Building A Virtual Multidisciplinary Team

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Abstract

This study introduces an effort in the direction of an effective dynamic mini-courseware design during the practice of learners from multidisciplinary in higher education including several areas of professions such as learning science, computing, information science, artistic design, curriculum development, management, marketing, and law. The nature of a heterogeneity in a multidisciplinary team contributes pecific mental cognition and expertise when achieving socio-emotion and task over a social representation in a common representational space (Gloor, 2006; Vlad - Petre Glăveanu; 2014). The finding suggests heterogeneity of teamwork is not limited to a boundary of location, enriched by a virtual multidisciplinary members in a Design Thinking process encompassing; Diverse inspiration, Sharing empathy, Generate idea, Competing prototype/solutions, and Pilot-testing via a widespread of geography and time differences. A promising result empowering the VR multidisciplinary team for a "power of thinking" through a communication technology that nurturing an iterative process of thinking with social-ethical practices with the end-users' empathy sharing.

Introduction

Aside from a professional skill, a demanding of non-routine analytical skills including problem-solving, communication, teamwork, creativity, and entrepreneurship are acquired to be the essential skillsets for all careers that ensure the employability during the disruptive change of the 21st century. In parallel with the country goal that aimed for uniting diverse individuals into a productive quality citizen of the country; Digital Education, a promising path that empower college students and life-long learners, intertwines content with technology encompassing approaches of technical perspective, learning perspective, collaboration in a social-ethical perspective. Such the digital education system falls under the lead of Educational Technology profession that aimed at facilitating a learning capacity by the process of creating, using, and managing technological enhanced environments. Digital Education system in a technical term means a system for teaching, learning and evaluation with some basic automatic features such as attendance monitoring, media audio visual lesson editing, online practice/exams, individual assessments, centralized data storage, etc. The system in a holistic approach allows an involvement of practitioner/professions in a broad range of disciplines and members from schools, colleges, universities, non-formal institutes, and private sectors. The Digital Education system includes a total management; a plan for a quality assurance, strategic teaching, learning engagement, monitoring, evaluation, financial and benefit control. The digital education system urge an effective team to work for the success; integrating knowledge and methods from different disciplines, using real synthesis of approaches. Several researches addressed issues of the content in the courseware product that focused on value for the learners and the development methods with multi-disciplinary team. A few concerns on a courseware development disciplines cooperate for the best of the quality of interactive product for learners. A courseware design are usually text, graphics, animations, video, and audio wherever it is functional or otherwise suitable. The level of interactivity is usually restricted to interactive forms available through technical aspects. A simple technical function somehow could reach an effective learning outcome when applying with a decent design of instruction/presentation. In the digital learning system from teaching/learning perspectives; content, technology, and delivering are holistically in concerns, as the fast speed of technological change disrupt shortening the life-cycle of knowledge, delivering mode, and how people learn. Multi-disciplinary team in a courseware development disciplines is likely to result in a dynamic and raise the level of learners' awareness in all aspects, especially when employing users' centered approach of Design Thinking.

