td></td>
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<tr>
<td>Real-life practice</td>
<td>63</td>
<td>58%</td>
</tr>
<tr>
<td>Outside classroom</td>
<td>46</td>
<td>21%</td>
</tr>
<tr>
<td>Outside classroom practice</td>
<td>27</td>
<td>25%</td>
</tr>
<tr>
<td>Blended classroom and outside</td>
<td>19</td>
<td>17%</td>
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## MOBILE-ENABLED TASKS FOR ESP STUDENTS

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<tr>
<th>Context affordances</th>
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<tr>
<td>ACTORS - Who</td>
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<td></td>
</tr>
<tr>
<td>Learning community</td>
<td>40</td>
<td>37%</td>
</tr>
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</table>

### TECHNOLOGY

#### FUNCTIONALITY - How

<table>
<thead>
<tr>
<th>Feature</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audio player functionality</td>
<td>31</td>
<td>28%</td>
</tr>
<tr>
<td>Audio files quality</td>
<td>13</td>
<td>12%</td>
</tr>
<tr>
<td>Mobile and computer</td>
<td>13</td>
<td>12%</td>
</tr>
<tr>
<td>Text support</td>
<td>12</td>
<td>11%</td>
</tr>
<tr>
<td>Inherent device affordances</td>
<td>8</td>
<td>7%</td>
</tr>
</tbody>
</table>

#### TECH CONTEXT - When and Where

<table>
<thead>
<tr>
<th>Feature</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexible on-the-move access</td>
<td>19</td>
<td>17%</td>
</tr>
<tr>
<td>Cross-platform</td>
<td>12</td>
<td>11%</td>
</tr>
</tbody>
</table>

Note. Ref Freq Total = reference frequency for both students and practitioners; Rel Freq Total = relative reference frequency for both students and practitioners.

The majority of the study data were qualitative, though some quantitative data were gathered through the surveys and subsequently analyzed using SPSS and Excel analytic tools. Subsequently, to ensure data triangulation, findings from the quantitative analysis were juxtaposed with the results of the qualitative data analysis. The regular rigorous examination of participant feedback and most frequent themes, as well as the interdependencies of those themes, led to the emergence of the MELLES design guidelines. As summarized in the Introduction, throughout the multiple cycles of the study, the overarching question posed to the research participants (both students and instructors) was:

What are the characteristics of an effective, pedagogically-sound mobile-enabled language learning system (MELLES) for students’ mobile devices, through which adult ESP students in a community college enhance their listening skills, while expanding their learning outside of the classroom?

This key research question aimed to elicit feedback on both the pedagogical as well as the technological dimensions of the solution, with primary focus on the pedagogical, following Fischer (2007). The context captured in the research question has two key components: (1) the intervention was designed for college ESP students using their own mobile devices and (2) it aimed to take learning out of the classroom into the real world, offering authentic language situations and challenges. Moreover, the investigation of the design of the mobile learning solution
was informed by current language learning pedagogy “which [is] predominantly social constructivist in nature” (Hoven, 2007, p. 1) and which led to the evolution of the Ecological Constructivist framework (Hoven, 2006, 2008; Hoven & Palalas, 2011; Palalas & Hoven, 2013), in tandem with the results of the study. The MELLES solution was designed, developed, and evaluated following a blend of Constructivist, Ecological Linguistic, and Ecological theories. As the MELL intervention relied on the use of mobile devices in a networked environment, several functionality and system requirement issues needed to be investigated as well. The project thereby enabled the creation of “learning conditions that learning theory suggests are productive, but that are not commonly practiced or are not well understood” (Design-Based Learning Research Collective, 2003, p. 1).

**Enactment Phase**

Over the seven months of the Enactment phase, 41 students and 6 practitioners were involved to varying degrees in the design, development and testing of the MELLES prototype (Table 2). As Herrington, McKenney, Reeves, and Oliver (2007) have commented, “(b)ecause of the highly situated nature of Design-Based Research, participants in a Design-Based Research study in education are central to the investigation” (p. 6).

