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Article

A Review of Literature on Co-Design Process for Education

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Abstract

The educational institutions in the Philippines continue to have all preparations in full swing as it ensures learning continuity amid the pandemic and even beyond. With technology as one of its aids and learning as its main concern, continuous exploration as to technology use in various learning modalities might be co-designed with its learners, teachers, and researchers. This article contained a review of six studies centered on the co-design process in integrating technology for education. The review focused on examining technology inclusions as to the process and outputs, exploring different co-design frameworks, and elaborating its implications to the Philippine basic education research agenda and the current learning modalities. With the gleam that the educational landscapes may eventually gain from collaborations among its stakeholders, this article explored the applicability of the co-design process in the context of basic education.

Keywords

co-design, co-design framework, design-based research, technology integration, basic education

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Introduction

Amid digital rise, technology use might be maximized if its users play a part in the design process, students, and teachers—in the case of education. As Kennedy and Dunn (2018) found that students had a sure stand on the things they wanted to see improve as to technology-enhanced learning, designing its use with the students through the co-design process might yield promising results.

Digital technology has brought a magnitude of support to education and its optimization is being taken into greater use as the world faces the pandemic. Since the Department of Education's announcement of ensuring learning continuity through varied learning modalities (Department of Education, 2020), there have been capacity trainings organized for teachers. Some of which are webinars about going virtual (EdutechAsia, 2020), the preparations for flexible classes (Peac.org.ph, 2020), online teaching (UPOU, 2020), and distance learning (Cañete, 2020).

Technology utilization was reported to be successful in the field of education (Young & Nichols, 2017; Nicolaou, Matsiola & Kalliris, 2019; Pechenkina & Aeschliman, 2017; Nueva, 2019). As Nueva (2019) reviewed that technology is integrated in the classroom use for instructional support, information referencing, and communication and collaboration platform, this era of online learning and blended learning might capitalize on its continuous utilization for education. With its utilization in education, users of technology might be the most opted voice to pinpoint what works and what does not. With that, the careful planning of technology use may play a crucial role in the design process. Co-design (Reeves, 2006) calls for enabling the users to collaborate with the researcher or the teacher in designing technology integration. And this review focuses on the enormous possibility of the co-design process' usefulness in the field of educational technology, specifically in the Philippines, and its efforts to promote learning continuity (Department of Education, 2020).

In particular, this review aims to (1) describe the co-design process as a design-based research; (2) explain technology integration through co-design; (3) identify the processes in co-designing ; and (4) provide implications for its use in the Philippine basic education context.

Method

The reviewed studies were collected from published articles on topics about co-design as a design-based research, co-design as used in technology integration and educational tool development, and co-design as a process. Six studies from 2013-2019 were selected to be reviewed in this paper. The papers were examined by providing an overview of the technology integration aspect as to its project output or process itself. In addition, the iterative cycle of different frameworks and the implications of its use on the context of the Philippine basic education landscape were included in the review.

A review of the Definitions of Co-design

The co-design or co-creation approach in research involves the collaboration of researchers and the end-users by allowing a detailed specification of interventions and outcome measures from the onset of the study (Goodyear-Smith, Jackson & Greenhalgh, 2015). Naranjo-Bock (2012) defined the co-design as a process of allowing users to be an active part of the creative refinement of a product which will later bring out diverse points of view in the design process and its output. This approach is under the umbrella of design-

based research. Design-based research is an approach that backs the exploration of educational problems and refining theory and its application through defining a pedagogical outcome and then focusing on the creation of a learning environment that supports the outcome (Reeves, Herrington, & Oliver, 2005; Wang & Hannafin, 2005). As noted by Kennedy-Clark (2013), design-based research is anchored on the fundamental principles enumerated by Reeves (2006). The fundamental principles of design-based research are to address complex problems in real life contexts while collaborating with practitioners, integrate known and hypothetical design principles with technological advances in rendering plausible solutions to complex problems, and conduct rigorous and reflective inquiry in testing, refining innovative learning environments and defining new design principles.

Since co-design is under the category of design-based research, its phases are similar to the preliminary phase, prototyping phase, and assessment stage (Plomp, 2017). According to Alghamdi and Li (2013), it was Reeves (2000; 2006) who developed design-based research and suggested phases. These phases include the analysis of practical problems by researchers and practitioners, the development of solutions with a theoretical framework, the evaluation and testing of solutions, and the documentation and reflection. And with these phases, one of the goals is to suggest new 'design principles'. The co-collaborator between the two designs sets each apart. The co-collaborator for design-based research is an expert or group of experts, while the co-design process involves the end-user.