Mini-courseware

Contemporary learning has been enriched by state of the art technology namely mobile Learning (m-Learning) and ubiquitous Learning (u-Learning). The learning via mobile is attracting considerable interest in the fields of professional learning and work-based education, as its capacity of just-in-time and on the job upskilling people at work. Some design approaches are inclined to merely adjust the content to fit the screens of mobile devices, still employing behavioural and cognitive paradigms. Numbers of research enrich mobile learning strategies that accommodate creation and sharing of content; learning across formal, non-formal settings and at work. Psychological implications are broaden to situated, socio-cognitive, cultural, multimodal and constructivist educational paradigms (Pimmer, C. & Pachler, N., 2008). The new generation of learning system via mobile device is precise, brief, effective, and can dynamically interact with learners' individual profiles, the term is coined "mini-courseware" (Li, Y., Guo, H., Gao, G., Huang, R., & Cheng, X., 2009) . Largely known as "micro-learning", skilled based learning approach, a courseware appears in relatively small learning units and short-term-focused strategies. The instructional strategy highlights a microlearning process which is the design to gain learners' interaction on the micro-content, learning time and cost effective, specific topic/unit, small part of curriculum, knowledge/skill elements, integrate/situated process, multi and mediated media form, active/pragmatist approach. For more example, Uptodate (known in a medical care) an evidence-based learning resource, a contemporary learning ground that has been enriched by state of the art technology of Big Data, Micro learning, Mini-courseware and mobile Learning. This type of courseware design has been integrated into the mainstream of education and training. This design direction has caused the field of Educational Technologist from scope of integrating media and learning to face an evolutionary challenge since this new demand of learning must effectively correspond to an individual learner's needs in an appropriate manner and at the right time, within a disruptive but short life-cycle of demanding knowledge and technology. The scope is broadened to other professions as Information Technologist, Computer Engineering, Business, Law, etc. For the teaching and learning part, a quality content/courseware is gained not only from technical or pedagogical part, but other areas of the contribution and precaution to the issues that will encounter along the development and implementing the learning courseware. A Multidisciplinary team, individuals from different disciplines work together contribute their disciplinary knowledge for success. Team, independent individuals effort collectively to achieve a common goal or task with an effective process, is beneficial to problem solving that brought various perspectives as claimed to meet effective possible solutions with components of combination of team, communication, coordination, motivation, and relationships of the team (Paulus, P, 2000; Hoegl, Martin & Hans Georg Gemuenden, 2001; Ilgen, D. & Hollenbeck, J., 2004). Team member could offer their unique knowledge and ability for team output and motivated individuals' ambitious to improve their performance (Katzenbach, J.&; Douglas, S., 2015). Recent research on teamwork enriched by various expertises could gain a group wisdom through a process of conceptualizing knowledge, virtue and emotional feelings, and operating in a practical action with the group judgment and ethical decision (Akgün, A.E, 2019).

Virtual Multidisciplinary Team

Team consists of a group of people with needed skills to accomplish a particular task. Working as a team may require a process to implement a team training to promote a shared goal, strategies, and resources, and participation as well. Not only a requirement in a workforce, some research propose several approaches for in higher education students training programs; for example, using an authentic context such as a simulation game development to enhance teamwork skills. The study employed a game-based software development to be an activity in enhancing a teamwork skill found an issue of a lack of acceptable group assessment (Sereti, et.al., 2019; Iacob & Faily, 2019). Researchers propose an evaluation providing immediate feedback allowing a transfer of learning which the skills will eventually be modified to a similar one.

Team, a group of individuals together working from different geographic locations synchronized and relay, could effectively perform in a geographically dispersion relying on communication technology, as known a virtual team (Nader, A., Shamsuddin, A.& Zahari, T, 2009; Zahari, T Nevogt, D., 2013).

A few process of virtual team is found; Lipnack, J. & Stamps, J. (1999) a virtual team, consisting of three major components; people, process and connection, promotes a dynamic and diverse group and a common team structure might not be a favor of the team. Nevogt, D. (2013) proposes a practical process and technological tools for virtual team. The guidelines of the virtual team are 1) Goal settings and valid explanation 2) clear and precise notification for tasks and its priority with deadlines and publish for member to be follow and monitor the progress 3) Follow-up based on the agreement tasks and timeline as a group not individual communication 4)Allow for

reasonable iterative process to develop the solutions 5) Technology mediates the process such as an online project blueprint--flowcharts, text-written, mind-maps, video; group and task internal communication; expert connections.

