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DESIGN PRINCIPLES OF COLLABORATIVE LEARNING SPACE CONNECTING TEACHERS AND REFUGEE CHILDREN - A DESIGN SCIENCE RESEARCH STUDY

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Abstract

Learning the German language is one of the most critical challenges for refugee children in Germany. It is a prerequisite to allow communication and integration into the educational system. To solve the underlying problem, we conceptualized a set of principles for the design of language learning systems to support collaboration between teachers and refugee children, using a Design Science Research approach. The proposed design principles offer functional and non-functional requirements of systems, including the integration of open educational resources, different media types to develop visual and audio narratives that can be linked to the cultural and social background. This study also illustrates the use of the proposed design principles by providing a working prototype of a learning system. In this, refugee children can learn the language collaboratively and with freely accessible learning resources. Furthermore, we discuss the proposed design principles with various socio-technical aspects of the well-being determinants to promote a positive system design for different cultural and generational settings. Overall, despite some limitations, the implemented design principles can optimize the potential of open educational resources for the research context and derive further recommendations for further research.

Keywords: Intergenerational Learning, Children Refugee, Learning Technology, Storytelling for Kids, Collaborative OER.

1 INTRODUCTION

In recent years, the number of refugees in Germany has risen, and many teachers, employees in schools and kindergartens, as well as volunteers, are currently engaged with refugee children and young people who have to learn German. Improving proficiency in German is one of the most critical and central goals for the refugees, to open up opportunities, and quickly adapt to the new environment. Therefore, language classes for acquiring the German language were opened in various German refugee centers, where the refugees can intensively learn German for at least one year before attending the preparatory course. Considering the lack of financial support for refugees, offering free solutions where refugee children can learn the German language free of charge is essential.

Open Educational Resources (OER) comes as a solution that allows refugee children to learn German. OER is an openly accessible, arbitrary digital form of learning material [1] also for language learning and thus enables refugee children to improve their communication skills. Such resources can be used directly or through a modification to adapt learning objectives and meet the needs of refugee children. However, adopting OER for co-creation of learning materials may entail higher personnel costs with limited available resources, the process requires specific competencies, and barriers exist that can hinder the co-creation of digital learning materials [2]. Moreover, a study in language learning shows that language learning is stressful, which can lead to demotivation in learning [3].

One possible solution that has been considered by the system designer and human-computer interaction community over the past decade is the positive computing approach [4]. The positive computing paradigm aims to promote wellbeing determinants (e.g., autonomy, relatedness, empathy, positive emotion, and altruism) and human potential through the design of technology [5] and can be utilized to address the barriers specifically in OER co-creation as well as provides a playful and meaningful experience [6]. One possible way that can be used to support wellbeing determinants for positive computing is through gamification [5, 6] that for language learning can be applied in the form of digital storytelling [7]. Digital storytelling is a proven concept that can bring game-based education for children and intergenerational settings [8].

Even though gamification is not a new concept for learning the language and involving children in both teaching and collaboration, to our knowledge, however, there is still a lack of potential to support teachers of refugee children to play the co-creation of OER. There is little known about design principles that combine OER and digital storytelling in a collaborative learning space for refugee children. Therefore, this study aims to fill the gap by conducting a Design Science Research (DSR) [9]. This study focuses on the design principles of the system by transforming the requirements into a working prototype. The proposed design principles can serve as a baseline for system developers to design an open system for the intergenerational and intercultural context.

The paper consists of the following sections. Next, the theoretical backgrounds are summarized as a basis for the system requirements. Afterward, we present the research method, followed by the results and the discussion about the further research direction. Finally, the last section gives an outlook on the study.

2 THEORETICAL BACKGROUND

2.1 Language learning through Open Educational Resources

OER is defined as any type of digital material that can be “re”-used and “re”-distributed freely for an educational purpose [10]. Since 2012, UNESCO officially introduced OER aim to tackle educational gaps around the world [11]. Although barriers exist in the multi-dimensional aspect, including, social, organizational, cultural, technological [6], The benefits of OER are clearly experienced by organizations and individuals [1, 10, 12].

