Positive Computing as Paradigm to Overcome Barriers to Global Co-authoring of Open Educational Resources

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***Abstract*—The adoption of Open Educational Resources (OER) can support collaboration and knowledge sharing. One of the main areas of the usage OER is the internationalization, i.e., the use in a global context. However, the globally distributed co-creation of digital materials is still low. Therefore, we identify essential barriers, in particular for co-authoring of OER in global environments. We use a design science research method to introduce a barrier framework for co-authoring OER in global settings and propose a wellbeing-based system design constructed from the barrier framework for OER co-authoring tool. We describe how positive computing concepts can be used to overcome barriers, emphasizing design that promotes the author's sense of competence, relatedness, and autonomy.**

I. Introduction

In this paper, we discuss barriers towards co-creation of Open Educational Resources (OER) in the international context. OER contains various digital materials for educational purposes [1]. The idea of promoting OER as a global movement came from UNESCO [2] in 2002 and UNESCO defines OER as teaching, learning or research material in the public domain or with an open license allowing free use, adaptation, and distribution [2]. The wide range of OER including learning contents, learning scenarios, OER supporting tools, and intellectual property license to promote openness of digital knowledge resources, offers benefits [3] both for the users and also the owners of OER. Reference [3] highlighted some benefits of OER, including the potential for knowledge sharing, cost savings and efficiency, the improvement of quality materials, support for independent learning and the potential for collaboration and partnership.

The early 2000s were the era of openness in innovation. The concept of open innovation was introduced to provide a new paradigm in accelerating the innovation process through open collaboration within and outside the organization [4]. Open innovation thus opens up new opportunities to strengthen the partnership between industry and academia [5] and has shifted the focus of collaboration from only recruiting employees to different types of knowledge transfer, technology transfer, and research-based collaboration [5]. The collaboration in knowledge can even be promoted by a new wave of openness for educational resources. Global collaboration and OER have been widely discussed as one of the fostering factors for open innovation that can be facilitated in the digital age [6]. Even though numerous collaboration tools for the creation of digital content already exist, the 5Rs principles (Reuse, Revise, Remix, Retain, Redistribute) of OER [7] adoption are eventually forgotten. The 5Rs of the OER focuses not only on the use of OER but also on the possibility of OER to be re-created collaboratively. Positive Computing (PoCom) as a new trend in technological design that has gained momentum in human-centered design and information system design [8]. The term was used in the design of products [9] and technologies [10]. Reference [11] classifies the implementation of the PoCom approach in a three-stage implementation of the wellbeing design. The minimum level also serves as a preventive design approach that addresses the obstacles, barriers or challenges to wellbeing and treats the barriers as errors and triggers for the redesign of the system [11]. In this study, we, therefore, integrate the barriers on the co-authoring activity through global collaboration and digital authoring, which include three main activities related to 5Rs OER authoring (finding, using and modifying) to support wellbeing based system design.

A decade after starting the global movement of OER, hundreds of studies of OER in the global context were conducted. However, the barriers of OER in international settings are not thoroughly researched as they vary over time and context [12]. An in-depth study of OER barriers categorizes the barriers into organizational/contextual, social, technical, quality and legal dimensions [12]. Another study on barriers to open knowledge specific to the public sector also uses the same dimensions [13] and was modified for developing countries by introducing a lack of resources, infrastructure issues, and organization management [14]. Reference [15] presents further barriers to global collaboration in the development of digital tools. Furthermore, a study in the context of the co-creation of OER in local settings shows the authors greater willingness to participate in a technical workshop of OER, but little interest in the practical execution [16]. The low level of practical participation [16] in the use of an authoring tool points to a challenge to be solved by integrating psychological wellbeing into the design of the online community system [17].

To investigate the issue of voluntary or free participation in the co-creation of OER on the global scale, a design science research [18] was conducted. Firstly, by identifying practical problems based on the relevant literature. Subsequently, barriers are then collected and analyzed to identify major barriers to positive design solutions. As part of the evaluation

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of the proposed framework, a list of barriers was discussed with experts from developing and developed country. Then, a quantitative evaluation of the importance of overcoming barriers using wellbeing-based design strategies by conducting an online survey in the global context. Finally, a PoCom paradigm was used to suggest interventions for overcoming the barriers by shifting the focus of technological design to wellbeing based value [11].

II. Related works

As a starting point, relevant concepts are discussed in the following subsection. The review begins with the key concept of Open Educational Resources (OER), notably Learning Object (LO) and the corresponding barriers to the development and usage of OER focusing on Authoring Tools (AT), in particular AT criteria are discussed. The review of the related work also includes problems that may arise in the global use of an AT, as well as the review on PoCom and how the concept of PoCom can be utilized to overcome the barriers.

A. Co-authoring OER in Global Context

Many of the digital materials used for knowledge exchange are open only regarding access and not adaptability [19] to support 5Rs principles. Therefore, we have divided the term ”co-authoring OER” into the tools for co-authoring activities and the ”learning object” as a result of co-authoring. In the digital authoring tool for reusing and modifying the OER, we have also included the concept of mobile authoring to support the massive expansion of mobile devices and collaborative authoring.