**Table 2. Participants involved in the enactment phase of the MELLES DBR study**

<table>
<thead>
<tr>
<th>Enactment Participants</th>
<th>Number of Participants</th>
<th>Enactment Activities</th>
</tr>
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<tbody>
<tr>
<td>Digital Design - Advanced Digital Design (Postgraduate, 2 semesters, School of Design): Interface Design</td>
<td>n=14 (7 L1 + 7 L2)</td>
<td>Two cohorts designed and evaluated MELL prototypes</td>
</tr>
<tr>
<td>Computer Programmer Analyst (School of Technology): Mobile Application Development</td>
<td>n=27</td>
<td>Two cohorts designed, developed, tested, and evaluated MELL prototypes; 4 students volunteered their time and feedback outside of their course work, and worked on MELLES design until Sep 2011</td>
</tr>
<tr>
<td>Experts: Mobile Programming COMM/ESL/ESP Wireless Technologies Mobile Interface Design Mobile Design and Development IT Programming</td>
<td>n=6</td>
<td>Designed and evaluated language tasks and MELL prototypes</td>
</tr>
</tbody>
</table>
During this phase, the mobi-english.mobi prototype (Figure 4) was designed and developed, following MELL conceptual models proposed by mobile design and programming students, as well as the results of the concurrent Evaluation cycles. All design and development decisions, processes, time and funding requirements, as well as challenges, were carefully documented. The subsequent versions of the design principles were mapped out and refined on the basis of the feedback gathered.

Figure 4. Screenshot of mobi-english.mobi audio tasks page (mobile interface)
Concurrent with the product design and construction, subsequent versions of the design principles were sketched and fed back into the system. Task analyses of ESP learning objectives resulted in the inclusion of eight MELL listening tasks in the MELLES intervention. The mobile technology system design constituted another part of this phase and led to the adoption of the WordPress\textsuperscript{3} mobile web framework in order to optimize cross-platform access to MELLES and its components.

In addition to the key focus of the research question, namely to elicit feedback on the pedagogical dimensions of the solution, the investigation was also able to delve into some technical aspects of the MELL system. This was made possible through the considerable mobile-technology expertise of participants, which enabled the examination of several system functionalities and components required for an effective intervention. At the same time, feedback concerning the limitations of the physical environment in which the learning took place was also invited.

As mentioned above, in addition to the evaluation data, feedback was also obtained from student-designers and programmers who created prototypes of how they conceived of effective ESP mobile solutions (Figure 2). Their responses and feedback on the MELLES system requirements were expressed in, and collected through, an ongoing dialogue and class assignments as well as design and development documentation, such as design presentations, diagrams of their solutions, and use cases (Appendix A; see also Palalas, 2012, pp. 161-164 for further illustrations).

Hence, the prototype MELLES incorporated eight complementary tasks that employed mobile technologies to mediate comprehension, communication, and language artefact construction activities leading to the co-creation of a collaboratively edited ESP resource. Students and practitioners completed all MELLES tasks in a hybrid environment with mobile tasks being integrated into their regular face-to-face courses. Students were therefore able to participate in group or pair work to complete some of the tasks, in addition to being encouraged to co-create multimedia artefacts, such as their dictionaries, and evaluate each other’s work by leaving comments and rating their audio recordings. Email and telephone formed the major means of communication, complemented by blogging, phlogging (blogging by phone), and by exchanging audio recordings. Students also visited Toronto landmarks and sites in order to complete MELL activities by working collaboratively and to provide the support and challenge of operating under real-life communication constraints.

Overall, this initial design incorporated a set of eight task types with a variety of learner participation modes, interaction, and activities, both pedagogical and technological. Tasks included, for example, the co-creation of an Idiom Bank and a Multimedia Dictionary, requiring students to create and add to the website their own idioms and dictionary items heard, recorded, and photographed in the real world. In other tasks, students participated in and recorded interviews with each other and people they met in the city, and responded to audio instructions for scavenger hunts and the creation of Toronto Landmark Lists. Blogs and audio reflec-
tion also figured in other MELLES tasks. More detail on these tasks is provided in the discussion below.

