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Developing an evaluation framework for identifying globally shared and locally specific requirements for the design and use of educational technology[1]

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Abstract: This paper presents a preliminary evaluation framework for identifying globally shared and locally specific requirements for the design and use of educational technology. The framework was developed initially from a literature review, and subsequently further refined in international collaboration between Chile, Finland, Singapore, South Korea, Spain, and the United Arab Emirates. It consists of three partially overlapping parts: I) Education, teaching and learning; II) Culture and society; and III) Design and use of technological learning solutions. In addition to providing an evaluation tool for designers and researchers, the framework can support educators' and student teachers' cultural awareness and sensibility both when selecting and using educational technology.

Introduction

There is an abundance of digital educational materials and resources shared and distributed on international markets. Educational technologies developed based on the demands of one sociocultural context are, however, unlikely to be directly suitable for other contexts. While the need for frameworks or models for evaluating cultural dimensions of ICT-enhanced learning has long been recognized (Henderson, 1996), and considering target users' specific contexts of use is highly recommended (Young, 2008), contextual design factors are yet commonly under emphasised and under evaluated (Rogers, Graham & Mayes, 2007). The study presented in this paper responds to this challenge by developing an evaluation framework for identifying both globally shared and locally specific requirements for the design and use of technological learning solutions.

The study forms part of the on-going Systemic Learning Solutions (SysTech) research project aimed at promoting 21st century learning with motivational learning solutions (e.g., Kankaanranta & Mäkelä, 2014). In 2014, this originally Finnish project extended to Chile, Hong Kong, Singapore, South Korea, Spain, and the United Arab Emirates. The framework created, employed, and refined in this international collaboration, combines and extends contents from various previous models (e.g., Edmundson, 2007; Henderson, 1996; Young, 2008). This is in order to support the identification of similarities and differences in the design and use of educational technology between regions, countries, and groups (within a country), without forgetting variations on the individual level (see Henderson, 1996; Hofstede, 1986; Inglehart & Welzel, 2010).

The method section will describe the framework development efforts based on a literature review and international collaboration. This is followed by the results section presenting the preliminary framework. In the discussion, we will demonstrate how the framework has been used and can be used in the future. Emphasis is especially on its applications to teacher education and teachers' professional development.

Method

For the literature review, significant electronic databases (e.g., ERIC, Google Scholar, JSTOR, ScienceDirect) were searched. Table 1 displays categories, some key words used in the search, and a number of studies selected for each category. Key words were used both separately and in various combinations. Literature chosen to be reviewed entailed both empirical and conceptual papers on cultural (and societal) dimensions, these included work on cultural dimensions: (a) in general (e.g., Inglehart & Welzel, 2010; Minkov & Hofstede, 2011; Trompenaars & Hampden-Turner, 1997); (b) in learning (e.g., Fisher & Waldrip, 1999; Hofstede, 1986); (c) in ICT (e.g., Marcus & Gould, 2000; Wallace et al., 2013); and (d) in ICT-enhanced learning (e.g., Henderson, 1996; Young, 2008). In the multidisciplinary field of educational technology, both predominantly educational (e.g., Reeves, 1994) and technological (e.g., Richter & Pawlowski, 2008) studies were chosen. Further, studies drawing insights from models of culture (e.g., Lee et al., 2008; Edmundson, 2007) were combined with studies representing international comparative studies (e.g., Law, Kankaanranta & Chow, 2005; OECD, 2013) and more technical perspectives (e.g., ISO, 2011).