Research review on a virtual team consists of 4 major components: members, social-emotion, process, and technology. The heterogeneous group of cognitive specific from multi-discipline joined a virtual team could bring an exceptional solution. Socio-emotion issues take a major part in this diverse cognitive sharing. Some research supports the face-to-face meeting could empower virtual team to share a mental model and lessen the diverse cultural difference that could obstacle an effective communication. (Suchan; Hayzak, 2001). Take process via Computer-Mediated Communication (CMC) is highlighted as a success factor of virtual team. Technology takes roles in keeping members in following up task process even more crucial than a face-to-face teamwork. Members could be in a silence without noticing the progress to the group and that cause an ambiguity and eventually become problematic. Group coordination and task-technology-structure fit could keep up the virtual team forward the work. Finally, collaborative technical aspect takes an essential effects on team 's performance in following the taks and the process and that contributing to the work and the satisfaction of belonging to the team. Technology could provide a nurturing climate of which members could build a trust and cohesion of the team using a dialog or conversation in small group to share positive or release a doubtful sharing mental models during a virtual team norm building. An extensive reliance on communication technology anyhow could reduce effective of virtual team. Some research and practices apply a reward system, creating trust, and communication culture for team cooperation, also periodical face-to-face meetings to form relationships and being a vehicle to coordinate activities. In addition, teamwork needs an ongoing practice to maintain and promote the development of a shared mental model of multidisciplinary participation with team resources and goals. In addition, immediate feedback on learning outcomes could facilitate the transfer of learning during the practices.

A social hierarchical structure appears in an organization or group that a top position or senior tends to become authoritative and individualism causing trouble in engaging collaborative work. Also, some task could be appropriate for individual work that also could lead to a conflict and damage to the teamwork. Using teamwork in a curriculum, senior project of software engineering team exposed students as complex learning in a professional work environment, and that students are well aware of the commitment before commencing the group project. However, unequal amount of individual's work was in cautious that could create conflict and lead to lower levels of performance (Iacob, C. & Faily, S. 2019).

Design Thinking

Learning design, is a practice of matching learning with constructive instruction enhanced by technology. Several research studies found Design Thinking to be a powerful method providing a solution-based approach to complex problem solving that addresses ill-defined teaching and learning problems. Design Thinking is a technique originated in 1960's in Engineering field for an innovative production. Later, 1970's the design became a subject in replace to traditional arts and crafts for secondary school in the U.K., and gradually link to technology study. Design Thinking, in 2003 has been introduced at the university programs in business and innovation areas (Lockwood, T., 2010).

The process of Design Think is to understand the learners needs, re-framing the problem in a learners-centric way, through brainstorming techniques, prototyping and testing (d.school at Stanford University, 2010; Adams, C., & Nash, J. B., 2016; Brenner, W., Uebernickel, F., & Abrell, T., 2016). Typically, the process primarily includes a technique to gain an empathic understanding of the problem from the learners' insight by engaging and empathizing with learners' based on their experiences and motivations in the learners' physical environment. A wide and open view, aside from courseware designer's personal assumption, will clearly give insight to the learners' status of the problems. The next stage, the gathered insightful information is analyzed and synthesized to define a core problem, and through teamwork will validate a defining task of a problem statement. Eventually, the solutions come through supported by a teaching/learning mechanism that is well enhanced by technological features and functions. Later, in a prototype phrase, the design team scales down versions to investigate the problem solutions from the ideate stage. The team will perform a validity of the test with a variety of small group sampling techniques. Thorough this stage of the testing, the details of the prototype are investigated based on learners' reaction whether to improve, accept, or reject on the basis of learners' reactions. The best solutions will tune in this pre-experimental stage. The design thinking process with a teamwork should give an innovative solution resulted from a multiple loops and in different angles.

Design Thinking is represented with three iterative stages: inspiration, ideation and implementation (Brown, 2008). Inspiration, motivating the search for solution, generated through interactions with target clients. Ideation is the process of generating, developing and testing various ideas leading to solutions. Finally, the

Implementation stage of design thinking plans a path to develop and run the selected concept. Review the development process of Design Thinking found common cores accordingly (Brown, 2009; Brown, T. & Wyatt, J. , 2010; Stickdorn & Schneider, 2010; Coakley, Roberto, & Segovis, 2014; Glen, Suciu, Baughn & Anson, 2015; Gachago, Morkel, Hitge, van Zyl & Ivala, 2017): 1) Inspiration, understanding the problems and opportunities; 2)Empathy, Users' center deep analysis from users' physical and emotional experiences; 3) Ideation, alternate between divergent and convergent thinking through a brainstorming and think outside the box 4) prototyping & implementation, the idea turn into a concrete product/process and iteratively evaluate and refine.