Furthermore, studies on OER, including the development of tools and models, are explored [1, 13]. The use of OER tools aims to improve language-learning effectiveness by providing an efficient and open way of accessing and sharing resources [14]. Generally, OER improves the quality of education, involve more people in the educational process, and reduce the cost of accessing educational materials [15]. The following four tools are examples of how OER can be used to support people learning new languages:

- LORO [14]: is a repository of open education resources for language learning and teaching. LORO includes different topics to learn the German language, but not specified for children. LORO used collaboratively in a workshop that provides for visual media.
- I2istudy [16]: is an open educational resource for learning foreign languages from native speakers, and the learning is achieved by utilizing pre-defined educational resources through live online interaction between the educator and the learner [16]. The tool allows people to learn their native language, where students and teachers can define the topic together. I2istudy also support different type of audio and video communication and visual learning materials.
- Produsage [17]: is a model to support language teaching and learning. It combines usage with the production of digital material to engage teachers and learners in reframing and repurposing resources [16]. Produsage utilizes videos that can be accessed through social media and online video platforms.
- Deutsch Interaktiv [18]: is a pedagogical approach for repurposing an OER that consists of authentic digital videos, slideshows, and audio texts and gives a contemporary overview of the culture and language in Germany, Austria, and Switzerland'. The tool includes videos, slideshows, audio, and text to support language learning within the online classroom.

The tools presented above provide information on design criteria that can be taken into account when designing a collaborative learning space for teachers and refugee children. Moreover, in terms of collaborative OER creation, [13] provides a tool for co-authoring OER in global environments, where authors can work simultaneously in real-time. The authors offer design principles for intercultural co-creation and multi-platform support for multiple devices [13]. All these criteria can be used as design principles for developing an OER tool for language learning. However, we found that none of the tools is designed to help teachers work with refugee children. Therefore, the following subsection discusses further design principles of digital storytelling to support joyful experiences for a collaborative learning space for teachers and refugee children.

2.2 Digital storytelling for playful learning

Game-based Learning (GBL) refers to a playful, educational activity in which game elements are used as mediators for knowledge transfer [19]. GBL describes a teaching approach that enables learners to develop innovative ideas and explore the relevant aspect of gameplay in a learning context. One of the playful learning approaches is digital storytelling. Storytelling involves interactivity in the exchange of knowledge between the narrator and the audience, which leads to transforming or influencing the way the story goes on [7]. In practical contexts, the audience can be active and participate in the narrative or construction of the story [7].

In terms of playfulness and meaningful system design that can potentially be used to drive the design of digital storytelling, Peters & Calvo also provided the METUX framework that can be used generally to design digital interaction [20]. The METUX (Motivation, Engagement, and Thriving in User Experience) focusses on Autonomy, Competence, and Relatedness as basic needs that are responsible for wellbeing and motivation. According to Self-Determination Theory (SDT) [21], these basic needs function across diverse cultures and developmental stages. Additionally, METUX states six spheres of experience with technology that can influence wellbeing [20]: 1) Adoption of the technology. 2) Interface: interaction with technology. 3) The task that should be enabled by technology. 4) Behavior: overall behavior influenced by technology. 5) Life of the user. 6) Society wellbeing beyond the user. Although the framework does not focus on storytelling, the guideline can be used to discuss the derived requirements.

Storytelling plays a vital role in the history of education for children and even for adults [8]. Teachers tell stories to children for knowledge transfer. Storytelling is an art of communication between people by drawing the audience's attention to listening and involving the imagination [22]. Storytelling is also used as a teaching tool for "organizational learning" through stories and continuous group dialogue between narratives [23]. [22] also points out the advantages of storytelling to create a sense of group attachment and a non-judgmental environment for knowledge volunteering.