CATEGORY	EXAMPLE KEY WORDS	n =
a) Cultural dimensions	cultural dimensions; models of culture; national culture; multiple culture; intercultural interaction	20
b) ...in learning	education; teaching; learning; comparative case study; international comparative research	20
c) ...in ICT	usability; user experience; internationalization; globalization; localization; contextualization	20
d) …in ICT-enhanced learning	e-learning; online learning; educational software; learning technology; instructional design	40

Table 1: Categories, example key words, and a number of studies selected to the literature review of each category

The framework was divided into three (partially overlapping) parts: I) Education, teaching and learning; II) Culture and society; and III) Design and use of technological learning solutions (for the similar categorization, see Rogers et al., 2007), entailing from 7 to 9 evaluation criteria (see Table 2) selected based on (a) their frequency and prominence in the literature reviewed and (b) suggestions received from research partners from seven participating countries. Before employing the framework in actual evaluations, we also tested its suitability for a country comparison by analysing the potential localization needs of Finnish learning solutions in the United Arab Emirates (Mäkelä, Kankaanranta, Young & Alshannag, 2014) as a type of a mock example (see Edmundson 2007).

PART I) Education, teaching, and learning	PART II) Culture and society	PART III) Design and use of technological learning solutions
E1 Educational needs and challenges E2 The educational system E3 The curricular goals and content E4 Organizational practices and operations E5 Educational practices at group level E6 The assessment system and practices E7 Learning objectives of the specific subject E8 Task-types and activities E9 Non-formal and informal learning contexts	C1 Ethnicity and ethnic diversity C2 Gender roles and differences C3 Behavioural conventions C4 Religious beliefs and customs C5 Geography, history and politics C6 Legal and socio-economic system C7 Numeric formatting C8 Visual and multimedia contents C9 Linguistic contents	D1 General ICT access and infrastructure D2 Technological design D3 Design of the visual/multimedia contents D4 Current trends in the ICT-enhanced learning D5 User-friendliness and ease of use D6 Accessibility and functional diversity D7 Connection to the users' everyday reality

Table 2: Preliminary evaluation framework

Results

I) Education, teaching and learning

The first criterion of part I (see Table 2, E1) is related to the degree to which educational technology addresses local *educational needs and challenges* (see Edmundson, 2007; Young, 2008) such as improving educational achievement, equity, or low student engagement and satisfaction levels (OECD, 2013). Further, although the need for motivating technological learning solutions is globally shared (Reeves, 1994), sources of motivation may be locally specific (Watkins, 2000). The second criterion (E2) explores how the learning solution fits to the local *educational system* (see Edmundson, 2007). Some possible differences to be considered are the year in which children start their obligatory school, total years of obligatory schooling, levels of flexibility, and heterogeneity or homogeneity of the system (Mäkelä et al., 2014). Closely related to E2, the third criterion (E3) focuses on the degree to which the solution's goals and contents match with generic *local curricular goals and content* (see Law et al., 2005; Richter & Pawlowski, 2007), which can be, for example, either sharply-focused and pre-specified or unfocused and individualized (Reeves, 1994).

Criterion E4 considers how well a technological learning tool fits to the local institutions' everyday *organizational practices and operations* such as change processes (Law et al., 2005), leadership style, level of collaboration amongst teachers, and teachers' learning and development opportunities (OECD, 2014). Also, differences related to E5, *educational practices at group level*, entailing instructional practices and strategies (e.g., didactic vs. facilitative), teacher and student roles, and levels of differentiation (Reeves, 1994; Young, 2008) may need to be considered. Further, attention should be given to E6, *the assessment system and practices* (e.g., Rogers et al. 2007), which may focus more either on quantity or quality, errorless learning or innovativeness and learning from experience, and measuring precisely with tests or evaluating through observation and dialogue (Hofstede, 1986; Reeves, 1996).

Criterion E7 pays attention to how well the learning solution promotes acquisition of *learning objectives of the specific subject/s*, which are likely to reflect differences related to the generic curricular goals and contents (see E3) and may vary, for example, from learning accurate domain-based contents to learning more generic cross-curricular competences (Hofstede, 1986; Law et al., 2005). E8 calls for evaluating how the tool matches locally typical *task-types and activities* (e.g., Rogers et al., 2007), which may range, for instance, from static to generative and repetitive to varied activities (Reeves, 1994, 3). Further, although self-directed and collaborative learning seems to be globally valued (Reeves, 1994; Young, 2008), some cultures and societies may be more accustomed to: deference and modelling instead of autonomous and self-directed work; or individual work and competition instead of collaborative activities (Fisher & Waldrip, 1999). Finally, criterion E9, *non-formal and informal learning contexts*, was included in part I in order to evaluate how well the learning solution suits these, less formal contexts of use.