Design thinking is found its largely used in software development organizations as a tool to follow a human-centered approach. Design Thinking also is claimed as a tool for undergraduate students' creative skills,problem solving, communication, as well as collaborative work, as known social and cognitive skills. Much more than that, Design Thinking, empowers students to train acquiring empathy towards others. (Valentim, N. M. C., Silva, W., & Conte, T., 2017) Brown (2008) uses a "persona", a character of users, to be an action to describe detail clients' characteristics, typically, represented in a textual form and photo, to motivate teams into thinking about users during the design process, making efficient design decisions. During the stage of Empathy; four areas accessing the users 1) Think and Feel: what users' perceive the issues/things 2) Hear: how the environment influences the users 3) See: what the users see in their environment 4) Say and Do: what the user says and how users behave in public. (Jahnke, I., Lee, Y., Pham, M., He, H., & Austin, L., 2019)

This research is aimed to provide guidelines of building up a virtual multidisciplinary team based on a design thinking process to achieve the target of a dynamic mini-courseware application. The study is conducted by a systematic review of research and best practices of design thinking process with the use of communication technology

Purposes

This empirical study aimed at outlining the process of building up a virtual multidisciplinary teamwork within a Design Thinking process. The study also explore tools and process in bridging communication among the multidisciplinary team while performing dynamic mini-courseware design. The main research questions are:

- What are the process and communication tools in the Design Thinking for a virtual multidisciplinary team?
- How the multidisciplinary team performed in the process of Design Thinking?

Methods

Building a virtual multidisciplinary team with Design Thinking process is a qualitative method in its nature.

1. the study employs a qualitative data collection using research and best practices review, analyze, and synthesize the process of Design thinking. In a matrix format, the synthesize process of Design Thinking is crossed analysis with a multidisciplinary team practice.
2. The result of the analysis of a virtual multidisciplinary teamwork with Design Thinking process is matched with a categorized technology, derived from a short-listed expert reviews, literature, and a software survey.
3. The study apply an empathy technique interview to understand the underlying opinions of some potential members that diving deeper into possible problems while making a team to complete the mini-courseware design. The data is gathered to identify the solutions with three experts' opinions. The process of Design Thinking in a virtual multi-disciplinary team was adjusted.
4. Eventually, the process of Design Thinking of the virtual multidisciplinary team via the technology toolkits was piloted. The researchers' participated and observed, followed by a semi-structured interview.

Results

Design Thinking with Multidisciplinary teamwork process consists of five stages namely: Diverse inspiration, Sharing Empathy, Generate Idea, Compete Prototype, and Pilot/Testing.

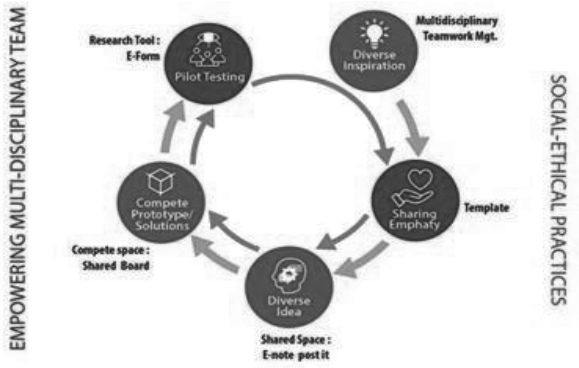

Figure 1. Model of building a virtual multidisciplinary team with design thinking

1. Diverse inspiration:

The Diverse group inspire: This stage emphasizes an awareness of the diversity of the group, welcome and persuade the group to the ultimate outcome. A clear and precise goal is announced on the homepage of the team. The group task is analyzed and along with the sub-teams' responsibility and timeline must be a group communication. This stage consists of 3 steps 1) Represents heterogeneous of the team via their work & profiles. 2) Selection to the sub-groups. 3) Group task analysis based on individual's expertise: Time & Task management.