The development of information and communication technologies has recently led to the digitization of storytelling [24], leading to a new genre called Digital Storytelling (DS) [25]. Digital storytelling is a process of narrating stories by simultaneously manipulating different types of media such as image and audio content, storylines, written text, videos, and transition effects using digital storytelling software [26]. Digital storytelling focuses on the harmony between images, music, narrative, and voice, giving strong messages to characters, situations, experiences, and ideas. Also, digital devices or software for digital storytelling, such as digital cameras, nonlinear editing software, and notebooks, are used to create their own stories [27]. Furthermore, [28] felt that collaborative digital storytelling is an essential and innovative way to educate children, help them communicate ideas, share knowledge, and make decisions. Moreover, [29] proved in his 2-year case study in a primary school classroom that if the digital storytelling projects are considered collaborative, the collaborative projects will have many advantages in different dimensions: a) to increase the learner's engagement in the digital storytelling projects, b) through cooperative work the learner will be able to produce quality writing.

Moreover, [30] summarized the benefits for children in a) helping children develop their interpersonal and historical skills. b) providing an effective means of transmitting and storing information. c) assisting children to develop communication skills. d) providing an excellent medium for creating non-linear stories. [31] outlines the concepts and characteristics of digital storytelling that can also be used by kindergarten teachers through 1) the use of digital technologies such as text, photos, moving images, animation, narrative, and music. 2) The use of digital devices such as digital cameras, computers, where the harmony between pictures, music, narrative, and language, and the story itself should also be continuous. 3) Collaboration and interactivity between learners. All criteria and features of digital storytelling can be integrated into OER's design principles to get an overall view of OER's design requirements towards collaborative systems for the kindergarten teacher.

3 METHODOLOGY

Design Science Research (DSR) method was applied to provide a particular design solution [9]. The DSR method fits for the study goal due to the involvement of stakeholders in the design process that offers a scientifically justified applicable design artifact [9]. The DSR process is an iterative process [9] that includes: 1) motivation and problem identification, 2) solutions definition, 3) design and development, 4) demonstration and evaluation, 5) and communication of the study results for the wider scholarly community.

In the problem identification process, beside the theoretical background, we also used a qualitative interview [32] to strengthen the study motivation with two street workers of a public institution (department for care and support of children and youth) that have experiences to develop a system for refugees in general. Although we targeted children between 3-6 years old, for this study, we collected and evaluated data indirectly by interviewing the teachers. We conceived our problem and design principles indirectly, as it is difficult to approach the refugee children due to the psychological and mental conditions of the refugee children [33]. Therefore, as the starting point of the problem identified for this study is: “How to design a storytelling platform to improve the communication and the German-speaking skills of refugee children?”

Once the problem was identified, the next step involved qualitative data collection through a semi-structured and narrative literature review [34]. We then developed a concept matrix [34] from various fields of study, including OER, collaborative learning, and digital storytelling. We analyzed a total of 67 literature as basic non-functional requirements for a collaborative language learning environment for teachers in kindergarten. We differentiated the design principles into functional and non-functional system requirements [13]. In terms of functional requirements, we analyzed the already available OER system for language learning and the digital storytelling tool for children. The prototype was qualitatively evaluated and reviewed by three experts and two teachers. The qualitative evaluation aims to determine whether (a) collaborative learning, OER, and game-related learning aspects are included in the learning environment and (b) the proposed tool is appropriate for working with child refugees. The following present the result of the design and demonstration of the proposed solution.

4 DESIGN AND DEVELOPMENT

In this section, we present the result of the study related to requirements and proof of concept.

4.1 Functional requirements

Based on the concept matrix and analysis of available tools. We can describe the activities in the collaborative learning for co-creation of OER specific for language learning. The following Table 1 is a description of the essential use cases and the specification of their inputs, triggers, results, preconditions, and post-conditions [35]. The requirements are derived from the analysis and observation of the different tools described in section two.