Co-design and its similar notions were also explored in other fields. For instance, it was explored in the field of products and services by checking the involvement of users in the design process (Sanders & Stappers, 2008), see figure 1. Its landscape was also explored among the participative, co-operative, and co-creation as applied to service designs (Holmlid, 2009), the benefits of co-design in service design projects (Steen, Manschot, & De Koning, 2010), and the effect of customer involvement in service design teams (Trischler, Pervan, Kely, & Scott, 2018). It was also explored in the field of public service through exploring ideas in public service design (Trischler, Dietrich & Rundle-Thiele, 2019), and in the potential impacts of digital technologies for public service (Lember, Brandsen, & Tõnurist, 2019). Co-design is also explored in the field of engineering particularly in engineering design process (Garcia-Sanz, 2019), in computer-based representations of products (Gyi & Campbell, 2010), and in co-designing the requirements and architectural objects (Pohl & Sikora, 2007).

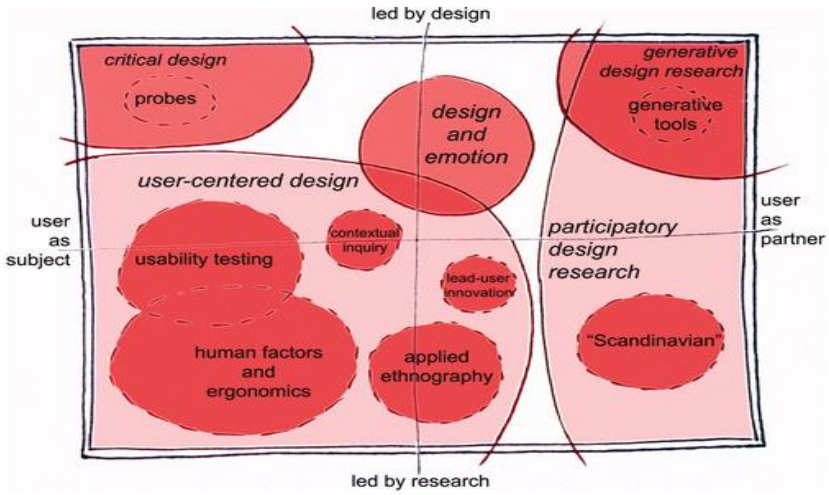


Figure 1: The current landscape of human-centered design research as practiced in the design and development of products and services. (Sanders & Stappers, 2008)

Co-design also shares view with the participatory educational design (Janssen. Könings, & van Merriënboer, 2017) where varied stakeholders are involved in the generation and consideration of alternative learning spaces, as it aims to create a mutual learning process and high quality and usable designs. This educational design sprouted from the notion that the proposal of change in education is easy, but its implementation is difficult, and its sustainability is way more difficult. Therefore, in the paper of Janssen, Könings, and van Merriënboer (2017), it laid out tools which may facilitate participatory educational design for classroom teaching. The laddering tool aids the participants to have a deeper understanding of each other's experiences which may eventually result to better decision-making, while the building block tool provides the non-professional participants with customary language to better discuss current and desirable teaching practices. Meanwhile in a study by Könings, Brand-Gruwel and van Merriënboer (2011), they identified the perceptions of teachers and students in the co-designed instruction as they called it 'participatory instructional redesign'. They took the perceptions of both co-designers and examined their congruence to re/design the instructional co-design.

It is also important to note that though co-design and participatory design are similar designs. However, Bäck, Friedrich, Ropponen, Harju and Hintikka (2013) discussed their slight difference. Their study emphasized that co-design focuses on the collaborative nature of design activities across the entire span of the design process (Sanders & Stappers, 2008), pays special attention to the early phases of design process where ideas are yet to be formulated (Sanders and Stappers, 2008), and is collaborative, methodologically transparent, continuous, and open to multiple viewpoints (Bradwell and Marr, 2008), while the participatory design may focus on one phase and may not be always open to multiple viewpoints.

Taking the internet into great use is the web-based co-design (Friedrich, 2013). Web-based co-design refers to designing new products and services together with users by having the application of social media tools and collaborative practices. "It includes early ideation (user innovation), active participation by users (participatory design), and systematic design process and methods (user-centered design)" as illustrated in figure 2.