DISCUSSION

MELLES Prototype

The MELLES intervention was designed as a learning network integrating ESP tasks, learning and linguistic resources supporting these tasks, communication and evaluation capabilities, and tools for building and sharing student artefacts. Most importantly, the resultant language practice was contextualized in real-life settings. In response to participant feedback and following the chief principles of ecological thinking—relationships, connectedness, dynamic process, and fluid context—all elements of the MELLES prototype interacted, forming a web of resources, student-generated artefacts, mobile tools, and their users. The interdependent system of interactions is represented in Figure 2 in the Introduction.

Accordingly, all individual and collaborative activities were linked together through their interrelated content and goals aiming at the development of a shared ESP online resource. Real-life communication, interaction and linguistic resource co-creation were the key drivers of the design. The MELLES mobile website, accessible from any mobile device via the mobi-english.mobi portal, connected the members of the learning community at a time and place convenient to them. To offer such choice and flexibility, tasks were designed so that they could be completed in a nonlinear fashion. Students could start from any task as long as they met the prerequisites of the signpost tasks (for instance Task 3, 4, and 6 outlined below) – periodic group assignments requiring completion of related vocabulary and listening comprehension activities. While all MELL tasks were related and fed into each other, thereby promoting flexibility, the signpost collaborative tasks ensured systematic progress and motivated students to maintain regular language practice.

Mobile devices provided tools for recording audio, snapping photos, and eventually exchanging those artefacts. Students also used their phones to access audio task directions and instructions, vocabulary resources, audio podcasts focusing on listening comprehension, pronunciation practice, and other language help created or selected by an ESP expert.

MELLES Listening Tasks

The MELLES language tasks aimed to stimulate the process of co-learning through both collaborative and individual (cognitively focused) activities while creating an evolving ESP resource. The eight interconnected, non-linear tasks guided students through a continuous process of interaction, encouraging communication with their peers and with L1 speakers who were an inherent part of the real-world language situations students found themselves in. Working individually and in groups, students completed language challenges, co-created multimedia artefacts, and evaluated each other’s work by leaving comments and rating each other’s audio recordings. To reinforce language practice and the spirit of collaboration,
some activities required students to visit Toronto sites together and support each other in completing communication challenges. These ESP activities, aimed at the development of aural skills, integrated all four language skills to provide a holistic learning context and practice of the whole language system (Palalas, 2012). By addressing different language competencies through these complementary tasks, students reported that they gradually developed into more advanced language speakers as well as adept users of, and contributors to the MELLES system.

Finally, the MELLES tasks were designed following the eight principles of task-based teaching proposed by Ellis (2003), which were adapted to reflect the MELL context and participants’ feedback. The modified principles are summarized below (italics indicate modifications to the original version; Ellis, 2003, pp. 276-278):

1. Ensure an appropriate level of task difficulty and exposure to authentic language and communicative challenges.
2. Establish clear goals for each task and ensure that they motivate learners to engage in language use.
3. Develop an appropriate orientation to performing the task in the students.
4. Ensure that students adopt an active role in tasks, both individual and collaborative tasks.
5. Encourage students to take risks.
6. Ensure that students are primarily focused on meaning when they perform a task.
7. Provide opportunities for focusing on form.
8. Require students to evaluate their performance and progress and their peers’ performance.

Details of the resulting MELLES tasks are presented below, using the Categories: Goal, type of Input, type of Output, Procedures for students to follow, any restrictions placed on student Time or Location, student Grouping (individual, pair, class), and the nature of the Interactivity embodied in tasks.