Table 1. The functional requirement (in the form of use cases) of the proposed system

Use case	Detail	ID
Create a story	Description: create a new story, added texts, pictures, and records. Input:-. Trigger: a create story button. Results: story page (URL). Precondition:-. Postcondition:-.	F1
Edit a story	Description: edit the content of a story (add/delete branch (create sub-story), edit or add/delete texts, records). Input: texts, images, records. Trigger: edit the story button. Results: changes in the story content. Precondition: created story. Postcondition: -	F2
Share a story	Description: share a story (share story scenes, records, pictures). Input:-. Trigger: share story button. Results:- Precondition: created story. Postcondition: -	F3
Delete a story	Description: delete story contents (delete branch, texts, records, and even the entire story). Input: story. Trigger: delete the story button. Results: items deleted from the story. Precondition: created story. Postcondition: -	F4
Add tutorial	Description: add examples to clarify how to use some functionalities (e.g., how to edit, delete story). Input: add a story. Trigger: add a tutorial button. Results: tutorial (URL). Precondition: -. Postcondition: -.	F5
Define and edit the license	Description: define the OER license type. Input:-. Trigger: define the OER license type button. Results: the license will be defined. Precondition: existed course. Postcondition: -.	F6
Evaluate a story	Description: Add comment, likes to give feedback for the story. Input:-. Trigger: add comment + like button. Results: feedback for the story. Precondition: story + registered user. Postcondition: -.	F7

4.2 Non-functional requirements

The requirements listed in Table 2 are design principles related to the condition and behavior of the technology that is relevant for the study context and already implemented in different fields of study. In Table 2, we also provide the sources of each requirement to support the selection of the requirement.

Table 2. Modified conceptual matrix for non-functional requirements.

Requirements	Sources	ID
The system should be able to support real-time collaborative work in small groups (children are divided into small groups and interact with each other).	[31, 36, 37]	NF1
The system's user interface should be simple enough for children to understand and use. (easy to navigate, user-friendly interface with short visual instructions)	[13, 38, 39, 40]	NF2
The system should be able to trigger the teacher to briefly describe the story (titles, goals, characters, scenes, pictures), classify the activities (before, after, and during the activities) and give individual feedback.	[7, 38, 41, 42]	NF3
The system should motivate children to express their thoughts by listing and identifying their favorite stories and clarifying their difficulties.	[31, 38, 39, 42]	NF4
The system should be able to display legible text in different languages, highly visible images, and audio text.*	[38, 40]	NF5
The system should support the recording of visual and acoustic narratives: Children can tell their stories and present correlated pictures.*	[7]	NF6
The system should support the nonlinear storytelling approach.	[7, 28, 30]	NF7
The texts should be written clearly and design for color blindness, with an optimal font size of 14 points or more for children.	[7, 43]	NF8
The system supports the use of a tangible user interface to control and access the system functionality.	[43]	NF9
The content should use more simple images, symbols, or voices that are familiar with the cultural background to describe the context of learning rather than many texts.*	[43]	NF10
The dimensions of the tangible component for system control (e.g., mouse) should be increased to an affordable size, and the number of clicks to access features should be minimized to 1 tick.	[43]	NF11
The system should be mobile-friendly by avoiding the simultaneous use of keyboard and mouse.	[43]	NF12
The system and features should be freely accessible.*	[13]	NF13
The system is supposed to be free of technical problems.	[13]	NF14
The user interface should be loaded quickly down to null seconds by storing the user interface components in the local storage for accessing the system via the internet	[13]	NF15
The system should enable the teachers to manage and share ownership of the learning material easily.*	[12, 13]	NF16

*specific non-functional requirements for collaborative digital learning space between teacher and refugee children

4.3 Implementation and demonstration

4.3.1 System architecture

The structure contains the building blocks of the system and the connections between the elements. We followed the design architecture of [44], which uses the Rest API and the NoSQL database to provide information on the responsive UI of the browser-based client-side and supports the design of the system for mobile and web-based applications [44]. For the implementation of the system architecture, we used an online open-source collaboration tool as a basis¹

¹ <https://github.com/RoMilton/whiteboard-cc> (last accessed: 25 March 2020)

4.3.2 User interface design

The user interface is conceptualized to make interaction with refugee children as easy and efficient as possible. With the help of customized icons that automatically adapt the selected language, as well as different bilingual short text, the system functionalities (adding images, audio, characters and drawings) can be directly accessed and facilitated with a mouse click. Furthermore, to improve the usability of the system, direct icons on the main screen (e.g., avoiding dropdown menus and submenus) replace searching for specific features. Figure 2 shows the main user interface design of the prototype.