II) Culture and society

The first criterion in part II (Table 2, C1) explores whether design features such as the choice of people or characters in visual representations (Nikolopolou, 2007) or the choice of music and voice-overs (Henderson 1996) fit local *ethnicity and ethnic diversity*. A second criterion (C2) to consider is whether the educational technology suits local educational and technological conventions related to *gender roles and differences* (e.g., Rogers et al., 2007). For example, although improving general gender equity or reducing the gender gap in computer use or in digital reading scores are globally shared concerns (OECD, 2011; 2013), local conventions may require single-gender education (see Mäkelä et al., 2014). Furthermore, instead of being gender neutral, products may be wished to be more clearly directed to either males or females (Lee et al., 2008; Marcus & Gould, 2000).

Moreover, it is important to evaluate the suitability of the educational technology with C3, local *behavioural conventions* which also influence both educational and technological practices. Some examples of this include: the level of power distance influencing the way people in higher positions (e.g., directors, teachers) or different aged people are addressed; levels of displaying emotions or controlling desires and impulses; and preference given to individualistic or collectivistic behaviour (Hofstede 1986; Minkov & Hofstede, 2011; Trompenaars & Hampden-

Turner, 1997). Additionally, customs and etiquette and even sense of humour may vary (Nikolopolou, 2007; Rogers et al., 2007). C4 focuses, in turn, on the suitability of the solution from the point of view of local *religious beliefs and customs*. Despite of the predominance of either traditional (religious) or secular-rational and self-expression values in a given culture (Inglehart & Welzel, 2010), local religion/s are typically present, for example, in local curriculums and institutional practices.

Criterion C5 reminds of the need to evaluate whether a learning solution is appropriate for the local *geography, history, and politics* and does not have improper references to them (Henderson, 1996; Young 2008). Attention should be paid, for instance, to: the familiarity of man-made and natural environments presented (Nikolopolou, 2007); specific historical events or viewpoints (Richter & Pawlowski 2007); and political systems and tendencies such as political instabilities (Richter & Pawlowski 2007; Rogers et al. 2007). Also C6, applicability to local *legal and socio-economic system* (e.g., Rogers et al., 2007) requires attention. Differences in legality issues may be related to rules, rights, standards and agreements as well as Internet security (Richter & Pawlowski, 2007). Country-differences in general socio-economic level or socio-economic equity (OECD, 2011; 2013) in turn, are likely to influence, for example, the affordability and economical accessibility of educational technology to the target audience (Young, 2008).

Criterion C7 focuses on the suitability of *numeric formatting* and conventions such as currency, data and time formats, and measurements (ISO, 2011). Also cultural conventions related to C8, *visual and multimedia contents* require careful attention as they are likely to include elements related to all other criteria (e.g., ethnical groups, behavioural conventions) in part II. There may also be differences related to aesthetic appeal, colours, and symbols (Marcus & Gould, 2000; Nikolopolou, 2007; Young, 2008). Finally, when evaluating the suitability of *linguistic contents* translated into local language/s, C9 seeks to identify technical (ISO, 2011) and stylistic requirements (Nikolopolou, 2007; Young, 2008), as well as uses of different national languages (Lee, 2003). In case a foreign/second language is used in teaching and learning, attention should be placed towards the adequate level of difficulty for the application situation (Rogers et al., 2007).