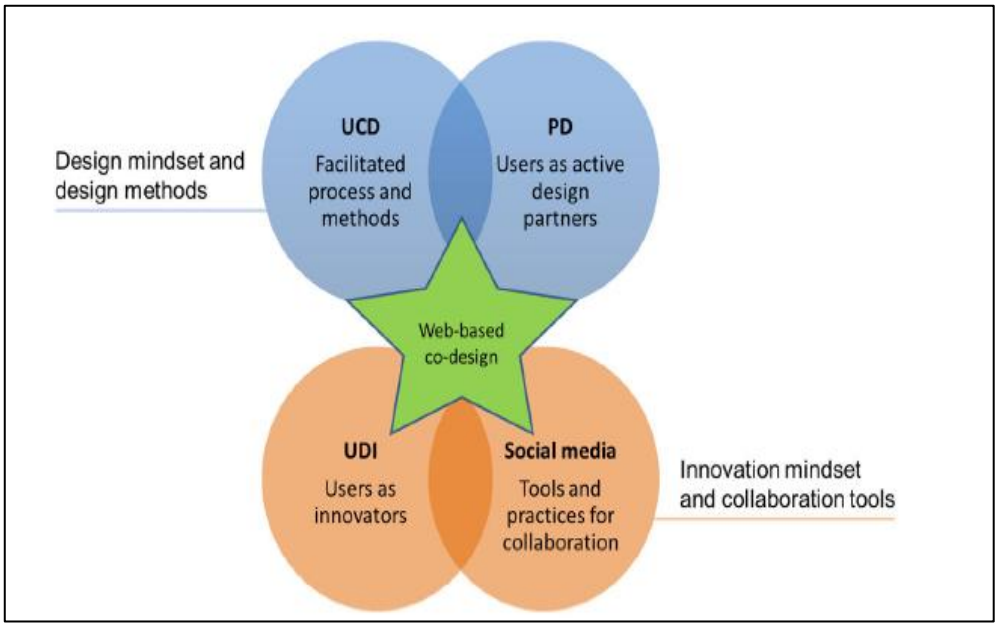


Figure 2: Web-based co-design framework by Friendrich (2013)

Co-Design for Technology Integration

The co-design process also sprouted from the idea of Carl Rogers (Rogers, 1969; Rogers & Freiberg, 1994) who proposed the facilitative learning theory. The facilitative learning theory states that learning may take place when the teacher acts as a facilitator of learning by the establishment of a safe environment in which learners are exposed to new knowledge and experience (Miller, 2001). It was discussed also that Rogers (1969) argued that the educator should encourage learners to plan for their directions based on their own interests and the use of co-design processes may enable learners as users of technology to be responsible for their own learning by planning and designing it with the teacher ahead of the instruction proper. It is in congruence with how students viewed technology-enhanced learning when Kennedy & Dun (2018) found that students had a clear stand on the things they wanted to see improve. The study also suggests that there is an apparent gap in precise understanding of what students want technology to be used for, when students frequently decide not to engage with technology-enhanced learning. This section reviews the technology integration in the co-design studies being reviewed in this paper.

Co-designing Inquiry-Based and Technology-Enhanced Learning Scenario (Barbera, Garcia & Fuertes-Alipse, 2017). With the help of CompendiumLD software to represent and share prototyping activities in a graphical manner, the study focused on detailed analysis of the co-design process. The paper identified the moments of change during the process of co-design and described the agents and causes which motivated them. Also, the study is part of a wider research project on re-designing a Sustainable Development online course delivered via a virtual campus.

Co-designing TEL Resources (Treasure-Jones & Joynes, 2017). In the context of health care education, co-design process was used to develop technology-enhanced learning tools with the users in the research project called The Learning Layers. The paper highlighted the collaborative development approach which gives importance to the expertise and creativity of the learners. It also focused more on the process of co-design rather than the output of the project.

Co-designing Virtual Manipulatives (Hansen, Mavrikis & Geraniou, 2016). The paper delved into the impact of the co-design process in a virtual manipulative named Fractions Lab on professional development and teaching and learning of fractions. It is vital to note that this study involved 21 primary mathematics specialist teachers as co-designers of the virtual manipulatives while checking their technological pedagogical content knowledge using the TPACK framework (tpack.org, 2012).

Co-designing Mobile Educational Tool (Mwandosya, Montero & Mbise, 2019). The paper focused on the participatory approach in co-designing the CBE (College of Business Education) Mobile Educational Tool, a mobile application prototype which helps the access to departmental-related materials and other teaching and educational functionalities. The process involved lecturers, researchers, and mobile application developers.

Co-designing Online Environment (Kyza & Nicolaidou, 2017). The study involved the researchers and three Science teachers in co-designing a web-based learning environment on Biotechnology, Genetic Engineering, and Genetically Modified Organisms (GMOs) for Grade 11 students in Cyprus. The STOCHAMOS, a web-based teaching and learning platform, was used as an authoring platform. Students in this study acted as users, testers, and informants rather than design partners.