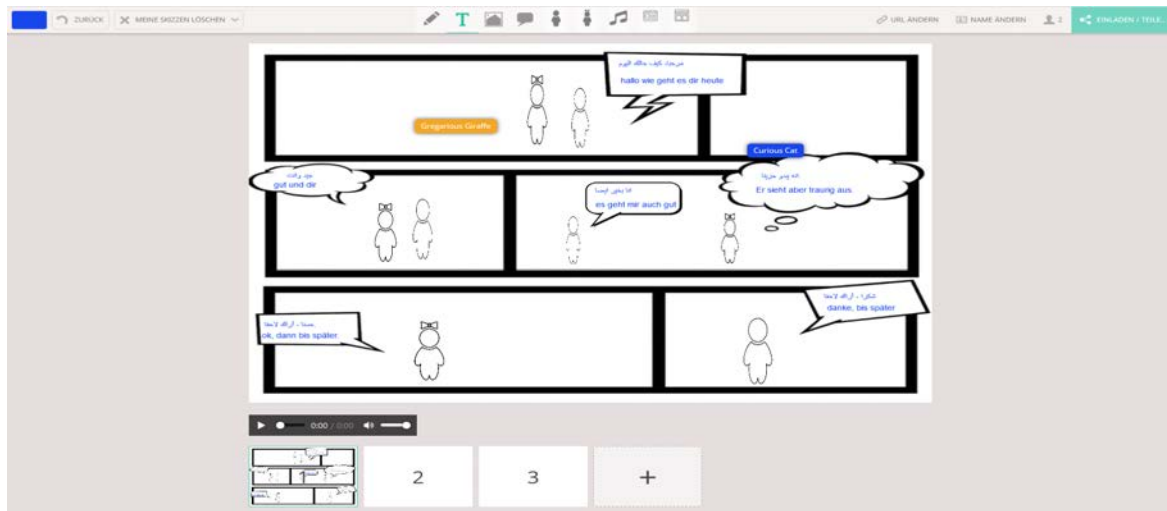


Figure 2. Example of collaboration activity in the main page for co-creation of storytelling

5 PROTOTYPE EVALUATION

The following are results of the interviews with the experts and teachers (evaluators) about those three concepts aspects (the collaborative learning, OER, and Game-based learning aspects) and the proposed tools:

- a) Learning Scenario Interview Results: Evaluators generally agree that the collaborative elements are embedded in the proposed collaborative learning space, as the learning environment allows the children to select the topic of the course with peers interactively, create/edit a story in collaboration and collaborate during the learning activities. E.g., expert statement: *"Children can collaborate with the teacher playfully using the system."* Furthermore, evaluators consider that the OER can support teachers and improve German teaching, as the OER tool offers different forms of learning resources (pictures, videos, activities such as multiple-choice) for different topics and motivates children to learn. E.g., a statement: *"OER supports not only German vocabulary but also any other language,"* other statement: *"OER offers different types of digital learning resources, e.g., pictures that can support learning with visual memory."* Moreover, the evaluators noted that the use of the tool encourages children to learn German because it is more engaging than the traditional learning method. Furthermore, the use of collaborative digital storytelling increases children's interest in learning because children are motivated to do more activities and have more fun with this learning method compared to the classical learning method in which they are passive. E.g., Statement of an expert: *"I think the tools cover funny aspects,"* another statement: *"With these two tool children have fun by default."*
- b) Tools interview results: The reviewers explained that children could easily use the proposed collaborative digital storytelling because, first, the user interface contains descriptive icons to facilitate the use of the tool's functionality; second, children can create and edit stories by adding (or removing) real-time images, text, audio, characters, and templates. For this tool, they also found it useful that children learn how to use it before they create a story. E.g., an expert statement: *"The symbols illustrate the functionality provided, but also the creation of a guide"* that can help children write a story is useful.