Task 1 (Idiom Bank) & Task 2 (Multimedia Dictionary)

**Goal:** To contribute to an online repository of idioms/multimedia dictionary by generating audio recordings (definition and illustration) and evaluating peers’ recordings

**Input:** Audio instructions, written task synopsis, language dictionaries - multimedia, student-generated examples of language usage (audio, visual), examples of audio entries and evaluations, real-life speech and context affordances; Language and techn. knowledge from previously completed tasks; Optional: Face-to-face instructions and feedback from facilitators

**Output:** Rehearsed speech: student-generated audio recordings, peer evaluation; Response to audio content: evaluation

**Procedures:**
° Follow audio instructions
° Record vocab. definitions
° Optional: take pictures illustrating the usage of vocab.
° Upload audio and images to the repository
° Listen to other students’ creations
° Evaluate classmates’ contributions (minimum 2)

Setting Time: No restrictions
Setting Location: No restrictions
Grouping: Recordings: individual or pair; Evaluation: individual or pair
Interactivity: Peers, teacher, content, technology, real-life language speakers and context

Task 3 (Audio Map) & Task 4 (Scavenger Hunt)

Goal: To collaboratively build an online multimedia map of Toronto by recording audio descriptions of Toronto landmarks and posting them to the class website

Input: Audio instructions and directions, audio descriptions of landmarks, examples of other students’ recordings, written task synopsis, language dictionaries - multimedia, real-life and student-generated examples of language usage (audio, visual), real-life speakers, situations, objects and other context affordances; Language and techn. knowledge from previously; Optional: face-to-face instructions and feedback from facilitators

Output: Impromptu speech: real-life communication; Rehearsed speech: student-generated audio recordings, peer evaluation; Response (written, spoken or visual) to audio content: evaluation, reflection, correction, answers to comprehension questions

Procedures:
° Follow audio instructions
° Listen to descriptions of landmarks
° Record podcasts
° Take pictures illustrating landmarks or as for Scavenger Hunt (SH) challenges
° Respond (written, spoken or visual) to SH audio challenges
° Upload artefacts
° Listen to other students’ recordings
° Comment/blog on classmates’ contributions (minimum 2)

Setting Time: Restricted by availability of the group or task partner
Setting Location: Restricted by the choice of Toronto landmarks and SH directions

Grouping: Landmark visits: group or pair; Recordings: individual or pair; Evaluation: individual
Interactivity: Peers, teacher, content, technology, real-life language speakers and context
Task 5 (Phlogging with iPadio) & Task 8 (Phlogging: Reflections)

**Goal:** To exchange your podcasts on topics of interest and share reflections by blogging via phone (phlogging) – exchanging voice recorded speech

**Input:** Audio instructions, student-generated examples of language usage (audio podcasts on topics of interest), examples of former students’ recordings, written task synopsis, language dictionaries - multimedia, students’ audio reflections, peer and facilitator audio comments/responses; Language and techn. knowledge from previously; Optional: face-to-face instructions and feedback from facilitators

**Output:** Rehearsed speech: student-generated audio recordings; Response to audio content: audio comments, questions, reflections

**Procedures:**
- Follow audio instructions
- Record audio podcasts (phlogs)
- Take pictures illustrating landmarks or as for Scavenger Hunt (SH) challenges
- Respond (written, spoken or visual) to SH audio challenges
- Upload artefacts
- Listen to other students’ recordings
- Comment/blog on classmates’ contributions (minimum 3)
- Evaluate classmates’ contributions (minimum 2)

**Setting Time:** No restrictions

**Setting Location:** No restrictions

**Grouping:** Recordings: individual; Evaluation: individual

**Interactivity:** Peers, teacher, content, technology

Task 6 (Student Radio)

**Goal:** To contribute to the student radio by creating an audio interview that provides information pertaining to the topic of interest to the students and peers

**Input:** Audio instructions, examples of other students’ interview recordings, written task synopsis, language dictionaries - multimedia, real-life and student-generated examples of language usage (audio, visual), real-life speakers, situations, objects and other context affordances; Language and techn. knowledge from previously; Optional: face-to-face instructions and feedback from facilitators