Technological tools: Web GroupBlog VS Individual

2. Sharing empathy:

Team have a conversation with the end-users for collecting even richer and more provocative ideas. Team with different thoughts will take away the mindset, observe the world to find what end-users' problems and how they are thinking, what they desire to do, and what they wish for. They collect insights by looking at the major problems as an insider, as if they were the users.

Technological tools: Research Template

3. Generate Idea:

Members of the team virtually propose their ideas via online canvas based on information received from the users' empathy stage. Members act as a team researcher and that resulting to different data from accessing end - users' opinions. A structured brainstorming process. Taking one provocative question at a time via an online canvas, coding by color. Members freely generate ideas via an online Post-It note which allow for visual image and other media to be linked. Eventually, members categorize those ideas in the same shade of color, and naturally the ideas are ranked. This lets the group move into a process of grouping and sorting ideas.

Technological tools: E-note Post-IT

4. Competing prototype/solutions:

At the core of the implementation process is prototyping: turning ideas into actual products and services that are then tested, evaluated, iterated, and refined. A prototype, or even a rough mock-up helps to gather feedback and improve the idea. Prototypes can speed up the process of innovation because they allow quick identification of strengths and weaknesses of proposed solutions and can prompt new ideas.

5. Pilot-testing: will take their roles in filtering the ideas, an iteratively improve through the implementation for its ultimate solutions.

Technological tools: E-research (form)

Table 1. Design Thinking process with a multidisciplinary Team

	Synthesized process	**Diverse Inspiration**	**Sharing Empathy**	**Generate Idea**	**Compete Prototype/ Solutions**	**Pilot /Testing**
	Brown (2009)	Inspiration	Ideation			Implementation
	Stickdorn& Schneider (2010)		Exploration	Creation	Reflection	Implementation
	Standford d.school (2010)		Empathy	Define /Ideate	Prototype	Test
	Coakley, Roberto, & Segovis (2014)	Inspiration		Ideation		Implementation
	Glen, Suciu, Baughn and Anson (2015)		Problem Finding, Observation	Visualization and Sense Making, Ideation	Prototype and Test	Viability Testing
	Gachago, Morkel, Hitge, van Zyl and Ivala (2017)	Collaboration and Generosity	Learner Empathy, Problem Orientation	Exploration and play		Reflection and Resilience, Focus on practice, Change Agents
	Synthesized process	**Diverse Inspiration**	**Sharing Empathy**	**Generate Idea**	**Compete Prototype/ Solutions**	**Pilot /Testing**
Synthesize team	Kirkman et al. (2002)					
Context		confidence and trust				
Team Structure			-common goals -member roles - roles - relationship			
Process				- virtual team performance - member training -evaluation		
Synthesize team	Powell et al. (2004)					
Context		-cultural difference -expertise				
Team Structure			-relationship skills -choesion			
Process				-communication - coordination -task- technology structure fit		
Synthesize team	Shaw (2012)					
Context		rewards routines resources				
Team Structure			- purpose - cleat roles - relationship skills			
Process						
Synthesize team	Zimmer, Christina. (2015)					
Context						
Team Structure			-leadership - working according to the specified structure			
Process				-communication - community		
Synthesize team	Ghiringhelli & Lazazzara (2016)					
Context		- training - locations				
Team Structure			- team selection - Positioning - Set team goals -motivation - team leader - member team performance			
Process				- meeting structure - performance evaluation - electronic communication - working with technology - facilitating the team - Security		