Reference [20] defines a Learning Object (LO) as a digital object developed to support the learning, education, and training and can be delivered across the network as needed. OER are therefore LOs that can be adapted and ”re-”distributed freely [21]. The definitions of the LO have almost the same meaning as OER, excluding the license [21]. Relevant barriers to OER have been identified [13][22] to understand the adoption and co-creation of OER by educators (including lack of awareness, lack of personal interest, lack of time, technical capacity) [23]. Since there is the similarity between OER and LO, the inclusion of LO barriers is therefore also relevant for the development of a barrier framework. However, challenges also arise from the tools for creating the LO. In this vein, next, the challenges in connection with LO’s co-authoring tool are discussed.

Authoring Tools (AT) are systems supporting content creation, for example by using hypertext or multimedia applications. They also support the content creation by linking together digital objects, such as a paragraph of text, an illustration, or a voice. By defining the relationship between digital objects and their arrangement in a suitable order, authors can produce an LO by combining all digital resources such as texts, images, videos, and metadata in a single LO. Based on [24] some criteria to select an AT was defined from the author’s point of view: Ease of use, easy installation or access, easy to back up the course material and support a wide variety of the production formats. Furthermore, Mobile Authoring (MA) is a feature that received high attention and should be taken into account when developing an AT. Therefore, AT’s criteria can be a particular challenge for OER co-creation (e.g., lack of support from the development team, the small screen on mobile devices, the limited storage capacity of mobile devices, limited battery power of mobile devices to run continuous and rapid changes in technology development for mobile devices [25].

OER is a promising concept for Global Collaboration (GC) [3] as they can contribute to the exchange of knowledge (for example between developed and less developed countries). Collaboration becomes an essential part of OER in a global context, especially to create an LO for a specific country or region that requires collaboration between educators with different locations and time zones. Tools or software to support the distribution, creation, and re-(use) of the OER is also part of digital resources in the OER [26]. Eight barriers related to collaboration in global software development [15] can serve as a starting point to understand global co-authoring of OER. The barriers are geographical and temporal distance, culture and language, fear and trust, organizational structure, process, and management, as well as infrastructure and product architecture [15]

B. Positive Computing

A current trend to system design is PoCom [8]. Based on positive psychology, PoCom focuses on the domain of human-computer interaction gaining more attention [27]. PoCom aims at promoting human wellbeing and enhance human potential through design interventions of the technological environment [11]. Regarding wellbeing, PoCom affects the design concept, design process, and the evaluation process [8] of a system.

In [11] the authors propose the integration of wellbeing to evaluate an existing system as part of the iterative design cycle. Three main strategies of the positive technology are presented [10]. The first strategy is to fostering the hedonic effect (induces positive and pleasant experiences). The next strategy is eudemonic (supporting a person in self-realization) and lastly is the social/interpersonal effect (improvement of social integration). These strategies are in line with the user activities of co-authoring OER. Concerning hedonic effects, different kinds of emotional experiences have arisen from the interaction between the user and the system. The use of wellbeing influences the positive emotion and makes a pleasant experience possible [10]. The eudemonic effect can be linked to the author’s authoring activity. OER authoring is a knowledge-based activity. The activity requires the author’s ability to express own knowledge in the digital form. Third, collaborative OER creation is an explicit aspect of the interpersonal/social dimension. The dimension of wellbeing reaches broad aspect of human life. Determinants of wellbeing are ranging from personal dimension to global index assessment of a country. Reference [11] provides wellbeing determinants that can be explicitly connected to design aspects. The proposed determinants consist of three main levels [11]: personal level including positive emotion, engagement, and motivation. Empathy and gratitude for the interpersonal level. Lastly regarding extra personal level is altruism and compassion. The design approach to PoCom ranging from no-implementation of wellbeing, preventative approach to reducing wellbeing inhibitor and trigger the process of system redesign, active and dedicated approach that utilize wellbeing determinants into the design

aspects [11], the group of wellbeing determinants in positive computing is [11]:

- Self (Intrapersonal), which includes positive emotions, motivation, engagement, self-awareness, mindfulness, and resilience. The type of system design interventions are: Design for emotions that bring feelings of joy (playfulness), interest (explore), pride (achievement), contentment (self-views), and love (safe, close relationship). Designing to cover unpleasant activities with intrinsically enjoyable system interaction through, for example, gamification. Design for a technology-mediated reflection for wellbeing; Design for autonomy versus design for minimalism; Using Aural, Haptic Feedback, and supporting nonjudgment.
- Social (Interpersonal), which includes gratitude and empathy. Several types of system design interventions are: Design to support expressions of gratitude and appreciation. Designing technological communication that can facilitate and improve the ability to express emotion by using more sophisticated approaches to annotation and labeling. Using the power of graphics and narratives; Heuristic design games. Design for cognitive and/or affective empathy.
- Transcendent (Extra-personal), which includes compassion and altruism. The type of system design interventions are: Design of collaborative behaviors to help and be helped; Focusing on factors to enhance group empathy, including relevance/similarity, goal congruence, and empowerment; Design to address judgment and blame; Design for inspiration that supports coping abilities to transform empathy into action; Design for movement and synchrony to enhance cooperative ability.

Our study, aiming to shift the preventative approach of co-authoring OER system to the approaches those utilizing and supporting wellbeing determinants. In this section, we identified several barriers that can be associated with OER's design in the global context. However, a consistent framework of barriers, as well as the integration of wellbeing based design for co-authoring OER, still does not yet exist.