Co-designing via Web (Friedrich, 2013). The study examined how social media can be used for user-centered design, participatory design, and user-driven innovation. The Owela (Open Web Lab) which includes blog-based discussion tools, user diaries, chat, questionnaires, and polls as web-based tools were made and used for the co-design process. However, the study pointed that it is not a substitute to the face-to-face method but a complement in order to secure constant interactions with the users.

Co-Design Process

For the overview of the co-design methods and practices, the article of Naranjo-Bock (2012) enumerated the different stages involved in the co-design starting with self-reflection research methods. This starts with reflective prompts that may enable the co-designers to reflect on their previous and current experiences and problems related to the present topic or concept at hand. The organization of co-design workshops is the next phase. In the duration of 90 minutes to 120 minutes, co-designers undergo workshops depending on the goal of the project. The strategies include collages, cognitive and context mapping, storyboards, inspiration cards, modeling, paper prototyping and sketching, and games. These strategies will unlock the ideas and concepts of the users as they co-design the project. It was also elaborated that pilot testing is typical in the co-design process to examine the effectiveness of the designed output, the time allocation, and the physical locale. The data obtained from these phases are tangible representations of the co-design aims.

Co-designing Inquiry-Based and Technology-Enhanced Learning Scenario (Barbera, Garcia & Fuertes-Alipse, 2017). As participated by one teacher, two students, and the researchers, the study applied the co-design methodology and various cited design models (Cober et al., 2015; Emin-Martinez et al., 2014; Spinuzzi, 2005; Zaphiris, Laghos, & Zacharia, 2005). The research consisted of five iterative cycles as shown in figure 3. The first phase with two workshops comprised of the introduction to the dynamics of co-design, the the second and third phases with three workshops focused on designing the learning scenarios, the fourth phase with two workshops dealt with prototyping the learning scenarios using Compendium LD program, and the last phase with four workshops were focused on critiquing the prototypes.

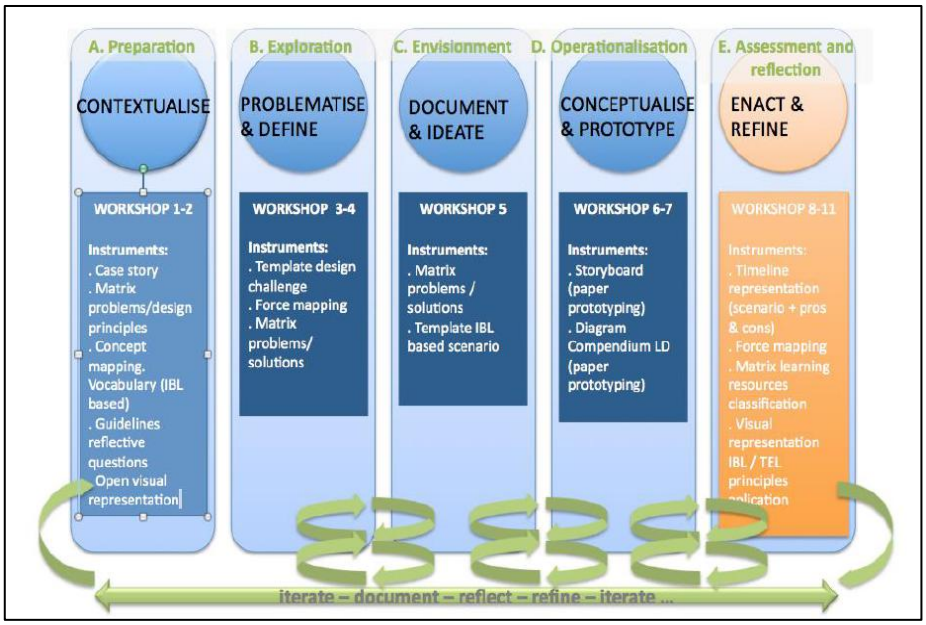


Figure 3. Co-design Process from Design-Based Research Framework (Barbera, Garcia & Fuertes-Alipse, 2017)

The iteration cycles of Barbera, Garcia and Fuertes-Alipse (2017) were well-defined citing the changes which occurred within the three versions. One of the strengths of the study was when the design iterations clearly showed the processes in each phase and the instruments needed. The use of the CompendiumLD software (Conole, 2009) to visually illustrate the intermingling ideas, arguments, and issues during the design process was also worth noting. It made the storyboarding, prototyping, and enactment time-saving and convenient. Since the co-design was utilized not to form or create new learning scenarios but to strengthen and refine the then learning scenarios, the co-design has enriched the learning scenarios, defined the roles of the agents involved, and figured that it acted as the mediator in the entire study.