Table 2. Design Thinking process in a Team mediated by communication technology

Synthesized process	**Diverse Inspiration**	**Sharing Empathy**	**Generate Idea**	**Compete Prototype/ Solutions**	**Pilot /Testing**
Synthesized tools of Design thinking					
Kayla Kurin (2015)		-Innovation Flowchart - Google ventures design sprint - Design thinking mix tapes - IDEO design kit	-WeTHINQ - Question Ladder	- Design thinking tool kit	-WeTHINQ
Robert Cserti (2019)		-Typeform -Zoom -Creatlr	-Smaply, -Userforge, -MakeMy Persona, -SessionLab, -Stormboard, IdeaFlip	Boords, Mockingbird, POP	UserTesting, HotJar, PingPong
Emily Esposito (2018)		-Join.me	-Boards - Free hand - Coggle - Focus Booster	- InVision Studio - Craft	- Ethnio - Lookback
Chloe (2018)		- Smaply - Usability tools	- Visual collaborative work platform: Morally - Mind map tools: Mind Manager, Coggle	- Mockplus - Pop app	- Silveback
Synthesized process	**Diverse Inspiration**	**Sharing Empathy**	**Generate Idea**	**Compete Prototype/ Solutions**	**Pilot /Testing**
Synthesized tools of virtual team					
Hu (2015)	YouTube, Yammer, Wiki, Google Apps: Sites, Docs, Video, Maps, Calendar, gadget World Clock, g-mail	Wiki, Google sites	Yammer, Elluminate Live (Blackboard Collaborate), Skyp, Google talk, chat	Google sites, YouTube	Blackboard, Google Apps
Chastain & Nathan-Roberts (2016)	Sharing calenders, Web-based training, e-mail, datbases	Blog, Application sharing	- Web conferenceing, Video & Audio conferenceing	Streaming Audio/video, Narrated slideshow	
Aritz, Waler, Cardon, & Li (2017)	g-mail, messenger	Google Docs, Dropbox	phone calls, Facebook, instant messaging, Skyp, Google Hangouts, Coference a call		LMS, Google Docs
Larson, Leung, & Mullane. (2017)	Slack	Dropbox, Google drive/Docs,	Face Time, Google Hangouts, Skype, Slack, Teleconference application, WhatsApp, Google Hangouts,		LMS, Google drive/Docs, Slack
Edwards & Wilson (2017)	e-mail		Electronic display tools, Electronic meeting systems, Video & Audio onferenceing		
Mukherjee & Natrajan (2017)	Blog, Yammer	Facebook, Google drive/Docs,	Disscusion Boards, Google Hangouts, Yammer		Google drive/Docs,
Ritika Tiwari (2018)	Asana, Basecamp		Trello, Slack		Trello, Slack
Orta-Castañon et al. (2018)		Dropbox, Onedrive, Google Drive/Docs, Facebook	Skype, Webex, Snapchat, Chat, Google Hangouts, Facebook live		LMS, Google Drive/Docs
Overview Features	**-Personal storage -Resources -Task & time Management**	**Template**	**Shared space**	**Compete area**	**Research Tool**
Synthesized process	**Diverse Inspiration**	**Sharing Empathy**	**Generate Idea**	**Compete Prototype/ Solutions**	**Pilot /Testing**

RQ 2. How the multidisciplinary team performed in the process of Design Thinking?

The observation and interview are based on the framework of the Process, (People) Team, and Technology in the Design Thinking for the mini-courseware of the Multidisciplinary team which are explored in the dimensions of Context, Team structure, in the process of Design Thinking (Kirkman et al., 2002; Powell et al., 2004; Shaw, 2012; Zimmer, 2015; Ghiringhelli & Lazazzara, 2016)

Context & Team Structure: Twenty three participants, Master degree program from different background; Psychology, Information Technology, Instructors, Business, Computer scientist, Trainer, and Marketing. They enrolled in the Class of 2019, Educational Technology. The objectives of the class are to design a mini-courseware incorporating to a Learning Center to serve various kinds of targeted learners such as Primary school students, Undergraduate students, and Life-Long Learners. In the orientation session, the Design Thinking process was explained and Communication tools were suggested for members to review and agree upon.