**Output:** Rehearsed and impromptu speech: real-life communication (prepared and ad-hoc interview questions, answers, comments), interview recordings

**Procedures:**
- Follow audio instructions
- Prepare and conduct an interview
- Record the interview
- Upload the audio
MOBILE-ENABLED TASKS FOR ESP STUDENTS

- Listen to other students’ recordings
- Comment/blog on classmates’ contributions (minimum 2)
- Evaluate classmates’ contributions (minimum 2)
- Optional: listen as a group in class and exchange feedback

**Setting Time:** Some restrictions (interviewee choice)

**Setting Location:** Some restrictions (interviewee choice)

**Grouping:** Interview: pair or group of 3; Recordings: pair or group of 3;
Evaluation: individual, pair or group/class

**Interactivity:** Peers, teacher, content, technology, real-life language speakers and context

**Task 7 (Listen on the Go)**

**Goal:** To practice listening comprehension skills on-the-go

**Input:** Audio instructions, written task synopsis, language dictionaries - multimedia, audio and written comprehension questions and language games related to the audio podcast; Optional: face-to-face instructions and feedback from facilitators

**Output:** Written responses to audio podcasts

**Procedures:**
- Follow audio instructions
- Listen to audio podcasts selected from the list (minimum 3)
- Complete language activities based on the audio (as per handouts)

**Setting Time:** No restrictions

**Setting Location:** No restrictions

**Grouping:** Listening: individual; Comprehension practice: individual

**Interactivity:** Peers, teacher, content, technology

As mentioned above, the MELL system promoted a balanced combination of individual, pair, and group activities, which, in turn, allowed for a relatively high level of flexibility in terms of the time and place of learning.

**CONCLUSION**

It was the aim of this study to present sufficient data and description to inform the practice of other educators and to provide some evidence for the effectiveness of DBR to address the shortcomings of most educational interventions, as noted by Reeves et al. (2011) discussed earlier. Due to the context-bound nature of this Design-Based Research study, and indeed, the nature of DBR studies in general, context-free statistical generalizations from sample to population are not possible. Consequently, an analytical generalization was provided through thick description of the study so that readers can potentially transfer the “research findings to theoretical propositions in relation to their own context” (Van der Akker et al., 2006, p. 49). The two major outcomes of the Enactment phase (Phase 2) of this study were the mobi-english.mobi prototype, which evolved as a result of multiple attempts to design stand-alone mobile learning objects which could be
ultimately integrated into one larger system, and a set of design guidelines that could be used to refine the tasks and evaluate the next cycle of developments. In summary, the **Essential Characteristics** of these guidelines can be represented as follows:

- active learning promoting motivation
- individual, peer, and group collaborative interaction: mutually supportive mix of in-class, real world, dynamic, and rehearsed language practice and use
- scaffolding and progressive support
- modularization for learner independence (time and location)
- self and peer evaluation promoting language awareness
- game elements and supporting visuals … as well as technical aspects such as:
  - restricting audio length to 5 minutes and task time to 10-15 minutes
  - student-controlled audio features
  - technical instructions easily accessible
  - evaluation metrics viewable by both students and instructors.

Appendix B provides details of both the **Essential Characteristics** (*Substantive Emphasis*) and the accompanying **Strategies** (*Procedural Emphasis*) emerging from the Enactment phase.

These refined MELLES guidelines or principles drove the final refinement of the MELLES prototype before it was launched for piloting by participants in November 2010. This MELL intervention prototype then served as the base for the subsequent cycles of the Evaluation phase in which eight practitioners and two external experts reviewed the testing of the refined system with five ESP classes. Due to the extended nature of this study and the interconnectedness among the constituent elements, the Evaluation findings are reported elsewhere (Palalas, 2012). However, as advocated by Fischer (2007), further exploration of both the guidelines and the educational intervention in other language contexts, together with mapping against standardized language assessment measures is recommended.