III. Method

The study used a Design Science Research (DSR) approach [28] and followed the DSR process [18]. DSR is an iterative process for problem-based solution design [18] with the goal of not designing the perfect artifact but achieving an improvement of the status quo [28]. It is therefore essential to evaluate artifacts as close as possible to their real environment and the intended areas of application [18]. Following [18], as part of the iterative process, the results of each process were reviewed to see if the results were related to the previous process and answered the identified problem. The following subsection presents the DSR process based on the Fig. 1.

A. Problem Identification

In [29] the authors summarized that there is an inter-relational effect between behavior, personal attributes, and environment. The personal attribute including personality demographic attributes, attitude as well as the environmental attribute related to person-system interaction influence the behavior goal [29]. As the person-system interaction is also part of PoCom [11], there is a slice of the barriers and wellbeing in human interactions with the system. Therefore, the Q1 was used as the basis to classify the barriers into two main categories (personal and environmental barriers dimension). Moreover, Q2 leads to the development of a wellbeing based solution to address the barriers.

Fig. 1. Modified DSR process, adapted from [18]

Q1. What are personal and technological barriers in globally distributed co-creation of OER?
Q2. Which barriers can be addressed and linked by a PoCom design approach?

B. Development of the Barrier Framework

As part of the preventive approach to PoCom, the first step in developing a wellbeing based system is to remove all barriers that can hinder the state of psychological wellbeing determinants. Therefore, we developed the barrier framework as part of the PoCom approach. In the solution-based process of DSR [18], the proposed barrier framework was developed by building a conceptual matrix through a literature review [30]. The data collection was done through the schema and inclusion criteria (e.g., explanation about the barriers related to collaboration, contain important criteria about OER, LO, and AT; explain how OER can be widely adopted and used, type of authoring system that can be used collaboratively, explain about barriers and challenges in multi-cultural collaboration). We used the keyword barrier plus one of the selected main subject (e.g., barrier+OER or barrier+learning object) in the time span from 2002 to 2015 of popular research database (google scholar, IEEE Xplorer and ScienceDirect). We excluded articles outside the scope of our research.

As the result of the search scheme, fifty-eight sources were collected (OER: nine sources, LO: twenty-one sources, GC: twelve sources, AT: eleven sources, and MA: five sources) and sixty-nine barriers were identified as the raw data from the literature. Furthermore, numbers of barriers were observed from three selected co-creation platforms of open knowledge (crowducate.me, idea-space.eu, and oercommons.org).

To find out which barriers are most closely related to the implementation of the system, general requirements of online community systems [31] were adopted. By using the general requirements [31] in the analysis, the list of barriers can be reduced and prioritized into a different type of issues. Virtual co-creation required digital interaction between online community members to perform tasks in globally distributed teams. We then followed the general requirements of online community systems [31] to classify the collected barriers, as a barrier framework can be used as a starting point for determining system requirements [32].

C. Mix Method Evaluation

For the qualitative evaluation, interviews with experts who were not involved in the development and writing process this paper were conducted to discuss the barriers to global co-authoring of OER. The interviews included university lectures with experience in global collaborative educational projects from Germany (more than twelve years experiences) and Indonesia (with more than three years of experience in the domain). Open questions were used to gain experience, opinions, feelings, and knowledge (regarding barriers and criteria) in digital co-creation of OER in the global context between developed and developing countries. An initial interview was designed and conducted to gain the real problem of participants without the influence of the pre-collected barrier list. After an initial discussion, the participants received a list of collected barriers and discussed the relevance of the barriers. Some notable barriers identified in the interviews are: Lack of existing tools to involve the student in the joint creation, lack of trusted resources and tools with their own language (Bahasa Indonesia), lack of integration for real-time social messaging (e.g. WhatsApp) to coordinate the team in the system and lack of system tools to support access via mobile devices.

In the quantitative evaluation, we aimed to receive feedback on the importance of three main strategies of positive technology [10] and the top five main barriers to overcome regarding the importance of the strategies. All strategies were questioned in relation -to overcoming most barriers listed in the chosen group. Each group of barriers was evaluated with three agreement related questions: 1) the importance of an OER co-authoring technology to induce positive and pleasant experiences-. 2) The importance of OER co-authoring technology to support people for engaging and self-realizing experiences-. 3) The importance of OER co-authoring technology to support and improve social integration and connectedness-. A 4-point Likert scale with "No option / don't know" was used, as suggested by Nadler et al. 2015, not to be locked in the mid-point and to obtain a consistent opinion of respondents [33]. An online questionnaire system was used and published on the crowdsourcing platform Amazon Mturk (www.mturk.com) for five days to attract global respondents. The Amazon Mturk was widely utilized for mass work requiring human intelligence on a global scale and was also exploited for research purposes [34],[35].

After five days, 60 people took part in the study. Some criteria were outlined to obtain valid data from the responses by following the guidelines for conducting research on the Amazon Mturk [35]. First, by accepting only Amazon Mturk with master qualification criteria to filter only those respondents who can demonstrate consistent accuracy and receive good feedback for their work based on the Amazon Mturk database (Automatic filtering by Amazon Mturk). Second, we accepted only results from respondents with experience in digital collaboration and experience in freely sharing/exchanging open knowledge for educational purposes (five responses were excluded). Third, we excluded the results of all respondents, with less than 2 minutes to complete the questionnaire to avoid frivolous completion of the questionnaire (two responses were excluded). Finally, we also excluded respondents with answering on No option / don't know more than 80% of the total question (two additional responses were excluded) as an indication of lack of knowledge.