Co-designing TEL resources (Treasure-Jones & Joynes, 2017). With a total of nine design iterations involving storyboarding, paper prototyping, and software prototyping, the study pointed out that the co-design process requires time investment and openness to novel ideas and compromise. The co-design loops in figure 4 centered on four core processes namely analyze, design, develop, and test. These were supported by design tools namely storytelling, storyboarding, games, paper prototyping, and testing of the design.

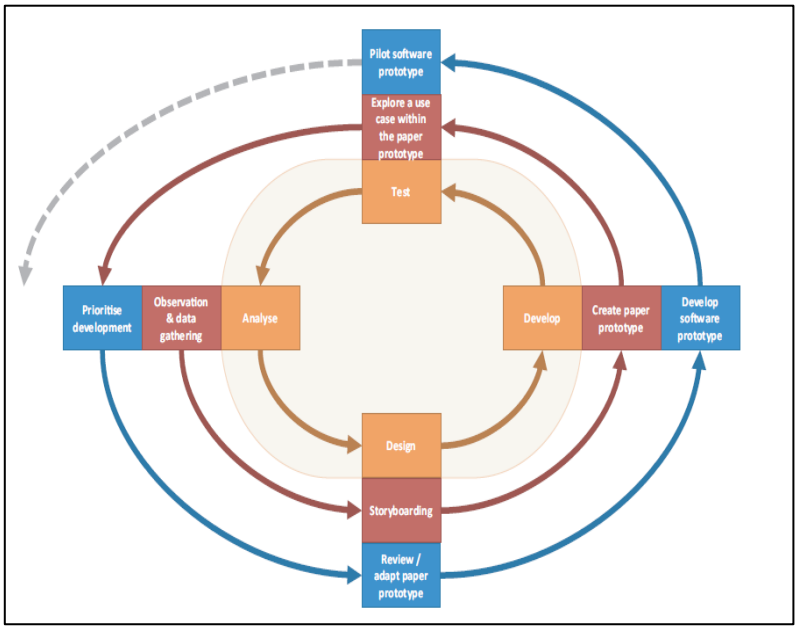


Figure 4 Agile development and Co-Design Process (Treasure-Jones & Joynes, 2017)

Co-designing Virtual Manipulatives (Hansen, Mavrikis & Geraniou, 2016). The study reported the transformation of the Fractions Lab as a virtual manipulatives. However, it has provided more discussion on the role of the co-designers, particularly the teachers' technological, pedagogical, and content knowledge using the TPACK framework shown on figure 5. Also, the learners ages 9-11 served as informants of the study and not as co-designers. The research followed the design-based method by utilizing the design-trial-reflection cycles comprising of four phases. These phases were (1) inquiry on teaching fractions, (2) observation and recording of actions, (3) immersion and engagement with experience, and (4) consideration of ideas.