In general, the evaluators suggest that the proposed solution can improve the German and communication skills of refugee children and increase the children's interest in learning the German

language. For further research, this learning environment should first be tested in practice under different conditions (e.g., age, educational level, or country of origin). Other important aspects, such as cultural aspects, can be considered to improve the proposed solution, as well as the use of non-digital learning materials, which can be combined with digital learning sources. For the proposed tool, a manual can be added describing how to edit a story for children; further image editing functions can also be added within the collaborative digital storytelling in the form of, Also, the created stories can be stored as images for further courses.

6 DISCUSSION

In this section, we first discuss the contextualization of the interventions for refugee children based on the METUX model for our system [20] following limitations and recommendations.

Table 3. Contextualization of the requirements of the proposed system

<i>METUX criteria</i>	<i>Contextualizing the design principles</i>	<i>Sources from the principles (ID)</i>
Adoption	Autonomy: Users need to use the system voluntarily. The gamification elements shall increase the joy of use for the children. Competence: Child-oriented design shall increase the perceived ease of use. Relatedness: The (perceived) usefulness of the approach is reported by the teachers	F1,F2,F5,NF2, NF3, NF4,NF5, NF6,NF7
Interface	Autonomy and competence: Child-oriented usability decisions. Relatedness: real-time visibility of others' input.	F1,F2, F3,F4, NF1,NF2,NF5, NF8, NF10, NF11,NF12
Task	Autonomy: freedom of choice on learning modules and story content. Competence: The design of exercises should increase step-by-step the difficulty and increase competence. Relatedness: stories shall fit real experiences of and are interesting for the children	F1,F2,F3, F6,F7, NF1,NF3, NF7, NF9, NF10, NF11
Behavior	Autonomy: children are willing to learn with the tool because it makes fun to tell stories. Competence: children use the tool because they see their language skill increasing	F1,F2, F3,F4, NF2,NF4, NF7, NF11
Life	Autonomy: more situations can be managed without help. Competence: increased language skill makes life easier and opens new options. Relatedness: Social isolation is broken.	F1,F2, F3,F4, F6,F7, NF1, NF4,NF6 NF7, NF12
Society	Communication and a common language are fundamental for social cohesion	F3,F6, F7,NF1, NF3,NF7, NF8

In Table 3, some conceptual principles are derived from the system requirements applied. In this study, we contribute to the knowledge base for system design for children in two-fold. First, we provide an extended set of functional and non-functional requirements, which extends the prior investigation of the requirements to the general requirements of OER [13]. Second, we introduce a novel set of interventions for the study context based on a positive computing approach [4]. For the practical contribution, the proposed design requirements and positive design interventions can be used as a starting point for the design of collaborative learning space, especially a system design for refugee children. Furthermore, we offer the design architecture, user interfaces, and use case of the system to help other developers to implement the proposed principles.

Providing a supportive tool for a learning space that integrates children in complex and multidimensional ways was a challenge. We had some difficulties in applying the DSR method in our study and mainly in collecting and validating the requirements from both sides, the refugee teachers and the refugee children. In addition, a specific methodology is needed to obtain perceptions that can support the development of a wellbeing-driven system design [4] that provides qualitative and quantitative data from the target group to gain more fine-tuned principles. We propose that requires not only collaboration with the teachers for data collection, but also the involvement of the adult refugee. Not just speak the refugee-children language, but to work with refugee children require who is emotionally, culturally, and experientially closer to the refugee children.

Validating the proposed outcomes by integrating the well-being factors may require different approaches with a multidimensional aspect [20]. Our study has only assessed the system based on the views of teachers and experts. One possible solution that can be implemented for further studies is to apply the Q-method to the DSR process [45]. The Q-method provides both quantitative and qualitative data that can help the system designer to understand the perceptions of the target user. The method combines positive and negative aspects, which can be constructed on positive computing principles. An opinion can be presented not only in the form of text but also in the way of pictures and videos [45]. Thus it may be used to validate the proposed principles in refugee children.

7 CONCLUSIONS

Our study offers functional and non-functional requirements to design principles for collaborative learning spaces that can be used for teachers to work with children refugees. We present applicable design principles for a collaborative storytelling system by transforming the principles into a working prototype. Although the prototype is still in the first phase of development, the evaluation results show the advantages of the tools through the integration of OER and digital storytelling for a collaborative language learning environment

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