**NOTES**

1. A study comparing students’ language proficiency vis-à-vis the language requirements of the college academic programs and the corresponding Canadian workplace.
2. Online collaborative tool supporting group work and communication; http://wiggio.com
3. WordPress Mobile Pack. A toolkit which helps mobilize any WordPress site (available via Internet from any mobile platform) and its components; it includes a mobile switcher which toggles between the desktop and mobile view, a selection of mobile themes, widgets, device adaptation and a mobile administration panel to allow users to edit the site.
REFERENCES


Kukulska-Hulme, A., & Shield, L. (2008). An overview of mobile assisted language learning: From content delivery to supported collaboration and interaction. ReCALL, 20(3), 271-289. doi:10.1017/S0958344008000335


APPENDIX A

INTERACTIVE MAP OF TORONTO—USE CASE

USE CASE

TASK: Collaborative Interactive Map of Toronto L

Each student/pair of students is responsible for one landmark. These digital resources form the base for the landmark. The map becomes the interface of the activity and if placeholders for the landmark photos and recording. The generated content.

How to play:
On their own time, students are directed by audio instructions. Once they arrive at the landmark, mini-podcasts followed audio questions about the landmark are sent these questions orally (recording) based on the inform (they can even record their answers) and on their own digital artefacts which can be contributed to the collection.

UC_Map_1_AudioRanking
Use Case #1: The peer audio recording reviewing process

Primary Actor

- Reviewer (each student has to review three recordings)
- Provides feedback for the author.

Preconditions

- Reviewer has a valid username and password
- Audio recording files have been received by reviewers.

Postconditions

- The recordings are assigned points (from 1 to 60) and are submitted to the database.
- Landmarks of Toronto will display links to the approved folder. Those recordings will be moved to the approved folder in a separate section.
- The recordings have to be rerecorded and re-submitted.

Special Requirements

- ???

Frequency of Occurrence

- Very often

Open Issues

- ???
Appendix B

Recommendations below detail the essential characteristics of the system in the category Substantive Emphasis, while the strategies needed to operationalize these form the category Procedural Emphasis.

Summary of Phase 2 Design Guidelines

Essential Characteristics (Substantive Emphasis)

- Motivation through active learning
- Group work: interaction and communication within the learning network
- Group work: collaboration and peer support within the learning network
- Inclusion of collaborative and individual activities (time and place independent)
- Scaffolding from experts and peers
- Socio-cultural knowledge (including visiting local landmarks and exploring cultural habits)
- Rehearsed and ad-hoc communication practice
- Dynamic language practice in the real-world setting including communicative situations involving authentic speakers of English
- Support from linguistic affordances present in the real-world context
- Sharing of learner-generated linguistic artefacts (audio, video, images)
- Blend of classroom and out-of-class real-life context
- Blend of in-person and mobile-mediated communication and interaction
- Reliance on inherent audio capability (Mobile technology affordances)
- Owning mobile technology
- Relevance to academic and professional goals
- Continuity and flexibility of practice derived from choice of timing and sequence of tasks completion
- Continuity of learning afforded by constituent tasks of MELLES being interrelated and building on each other in a cyclical fashion
- Advancement of learning supported by progressively more demanding language tasks (linguistically and technologically)
- Accommodation for interrupted episodic learning – modular design with each audio not exceeding 5 minutes or activity within a task 10-15 minutes
- Educational game elements including rewards (ranking, point system), challenges, competition (group or individual), engaging visual interface
- Visual support for language content
- Metrics on students’ progress - user profile and progress report
- Support for technology – instructions how to use the system (audio), tips and pointers to web-based resources
- Audio player/recorder functionality: ability to control audio recordings
STRATEGY
(PROCEDURAL EMPHASIS)