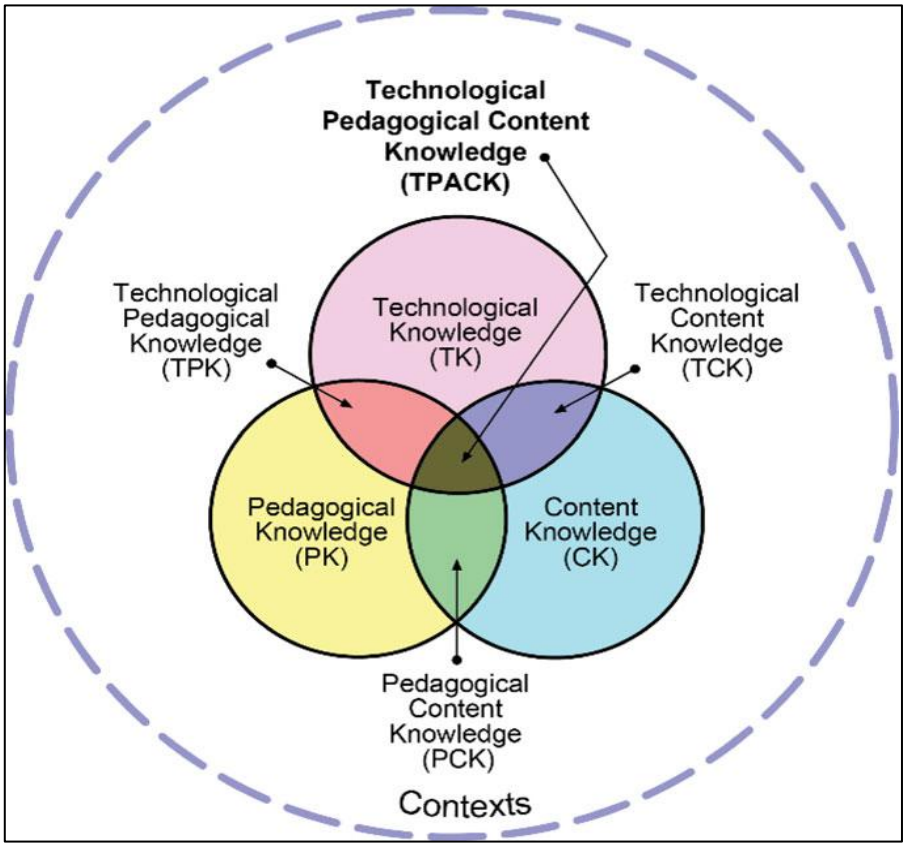


Figure 5 TPACK Framework (tpack.org, 2012)

As suggested in their paper, virtual manipulatives for the Sciences and Mathematics, Reading, and Literature may be co-designed with learners. Young Filipino learners may point out what works for them, so if they may be provided with an opportunity to co-design virtual manipulatives with the teacher, there might be an added enjoyment and leaning among the them.

Co-designing Mobile Educational Tool (Mwandosya, Montero & Mbise, 2019). With the goal of developing a mobile educational tool, the participants were 25 lecturers, three researchers, and one application developer. There were four workshops following the phases illustrated on figure 6. The process started with the explication of the problem, then outlining the artifact, followed by the development of the artifact, and the initial evaluation of the prototype.

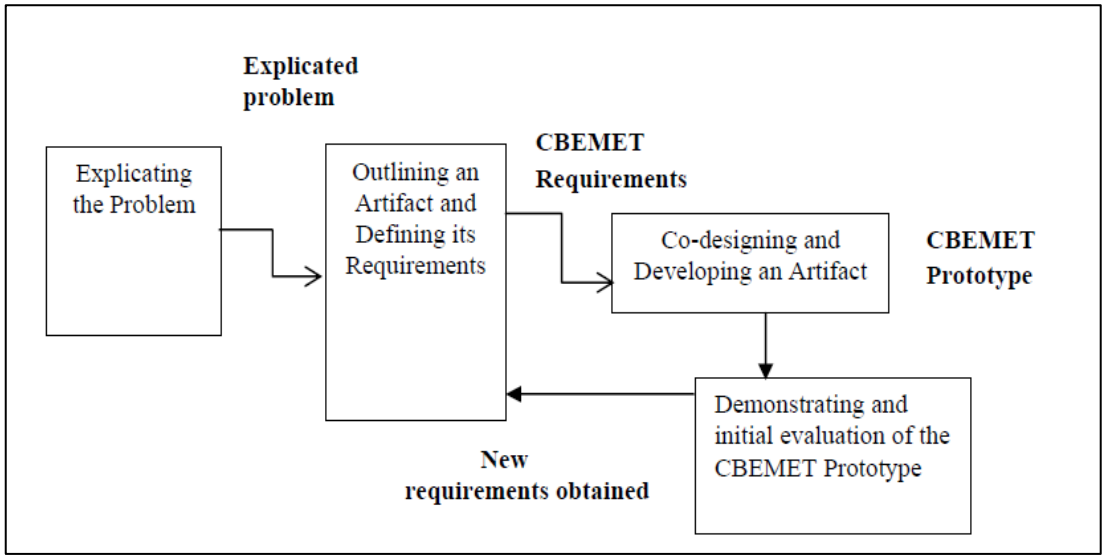


Figure 6. Design Science Research Framework (Johannesson & Perjons, 2014)

The study found it lacking as to the usual rigidity of the iteration cycles in other countries like United Kingdom, England, Finland, and the US since the iterations of Mwandosya, Montero and Mbise (2019) were limited to three cycles among lecturers and an application developer. However, the use of co-design was taken into consideration to contextually design a mobile education tool in Tanzania. As handy and as mobile as it is, applications utilizing smartphones or mobile devices may also be co-designed with the learners in the basic education in the Philippines. They may have a clearer view of what works for them as they learn. For instance, teachers may co-design flash cards video lessons, games, or e-books which can be accessed by Filipino co-designers and learners using mobile devices.