Communication Technology: Toolkits were introduced. Main features are Web Blog of the project consisting of: Individual and sub-group profiles; Project Management, "Persona" Template, Online Sticky Note, Whiteboard (JamBoard), Survey tools.

Table 3 Members, design task in the Virtual Multidisciplinary Team

Sessions	Total of 21 members	Disciplines
Identy: what's a matter!	3	Psychology, Information Technology, Instructor
Open thinking for creativity	3	Teacher, Sciencetist, Business
Digital Teachers	3	Teacher, Computer Science, Management
Inter-generation in a Co-learning space	3	Business, Trainer, Information Technology
Language Market	3	Teacher, Computer Science, Business
Go Gamification	3	Teacher, Marketing, Computer Science
ICT Integration	3	Teacher, Trainer, Information Technology

Process

Diverse inspiration: participants put their profiles on the web projects and expressed their inspirations and their opinions on the mini-courseware design project. Later, members decided to join the sub-group themselves into 7 groups in a total of 21. Two could not decide to be members of any teams due to their feelings of lacking a proper knowledge to join the project.

Team structure: The leaders form themselves for each sub-group and the whole project. The timeline and task was proposed and leave a week for members to agree, add opinions, or adjusted.

Communication: Communication among themselves were not often, unless the deadline was approaching.

Sharing Empathy: Members were trained and provided resources for the end-users interview. They worked as a group, making a decision on the questions to explore. Then, they worked in a pair and switch, using video conference to interview with the end-users. Individually, the team member wrote the data onto the template. As a group, they interpreted the data together and share with other groups.

Team structure: Members whose expertises are not in the area of Information Technology and Computer Science/Engineering take the lead with a support from members from Social Sciences interpreting and synthesize the insights of users' feelings leading to solutions or opportunities for change.

Communication: Sharing online Template “persona”; individuals in the team wrote the data very similar. Few data were slightly different from others.

Generate idea: A structured brainstorming process occurred over an asynchronous mode of communication. Taking one provocative question at a time via an online canvas, coding by color. Members freely generate ideas via an online Post-It note which allow for visual image and other media to be linked. Eventually, members categorize those ideas in the same shade of color, and naturally the ideas are ranked. This lets the group move into a process of grouping and sorting ideas.

Members put their own idea on the sub-group and share to the other group members. Using an online sticky note, others came to comments, clarify and adding more resources.

Team structure: Members voluntary expressed and disseminate their ideas; while responded to other comments.

Compete Prototyping/ solutions: A blog of team project displayed 5 learning activities and 2 wireframes; open

Team structure: As a team, members in a sub-group responded to the comments and suggestions of other teams. Meanwhile, working as a commentator, individual member accessed other group works and contributed their opinions.

Communication: There are some problems when an individual had to perfrom two functions as an evaluator and designer. Not all of them comments others, either responded to other members. The rating was offered by members from other groups.

Pilot/testing: The E-questionaires were distributed to the potential end-users to gain their opinions, including a couple follow-up interview. Some notices on the results were put to the comments on the blog for further improved.

Team structure: Members as a team of multidisciplinary acts as a research team; coordinate the results.

Communication: Face-to-face is required from the members to clarify the whole process before further improvement.

Discussions

1. Diverse Inspiration: The multidisciplinary team was formed, acquired by a specific cognition and social-emotion in a sub group.

1.1 Team confidence and trust must be earlier established with the team. The members selection to the team will help members to matched themselves and show their interpersonal skills to be taken to the sub-group. Members represented their expertise and eventually be selected from the subgroup. The selection of virtual team members is the selection to fit both expertise to match the task and interpersonal skills to be in the selected group. Interpersonal skills especially cultural awareness are more important as team members attempt to communicate effectively without relying on traditional non-verbal cues (Kirkman, 2002).