Generally, data from 51 adults were selected as the valid responses (85% of 60 responses). They were 70.6% male and 29.4% female, between 18 and 55 years old (23-29 years old = 35.3%, 30-35 year old = 33.3%, 36-39 years old = 19.6%, 40-45 years old = 3.9%, 46-50 years old = 3.9%, 51-55 years old = 3.9%). It also reports on the following ethnic diversity by continent: North America = 27.5%, Asia = 51%, Africa = 5.9%, Europe = 13.7%. South America = 2%. Although the cultural background of the respondents consists of different ethnic groups, only North America (52.9% of respondents) and Asia (47.1%) are the continents in which the respondents reside. Furthermore, the value of the Cronbach Alpha (α=0.88) indicates a good internal consistency of the selected data for analysis.

To find the five most important barriers to positive system design strategies. Each answer is weighted (Strongly disagree = -2, Disagree = -1, no option = 0; Agree = 1, Strongly agree = 2) and summed up the total of all the respondents' answers. Next, the proposed barrier frameworks for the co-authoring of OER in the global settings and the qualitative evaluation for overcoming the barrier framework are presented in Section 4.

IV. Results

A. Barrier Framework

The framework of barriers was constructed by combining previously identified barriers with findings from the interviews. The barriers were classified into the social-personal and technical-environment dimensions. Table I shows the list of barriers to co-creation of OER in global settings. A barrier framework can be used as a basis for problem-based design, such as the design of OER adoption framework [23] or the (re-) design of requirements for a collaborative OER authoring system [32].

Choosing a determinant as a starting point for a PoCom project is a challenge for the designers [11]. Therefore, in this study, we discuss how the PoCom paradigm can be used to overcome obstacles in system design related to the determinant of well-being.

Based on the expert interviews, the lack of internet connection [36],[37] was modified as the gap to the connection speed. The proposed barrier framework consists of seven of eight dimensions of the general requirements of online communities [31]. The missing dimension that security issues seem to be only one as the lack of document security [38], which was also eliminated because it was not the problem for the interviewees. That can potentially happen because the concept of free and open system biases the importance of security among the authors. Unlike security, the privacy dimension is taken into account because of person-professional information to validate the OER quality. Two focus dimensions of the barrier framework are briefly presented.

1) Social-Personal dimension: The barriers in this dimension are divided into two main categories: a) the barriers categories of the interpersonal gap, the barriers in this group are, e.g., limited community participation, timely feedback, cultural distance, and different working style.

Moreover, some barriers were added or reinforced through the interviews: Lack of cultural support, lack of appreciation, lack of coordination and lack of mutual trust. From the point of view of self-personal interaction b), the barrier categories that mainly relate to the knowledge gap, e.g. lack of education, lack of knowledge about access to the OER and lack of technical skills are the following The complete barriers of the social-personal dimension can be seen in Table I with the correspondence sources.

TABLE I. SOCIAL-PERSONAL BARRIERS

Key issue: Interpersonal gaps	
Barriers	**Sub-barriers**
Lack of cultural conformity	The absence of state and cultural support [39] Cultural distance between collaborators [22], [13]
lack of feedback and emotional appreciation	Lack of timely feedback [40], [37] Lack of appreciation * Lack of mutual trust [13], *
Poor teamwork	Different working style [41], * Lack of coordination [13], *
Lack of community support	Limited community participation [1] Missing community support [42], [1], *
Key issue: Knowledge gaps	
Barriers	**Sub-barriers**
Lack of training for OER concept and environment	Missing current issues related to the OER development [36], [43], * Lack of contextual information regarding OER, how OER can be used and modified [41], * Lack of understanding for the possibilities of the tool [12], * Lack of knowledge about the efficiency of development costs [44] Lack of a business model for open content [22] Lack of knowledge about how to assess OER quality [45], [13], [40], [46] Unclear intellectual property rights and copyright [20], [41] Different languages [47], [48], *
Lack of ability to operationalize tools	Lack of knowledge of where and how to find OER [13] Lack of training on how to design an OER [41], * Lack of technical support for OER creation [45] Different format of typing/style of different culture, e.g., Abbreviation left to right (for Latin) vs. right to left (for Arabic). * Limited technological skills/knowledge [41], [13], [44], [49], [47], [37], *
***interview, **observation, ***interview, and observation**	

2) Technical-environment dimension: The technical-environmental dimension is a list of barriers to human-system and system-to-system interaction. The first group of barriers is the issue of the extendibility of the system or the use of elements outside the system as a system extension [31]. The barriers in this category are the structure of the OER metadata, the lack of shared storage and the lack of integration into social media communication.

The second category are barriers that support the flexibility of the system to adapt to new environments [31], the barriers in this category are, e.g., the speed of the Internet connection, the variety of device specifications for access to the co-authoring system, the lack of standalone capabilities and differences in the technological infrastructure.

The third group of the technical dimension is the barriers that hinder the system's reliability or the ability to continue operating in the case of a fault. The barriers in the category of reliability include the scalability to handle a large number of user and the lack of error prevention.

Next, the group of barriers that are associated with the functionality of the system, this can be basic functionality, expected functionality or the desired change to the digital environment [31]. The barriers in this category including the difficulty of working with a moving graphics in mobile devices and difficulties in creating a sequential learning object, lack of OER localization and OER interactivity, lack of traceable tasks, and the lack of simultaneous editing.