III) Design and use of technological learning solutions

The first criterion of part III (Table 2, D1), *general ICT access and infrastructure*, is concerned with: the suitability of the educational technology in relation to the state of development of the infrastructure (Richter & Pawlowski, 2011); internet access and speed (Rogers et al., 2007); and/or levels of inequality in the use of computers at school or home (OECD, 2011). D2 calls for evaluating the suitability of the *technological design* in the local context, which may vary based on both infrastructural (D1) and cultural differences (Edmundson, 2007; Young, 2008). For instance, in spite of shared international standards (Richter & Pawlowski, 2007), there may be local preferences related to navigation, formats of informative and diagnostic messages, and interactive responses (ISO, 2011) or expectations on the speed of achieving navigational and functional goals (Marcus & Gould, 2000). Further, although it may be possible to design inherently flexible tools allowing the creation of culturally responsive contents and interface (Lee, 2003), preferences between teacher-proof design with little possibilities for changes and easily modifiable programs may vary (Reeves, 1994).

Criterion D3 focuses on the suitability of the *design of the visual/multimedia contents* from the technological perspective (cf. C8). Cultural preferences in the design may range, for example, from design with axial symmetry to a more asymmetric layout; and from simple, clear imagery and limited choices to more complex and media rich design (Marcus & Gould, 2000). D4, which is closely related to part I (Table 2), looks at the learning solution's fit to *current* (local) *trends in the ICT-enhanced learning* ranging from more traditional (e.g., expository teaching; task-based learning; information search) to more emerging (e.g., project work; media production; learning beyond the classroom) practices (Law et al., 2005). Further, although allowing time and space for independent learning is generally encouraged (e.g., Young, 2008), cultural differences may influence preference given for either working together in face to face environments or for working independently at a place and time that suits individuals (Downey et al., 2007).

Criterion D5 considers possible differences in experienced *user-friendliness and ease of use*: cultural differences may, for instance, explain why some users experience high levels of frustration when using complex systems (Downey et al., 2007) while others enjoy exploring things (Lee et al., 2008); or why some users give preference for satisfaction more than for efficiency or effectiveness (Wallace et al., 2013). D6, *accessibility and functional diversity,* reminds that, while educational technology which is designed on the bases of universal design

principles (see Connell et al., 1997) is likely to be generally accessible, some locally specific needs for hardware and software diversification (see Young, 2008) may need to be considered. Finally, D7, *connection to the users' everyday reality,* was included in the framework in order to see whether the learning solution is connected, for example, to the learners' prior knowledge, outside of school metacognitive strategies, and cultural practices (Lee, 2003), also including uses of technologies that they are familiar with (Rogers et al., 2007).

Discussion

The preliminary framework is yet a "beta version" to be refined based on the findings from the actual evaluations, and thus, may still undergo changes. At the time of writing this article, more than 100 experts (e.g., directors, teachers, researchers, developers) from seven participant countries have employed the framework when evaluating the suitability of 30 different learning solutions (e.g., learning games, simulations, mobile learning systems, online course platforms) in their countries of origin. Evaluation sessions have provided participants with professional development opportunities such as: an introduction to an evaluation method; possibilities to familiarize with new learning solutions; and ideas and tools for one's own work. Also, some student teachers have been invited to participate in the evaluations. In spring 2015, we will introduce the evaluation method in a computer teacher education course at our university.

Despite the work-in-progress nature of this research, the framework described in this paper can already be used for identifying globally shared and locally specific requirements for learning solutions and their use. As a specific application in the context of teacher education (pre-service, in-service, and graduate teacher education; faculty and staff development), the framework can be used in "culture-based training" (Young 2008, 115) to support student teachers' and educators' cultural awareness and sensibility both when selecting and using educational technology either in international or national contexts of use. In addition to focusing on evaluating the suitability of learning solutions for specific sociocultural contexts, one may also reflect on whether locally novel tools could be used to promote desirable educational or sociocultural changes such as quality and equity (Mäkelä et al., 2014). Introducing locally new elements (e.g., more interaction, participation, problem solving, and creativity) may only require additional support and being "more explicit about what is expected" (Rogers et al., 2007, 212).

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