Learners:
• Actively engage in communication through interaction and discourse with inter-
locutors who may be more, equally, or less competent
• Combine autonomous and collaborative learning
• Create artefacts and share them via MELLES (audio, video, images, some text)
• Contribute their feedback and evaluation of peers’ artefacts (rating system, audio
recordings)
• Apply creative effort to a communication situation (for instance, create learning
materials or other artefacts)

Experts:
• Provide/point to clear instructions and directions for a listening task
• Offer in-person (immediate) and recorded (delayed) feedback and evaluation
• Moderate the MELLES website (for instance, step in when the instability was
apparent)
• Ensure constant inflow of information and exchange of ideas
• Facilitate the artefact construction
• Develop new or modify existing mobile tasks and activities when needed
• Maintain the steady flow of information and interaction, thus help glue the learn-
ing network
• Promote learner ownership and agency
• Provide technology support and point to tech resources incorporated in MELLES
(mainly in the initial stages of the learning process; mobile technologies tend to
become transparent after one-two demos)

Mobile Technology (MELLES):
• Provide platform to coordinate/direct learning process - flexible structure that
learners can always fall back onto
• Enable synchronous and asynchronous communication
• Act as a repository of students’ artefacts and a meeting point for discussions and
evaluations
• Deliver audio content (instructions, directions, task-related information, pronun-
ciation examples)
• Distribute text-based content (brief instructions, task-related information, vo-
cabulary, links)
• Offer apps supporting language learning (audio dictionaries, translators, flash
cards)
• Enable access to the learning resources selected by experts and suggested by
others
• Facilitate scaffolding support by connecting to experts and peers
• Enable linguistic artefacts creation (voice recorder, camera, note taking option,
memor app)
• Assist with the perception of and interaction with the affordances (for instance, audio directions instruct students to collect evidence of various features of a Victorian style home)
• Connect to the MELLES website
• Enable exchange of delayed feedback (audio, rating system – such as the Facebook Like button, some text)
• Provide tools to evaluate peers’ artefacts (audio, rating system, some text)
• Facilitate immediate feedback (messages, alerts)
• Assist in communication within the learning network (voice, text, blogging, phlogging)
• Help showcase learner-generated artefacts by offering tools for upload and viewing
• Enable authentic assessment of linguistic skills (carry out linguistic functions in real-life situations in response to audio instructions)
• Offer simple yet engaging mobile interface to MELLES (clear, coherent, and consistent)
• Provide browser-based access from any device by creating platform independent architecture (any mobile or computer platform)
• Allow for the MELLES website to evolve to accommodate future learners
• Allow for interrupted episodic learning (modular design with pause, replay buttons and records of learner progress)
• Build in audio player/recorder controls (locally on the device): play, record, adjust audio speed, pause, fast forward, rewind, replay, delete
• Provide user profile and progress report
• Integrate technology support – instructions how to use the system (audio), tips and pointers to web-based resources

Activities:
• Aim at meaning making through meaningful communicative goals
• Promote sharing of meaning with others
• Promote interaction with others, content, technology, environment
• Include individual and collaborative activities
• Offer a blend of social, cognitive, and teaching presence
• Draw on the affordances of the context and point to those linguistic affordances
• Challenge learners linguistically in real-life communication situations
• Reflect or include real-world tasks that learners will encounter outside the classroom
• Integrate listening, speaking, reading, and writing but are guided by listening learning outcomes
• Encompass rehearsed and ad-hoc communication
• Combine listening with pronunciation practice
• Integrate socio-cultural skills
• Contribute to the learning network their feedback and artefacts via MELLES
• Include task-related linguistic materials (such as a vocabulary list) and pointers to other linguistic resources; provide text-based support
• Provide clear instructions and directions
• Blend creativity and competition in learner-generated artefacts exchange
• Design tasks to feed into each other forming a web of listening activities yet allowing for choice of timing and sequence of tasks completion
• Allow for interrupted episodic learning – modular design with each audio not exceeding 5 minutes or activity within a task 10-15 minutes
• Provide scaffolding through visual representation of audio content - message redundancy