TABLE II. TECHNICAL-ENVIRONMENTAL BARRIERS

Key issue: Extendibility	
Barriers	**Sub-barriers**
Lack of a common system architecture for external integration capability	The different structure of OER metadata [43], [48], *** Lack of shared storage for digital resources [43], [20], [25] Lack of integration to social media communication [1], [41], [42], [20], *
Key issue: Flexibility	
Barriers	**Sub-barriers**
Lack of system-design customization	Lack of intercultural system design [48] Different specification of the technology used [25], *
Lack of design responsiveness	Lack of support to access via mobile devices * Different size of the screen to access the system [25], *
lack of supporting technological infrastructure	Lack of standalone possibility [50] A gap of internet connection speed [36], [37], * Difficulty in accessing a proper networking technology [47]
Regulation and technological changes	Fast moving forward of technological development [25] Different criteria of OER provider [51]
Key issue: Reliability	
Barriers	**Sub-barriers**
Lack of reliability	Scalability to handle a large number of the user [51] Lack of error prevention [52], *
Key issue: Functionality	
Barriers	**Sub-barriers**
Editing limitation	Difficulty to create a sequential learning object [53] Lack of concurrent editing of OER *** Difficulty to work with moving graphics in mobile devices [25]
lack of tools for individual encouragement	Difficulty in designing OER for a different type of learners [46], [49] Lack of OER-localization [36], [41] Lack of OER interactivity [39], [13]
Lack of work tracking and monitoring	Difficulty to find related OER [36], [39], [41], [45], *** Lack of trackable accomplished task and LO [50], **
Key issue: Usability	
Barriers	**Sub-barriers**
lack of recognisability and understability of the system function	Lack of tutorial how to co-create OER [41], [13], [47], [37], [22], * Lack of an easy way to revise OER [49] Difficulty to reuse a small part of an LO [44], [49], [36], [20], *
Different preferences for system interaction	Different type of preferred interaction design [48],*
Key issue: Connectivity	
Barriers	**Sub-barriers**
Lack of supportive socialization tools	Lack of forum to discuss problems [42] Missing notification of change [22], ** Lack of OERs students of end-user integration *
Difficulties in adapting various communication channels	Different type of communication channel * Difficulty in synchronizing working time [41], * Lack of real-time communication channel [46], [44], [49], [53], [20], [40]
Key issue: Privacy	
Barriers	**Sub-barriers**
lack of a clear data protection agreement	Lack of validity of OER. level of required information about the author of OER [36], * Lack of privacy [38]
***interview, **observation, ***interview, and observation**	

Also, Table II shows the group of barriers related to the usability or minimization of the costs of actions [31], connectivity or the communication channel [31] and privacy or to demarcate the release of self-information via any channel [31] as well as the full set of barriers in the technical-ecological

dimension.

B. Analysis of the importance for the integration of wellbeing determinants into system design

This section presents the result of the quantitative evaluation. Below is the graphical representation of the agreement level relevant to the three positive technological strategies [10] for respondents to overcome the group of barriers. ***strategy-1*** = an OER co-authoring technology used to induce positive and pleasant experiences; ***strategy-2*** = an OER co-authoring technology used to support individuals in reaching engaging and self-actualizing; ***strategy-3*** = an OER co-authoring experiences used to support and improve social integration and connectedness.

1) Question to the respondents for strategy-1: "I think it is important to me that an OER co-authoring technology *used to induce positive and pleasant experiences* to overcome the majority of barriers mentioned in.: " each key issue in Barrier Framework. The result of this question can be seen in Fig. 2.

TABLE III. WEIGHT VALUE OF THE BARRIERS RELATED TO STRATEGY-1

Group of barriers	Weight value
knowledge-based barriers	65,00
interpersonal barriers	63,00
barriers concerning the privacy	54,00
barriers concerning the functionality	53,00
barriers concerning the extendibility	52,00
barriers concerning the flexibility	48,00
barriers concerning the connectivity	45,00
barriers concerning the reliability	44,00
barriers concerning the usability	42,00

Overall, the mean value of combined response between agreeing and strongly agree for question strategy-1 is 84.53%, indicating greater agreement with the importance of positive and pleasing experiences in design technology to overcome the barrier framework. In Strategy 1, usability barriers received a lower acceptance of 76.47% compared to other barrier groups. Despite positive experiences also related to the usability of the system, the respondents' concern more about privacy in terms of co-authoring OER to get pleasant experiences. An indication of the importance of eliminating the fear of losing personal data in volunteering to create open knowledge. In addition, through the calculation of the weight value, Table III shows the five main group of barriers that have a higher effect through the implementation of strategy-1 in the design of co-authoring of OER.

2) Question to the respondents for strategy-2: "I think it is important to me that an OER co-authoring technology *used to support individuals in reaching engaging and self-actualizing* to overcome the majority of barriers mentioned in.: " each key issue in Barrier Framework. The result related to the question for strategy-2 is presented in Fig. 3.