Co-designing Online Environment (Kyza & Nicolaidou, 2017). Grounded from Design-Based research method, the study used the Professional Development Design Framework (PDDF) of Loucks-Horsley et al. (2010) which was organized in six sequential but highly iterative phases. Design phases consisted of 31 design meetings among the researchers and three science teachers followed different meeting foci. The team developed an inquiry-based learning space for grade 11 students using the Stochasmos web-based teaching and learning platform (Kyza & Constantinou, 2007) for Biotechnology, Genetic Engineering and Genetically Modified Organisms (GMOs). The development adhered to the four-phased design composed of the initial design, the first enactment, the redesign, and the second enactment. It is also important to note that students were not part of the design process but as members of the enactment process. To be at par with the changing educational landscape from traditional face-to-face scenarios, the Philippine basic education may co-design

an online environment with learners who will be using learning resource management systems and other online learning platforms.

Co-designing via Web (Friedrich, 2013). From the combination of user-centered design, participatory design, and user-driven innovation, the web-based co-design via Owela (Open Web Lab) as illustrated in figure 7, was used for innovation and design purposes among six case studies listed in table 1. Web-based co-design focused on how social media tools can be used to support users' participation in the design and innovation processes and how collaborative channel changes the user participation during the design process.

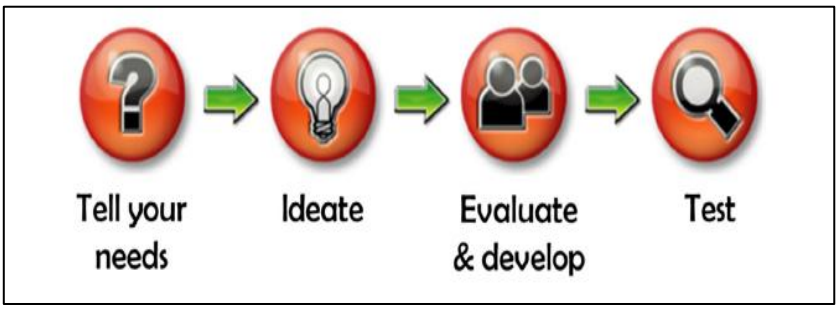


Figure 7. The Ideal Idea Tube Process of Owela in 2007 (Friedrich, 2013)

The first version of Owela was in 2007, and with the web-based co-design throughout six case studies on its use as a web-based co-design tool, it was iteratively developed by Friedrich (2013). The key elements on the use of Owela were listed on table 1. It capitalized the two primary case studies which lasted for ten months and six months having various participants such as the users, the researchers, and the software developers. Also, there were varied phases involved from one case to another, among user-participants ranging from 4 to 47.

Case study	Focus and objectives	Phases of the innovation process	Duration	Participants in online co-creation
Primary cases				
Mobideas	Co-design of a mobile social media service based on users' ideas and needs	Whole process: needs, ideas, concepts, features, prototyping	6 months	33 users online 4 software developers 2 researchers as facilitators
Monimos	Co-design of a social media service to support immigrant networking and civic participation	Whole process: needs, ideas, concepts, features, prototyping, launch	10 months (and on-going after the research project)	32 users online 8–14 users in the core team 1 designer 1 software developer 6–8 researchers
Supplementary cases				
Tilkut	Evaluation and further improvement of a social bookmarking service	Concept development and prorotyping	2 x 3 weeks	40 respondents in a survey 7 users in online testing
SuperF	Understanding of users' perceptions of cloud services and their security and collecting ideas for new services	Fuzzy front end: user needs, ideas, concept evaluation	1 month	47 end-users (in two groups) 4 company representatives 2 researchers as facilitators
Events	Development of a mobile event management service	Prototype testing	1 month	4 users 3 developers 3 researchers
City Adventure	Development of an adventure service based on a first concept	Ideation, concept evaluation and testing	2 weeks	47 users 1 company representative 1 researcher

Table 1. Key Elements of Primary and Secondary Case Studies on the Use of Owela in Web Co-design (Friedrich, 2013)

It is vital to note that the web-based co-design of Friedrich (2013) through Owela was heavily dependent on the active online users, therefore internet connectivity would also play a big role in the success of the online co-design. Co-designing web-based learning may also be an used by Filipino teachers and students in the continuous search of how learning may improve through online technology.

Co-Design Directions for the Philippine Education

This section elaborates how the co-design process might flourish in the Philippine educational landscape in the present time as to technology integration, involvement of students as co-designers, its applicability to the current delivery modalities in the Philippines, and the research agenda of the Department of Education.