Overall, the mean value of combined response between agreeing and strongly agree for question strategy-2 is 87.36%, indicating greater agreement with the importance of supporting individuals in achieving engagement and self-realization to overcome most obstacles. With the strategy-2, despite the functionality associated with barriers received the higher acceptance of 92.16% compared to other barriers of technical

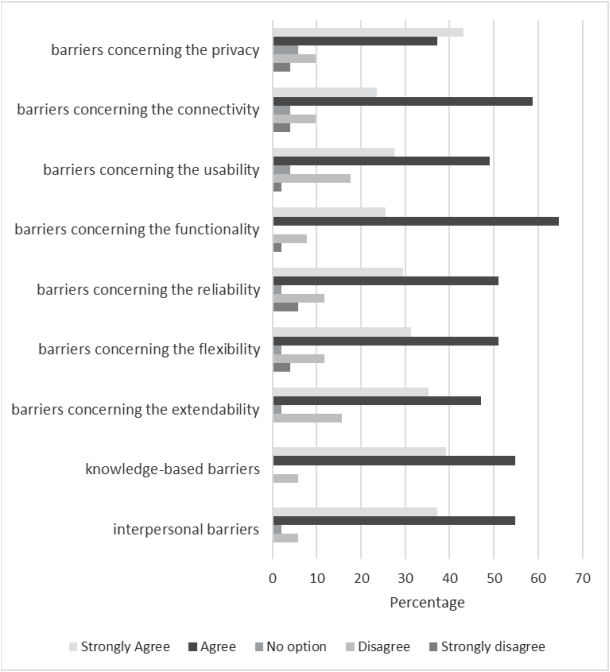

Fig. 2. Percentage of agreement to the importance of the strategy-1 to overcome the barriers framework

TABLE IV. WEIGHT VALUE OF THE BARRIERS RELATED TO STRATEGY-2

Group of barriers	Weight value
knowledge-based barriers	70,00
interpersonal barriers	69,00
barriers concerning the flexibility	67,00
barriers concerning the functionality	63,00
barriers concerning the privacy	60,00
barriers concerning the connectivity	55,00
barriers concerning the usability	52,00
barriers concerning the reliability	44,00
barriers concerning the extendibility	43,00

groups, the weight value shows that the flexibility issues are the main technical barriers group, which can be resolved through the implementation of Strategy-2 in the design of OER co-authoring tools. This is not surprising as the flexibility to integrate the system with external elements allows the user to customize the functionality as a system extension. Besides, through the calculation of the weight value, Table IV shows the five main group of barriers that have a higher effect through the implementation of strategy-2 in the design of co-authoring of OER.

3) Question to the respondents for strategy-3: "I think it is important for me that an OER co-authoring technology *used to support and improve social integration and connectedness* to overcome the majority of barriers mentioned in.: " each key issue in Barrier Framework. The result of this question can be seen in Fig. 4.

For Question strategy-3, the mean value of combined response between agreeing and strongly agree is 87.36%, also indicating the greater agreement of with the importance to support and improve social integration and connectedness in design OER-coauthoring technology to overcome the barrier framework. In Strategy 3, functionality, flexibility, and privacy

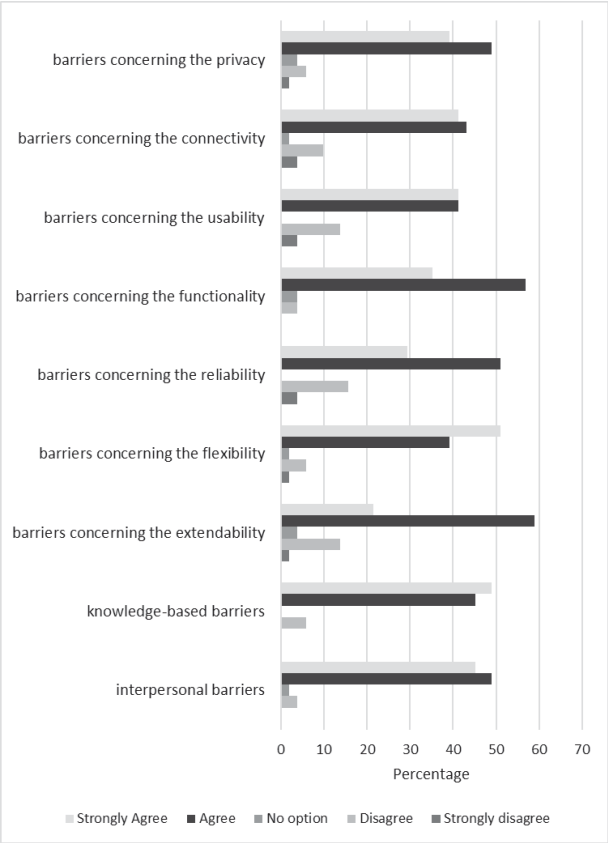

Fig. 3. Percentage of agreement to the importance of the strategy-2 to overcome the barriers framework

TABLE V. WEIGHT VALUE OF THE BARRIERS RELATED TO STRATEGY-2

Group of barriers	Weight value
knowledge-based barriers	67,00
interpersonal barriers	67,00
barriers concerning the reliability	61,00
barriers concerning the functionality	61,00
barriers concerning the connectivity	59,00
barriers concerning the extendibility	58,00
barriers concerning the flexibility	55,00
barriers concerning the privacy	49,00
barriers concerning the usability	45,00

are the top three that received a higher acceptance percentage compared to other barrier groups. However, the calculation of weight value shows only functionality is in the top three. The primary activity of the system is co-authoring, which include activity related to the communication, coordination, and collaboration required the system to prioritize the barriers in connectivity and reliability. Table V shows the five main group of barriers that have a higher effect through the implementation of strategy-3 in the design of co-authoring of OER.

Next, the discussion of how the proposed framework can contribute to positive system design.

V. POSITIVE COMPUTING AS A PARADIGM TO OVERCOME THE BARRIER FRAMEWORK

PoCom can be described as the integration of wellbeing determinants into the design of the technological environment.

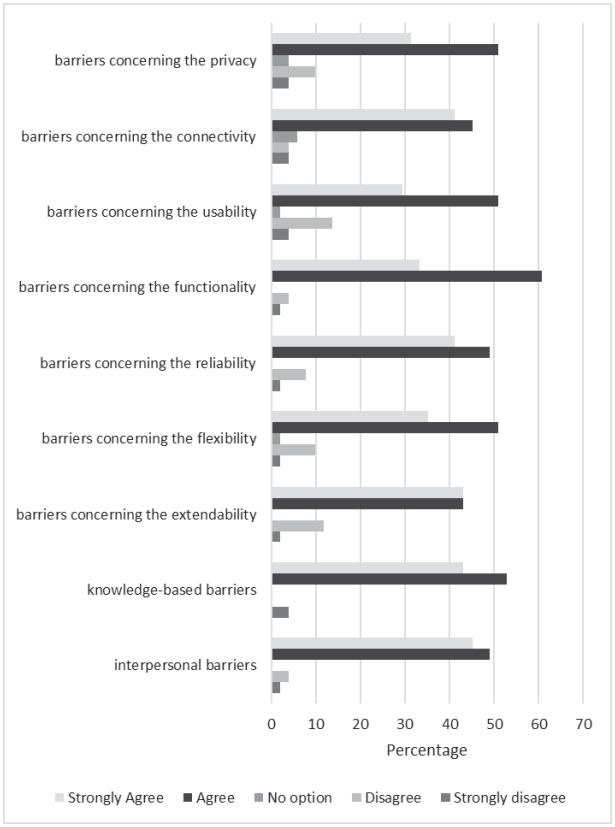

Fig. 4. Percentage of agreement to the importance of the strategy-3 to overcome the barriers framework

Because determinants of wellbeing are facilitated by the combination of hardware and software in the digital technology to support human flourish, we also can summarize the term of ***PoCom as the system design for wellbeing inclusion and the enhancement of human potential in the digital environment***. The design for human potential in this context means for us the design of technology that is familiar with the user attributes (competence, experiences, physical and psychological properties) so they can naturally use the technology to overcome barriers and to support the co-authoring process specifically. Motivating also means designing a system of self-realization that makes people reach whom they want to be and feel fulfilled [11]. The result of the system can then be evaluated by measuring the intervention or flow experience (Fit condition between task and user competence) during the use of the system.

By adopting the positive technology [10] and integrating the positive computer framework 10), Fig. 5. shows how barriers can be linked to wellbeing determinants [11] and addressed through technological interventions proposed by [11]. [54] identified three pillars of the wellbeing that should be addressed by the technology: 1) the emotional quality that can be improved by the presence of positive emotions (hedonic level). 2) The commitment that aims at the use of personal strengths and talents and can be supported by technologies (eudemonic level), and 3) the connectedness that can focus on collective and social goals and be supported by technologies that improve social integration and connectedness (social and

interpersonal level). Social-personal dimension is still mainly barriers that can be addressed by implementing wellbeing-based system design. At the social and interpersonal level, the social integration and connection of people are in the foreground, which can, for example, be supported by social networks. This level addresses barriers such as lack of a forum to discuss problems. Design principles should support collaborative behaviors. In the case of an OER Co-authoring Platform, a discussion platform, e.g., a forum should be integrated. In companies, the introduction of enterprise social networks has proven advantages such as access to new people and expertise [55].

The percentage of agreement on the importance (overall mean $>$ 80%) of positive strategies to be applied in the development of co-authoring tools as a suggestion for the system designer to cover three areas of positive technology, including positive experiences by providing autonomy of personal privacy. Support personal engagement and self-realization by improving system flexibility for integration with external elements in extending system functionality. Moreover, support social integration by improving system reliability, which supports the functionalities of social relatedness.

At the hedonic level, there is a barrier to extendability, e.g., missing system extensions for integration with the outer elements. Multiple communication and coordination tools that provide an API give the user the feeling of autonomy from a particular system which can evoke positive emotions. At the eudemonic level, three major technical barriers for system designers are the challenge of providing a design for engagement and self-realization. The system's flexibility attracts the significant attention, which means that system adaptation is needed to fit different cultural sensitivity and the need for system responsiveness to different types of mobile devices with which they are already familiar. Therefore, an OER co-authoring platform should also offer the possibility of using author mobility, cultural identity inclusion as well as the integration of external tools as the system extension. The design framework support [56] the link between ownership and access to the Internet improves the quality of life and positive emotions.

Based on the evaluation and the analysis of barrier framework (Table I & Table II), self-determination theory [57], which contains 1) autonomy (can be correlated with barriers in the hedonic level). 2) Competence (barriers related to eudemonic level), and 3) relatedness (barriers related to social and interpersonal level) can be used as the underlying theory to redesign co-authoring tools that can promote wellbeing as well as enhance human potential, see Fig. 5.