All the reviewed papers used the co-design process in integrating technology whether on the project outputs (Friedrich, 2013; Kyza & Nicolaidou, 2017; Mwandosya, Montero & Mbise, 2019; Hansen, Mavrikis & Geraniou, 2016; Treasure-Jones & Joynes, 2017; Barbera, Garcia & Fuertes-Alipse, 2017) or the design cycles (Friedrich, 2013; Mwandosya, Montero & Mbise, 2019; Barbera, Garcia & Fuertes-Alipse, 2017). Therefore, the literature is rich with targeting technology as an intervening or an end point of the co-design process. In that same way, technology use becomes vital as the Philippines (Department of Education, 2020) ensures that learning should continue amidst the COVID-19 pandemic. A safer access is the adherence to the safety protocols via varied

learning modalities aside from face-to-face classes. Though Dotong, De Castro, Dolot and Prenda (2016) noted that the ICT Development Index of the Philippines is 4.39, which is half of Singapore's 8.64, Nueva (2019) reported digital divide among teachers, and Carbonilla Gorra and Bhati (2016) found that students have disruptive activities while using computers, there are still myriads of opportunities to deliver learning among learners. And these opportunities may be better explored through the co-design process, involving learners.

The opportunity to explore technology integration in this time of shift in education caused by the pandemic is crucial. Future explorations on enhancing teaching and learning processes with technology use may be co-designed with learners, who knew how best they can learn through technology use (Kennedy & Dunn, 2018). Therefore, teachers in the Philippines may consider collaborating with learners as the users of technology-enhanced instruction. The co-design process may also enable teachers to plan and design materials like games, online activities, or video lessons, whereby numerous studies have cited its advantages in enriching learning.

Learners as co-designers found from the works of Treasure-Jones and Joynes (2017) and Barbera, Garcia and Fuertes-Alipse (2017) can play an important role. Their paper emphasized the importance of users in the collaborative effort of designing. In the paper of Treasure-Jones & Joynes (2017), the importance of involving learners in the design and development of educational resources was centered. It placed importance on the definition of the design process. Moreover, the development of the tools is based on the assessed needs and availability of opportunities and resources which emphasizes the belief that co-design tools are not just designed for users but with users. Meanwhile, the study of Barbera, Garcia, and Fuertes-Alpiste (2017) has noted that some of the learners' proposals were not included as they were not feasible for short-term use. Other times, the excessive rigid preconceptions of students have hindered them from openly evaluating the alternatives and solutions.

In addition, co-design encourages the participation of learners in the design process. Teachers may also take advantage of the possibility to amplify what students want technology to be used for and how they want it to be used as they learn or acquire skills. Teachers may also take the opportunity to develop and design tools, materials, or programs enhanced with technology, with the increased confidence that learners would enjoy the use and enjoy the learning process because they are part of deciding which portions are effective.

Just like how learners as users may benefit from the co-design process, it may also be beneficial to the professional development of teachers. The study of Kyza and Nicolaidou (2017) examined the contribution of the co-design process to the professional development of teachers with 31 design meetings over the period of two years. The findings signified that the co-design approach addressed the professional development needs of the teachers, had a greater impact on the teacher, and met students' learning and motivation needs. This is also parallel with the aims of the co-design process of Hansen, Mavrikis, and Geraniou (2016). Teachers may continuously gear up for the continuous adjustments brought by the changes in learning modalities through the co-design process. It may help in the search for effective and relevant technology-enhanced techniques, tools, and practices aligned with what learners agreed upon or what they believe would work best. If there is collaboration between teachers and learners as to technology use, it may also help teachers' productivity, efficiency, and quality of instruction, regardless of the learning modality being used.

The Basic Education Research Agenda (Department of Education, 2016) calls for research capitalizing on various agendas and one of which is on teaching and learning. Its main themes are instruction, curriculum, learners, and assessment. All of which might be explored using the co-design process involving teachers, researchers, curriculum makers, and learners. The co-design may provide an extensive search for evidence that would lead to how much a co-designed tool, material, or program would benefit the teaching and learning processes. Action research may also be conducted which deals with how learners collaborate in the design-making processes. Since there is a continuous encouragement of elevating the quality of education, co-design may be an interesting field of educational research to explore.

Conclusions

The co-design as an umbrella of design-based research extensively explored in the European regions centered on how its process, key players involved, design iterations, and technology use. In this review, opportunities for the global South to explore the co-design process and expand the research fields in basic education using co-design processes were tackled. Though the process is rigid and time-consuming because of its iterative and reflective aspects and the need for online technology, there are still results indicating its benefits for learners and teachers for being collaborators in the co-design process. This may be novel in basic education because teachers and curriculum planners are mostly involved in crafting and designing technology-enhanced learning tools, while learners remain as recipients. Therefore, as the Philippines and most of the countries continue to grapple with pedagogical difficulties brought by the pandemic, co-designing newly explored modalities, online strategies, and platforms may continuously elevate the quality of basic education. It may be a good opportunity to involve learners in the process of designing something they will be using.

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