In this study, a higher number of respondents agree on the importance of positive experiences, support for self-realization and social inclusion in removing the barriers to the OER co-authors. The integration of the positive technology strategy and wellbeing-based design supports the previous study on the importance of psychological wellbeing for the online community [17]. This study suggests that the "re-design" of OER co-authoring tools should assess whether the three strategies are already implemented and supported by the system design. A system designer can improve the user's wellbeing by analyzing the user profiles and ensuring that an OER co-authoring system encompasses all three positive technology strategies. As a

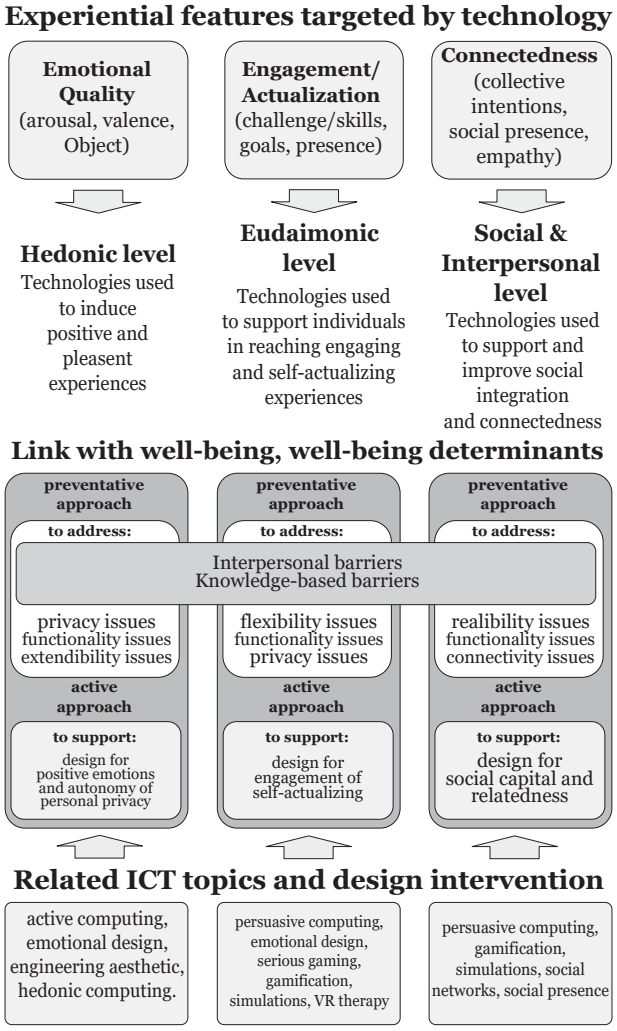

Fig. 5. Overcoming the barriers through PoCom, (adapted from [10])

starting point for the wellbeing based identification of user profiles, positive-personas [58] can be used by the system designer to support wellbeing factors in the technological design.

VI. Key Limitation and Further Research

The study has some limitations. First, the assessment of barriers focuses on generalization, not on specialization, which leads to a more diverse interpretation of barriers. The aim of the generalization is that the results can serve as a starting point for more specific or practical case studies in the further development of co-authoring of OER. The generalization of the study also shows the second limitation that in the quantitative evaluation the questionnaire was asked about the relationship of the barriers-key issues to the positive strategy in order to minimize the complexity of the questionnaire and to minimize the working time for the interviewees. In the future, the list of barriers and sub-barriers can also be quantitatively validated for a more specific target group or any OER community. Thirdly, the list of sub-barriers collected in the structured literature review may not contain all the necessary barriers but was elaborated with the help of an expert interview. Fourth,

the data analyses in the interview only have an academic perspective that focuses on the university level; data from other industries such as school authors, educational consultants, open community, and public institutions may be valuable and necessary for further evaluations.

VII. Conclusion

In this study, the research question Q1 and Q2 were addressed to provide PoCom based system design for volunteering of OER co-authoring. The PoCom design approach starting on the barriers identification to wellbeing determinant, and the active approach to overcome the barriers. Although barriers of OER adoption have been found in knowledge management and information system domain, to our knowledge these barriers lack the domain of human-computer interaction that results in the lack of motivation of the author [16] to cooperate in the digital world. Our study first, provides barriers framework for OER co-authoring that includes all necessary barriers with limiting to a wellbeing approach, then we provide PoCom design concept to address the barriers to PoCom. We articulated the OER barriers from the personal and environmental aspects of LO, AT, MA and GC. The proposed barrier framework lays the foundation for the wellbeing-based design of a co-authoring tool that can initially take a preventative design approach to barriers as an obstacle to wellbeing and trigger the redesign of a system [11]. Second, as the active approach to supporting user attributes, competence, autonomy, and relatedness (e.g., design to support express of gratitude and appreciation) for the co-authoring in the OER system.

We argue that our study on the barrier framework and PoCom design approach for OER co-authors can be the basis for the development of technologies that support and encourage knowledge sharing and introduce the importance of maintaining wellbeing factors in technological design for the open innovation community. The research presented in this paper, therefore, goes beyond previous work on identifying the institutional dimension of the barrier and focusing more on the technical level of system design and the correspondence strategy addressing the barriers based on PoCom technology. The contribution of the proposed barrier can be applied directly to the requirements of the system and may have a more practical impact on technological design (e.g., a questionnaire for the user study). Even though limitations exist, communication of the resulting study by the research community can mutually benefit, both to the community as a starting point for the problem-based system design and the improvement of the research. Further study, can engage more experts including experts from the industry and compare the redesign of an existing AT for OER based on the proposed barrier framework.

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