1.2 Task & time management: Member recognition as unique expertise and contribution to the group will have consistently appeared on the group task & timeline. This stage is adapted to be a loose structure of the virtual multidisciplinary team that should be distributed and not strictly hierarchical structuring. Task and timeline, however, will support communication in the sub-group/community, leading and structure the work to be structured and followed by the group (Kirkman et al., 2002; Powell et al., 2004; Shaw, 2012; Zimmer, 2015; Ghiringhelli & Lazazzara, 2016) Team leader is still needed nominated by the members who for see the challenges of the lead the activity over the non face-to-face with his/her special characteristics. The discussion on the team leader who must have both task-related and socio-emotional strength to accommodate the cultural, experiential, and distance differences of virtual teams (Ford, Piccolo, & Ford (2017).

1.3 Communication: Towards the communication in the context of the virtual multi-disciplinary team; Technology as a "task & time management" features support the task structuring, direction, feedback; as appeared

in the Bal and Gundry model (Ghiringhelli & Lazazzara, 2016) identified the areas in relation to team members such as team objectives for group motivation, meeting behavior derived from the trust, reward structure claimed by motivation and goal setting, and team selection occurred by supporting culture. In relation to technology, appropriate technology is selected to facilitate team effectiveness through a compelling communication channel (Ford, Piccolo, & Ford, 2017; Serrat, O., 2017; Alsharo, M., Gregg, D., & Ramirez, R. (2017)

In addition, group communication via a group "task & timeline management tool" instantly notice the updated task of the group. The rapid responses by the system will stimulate team members for the reliable group performance. While personal and sub-group communication consistently follow-through will established the "trust" and "motivate" and bring up social existence that caused an awareness of the socio-emotion in the group (Kirkman et al., 2002)

2. Sharing Empathy: This process of the group to experience the real users' problems.

Originally, at the inspiration phase, designers look for the opportunities with the current status of users' needs by observing and collecting insightful data from the users (Brown, 2019). At the stage of diverse group inspiration, the focus is shifted from the end-users to the multidisciplinary team. The purpose is to draw the pictures of users' problems from different angles of expertise of the team. The team represents the end-users', extreme points of view of problems and turns to a provocative ideas. An awareness of the diversity of the group, and welcome and persuade the group to the ultimate outcome. A clear and precise goal is announced on the homepage of the team. The group task is analyzed and along with the sub-team responsibility and timeline must be a group communication.

2.1 Persona: Using the "persona" technique (Brown, 2009), members from their perspectives will have experience in an insightful of the end-users. Empathy brings in the centerpiece of a human-centered design process from multiple perspectives in intrepreting how end-users perceive the problems (Standford, 2012). Similar to a qualitative research approach that is a scientifically gather non-numerical data. The "Sharing Empathy" discloses why and how a certain phenomenon occur and can be employed across all disciplined. This method will help understanding end-users needs, through an observation leading to empathy, insights and analysis, gaining an unfiltered understanding of the user's experience, abilities, and constraints. (Glen, Suciu, Baughn and Anson, 2015). Eventually, the "Sharing Analysis" will be analyzed breaking apart the root causes of a problem from multiple perspectives.

2.2 Problem oriented: The Communication Tool that supports analysis of problems and causes, cause-effect online collaborative diagram facilitate generative brainstorming from different points of view of the interdisciplinary group, rather than quickly jump into solutions. This problem orientation activity supports team to timely explore the problem from many different viewpoints, thereby remaining in the problem space for longer (Lawson, 2005 cited in Gachago, Morkel, Hitge, van Zyl and Ivala, 2017)

3. Idea generation;

At this stage, idea generation of the multidisciplinary team was brought into attention. This stage coincided with the work of Brown (2008) who proposed a divergent thinking from multidisciplinary; per se members from psychology, business/marketing, engineer. He postulated the "T-shaped" member; the vertical line-an individual with a depth skill, and the top of the "T" comes from openness, curiosity, and optimism from other people and disciplines. Technology supports idea generation and convergence easily present with color coding, simply as an online sticky notes, visual aids. (Brown, 2009). The colorful sticky notes could be easily rearranged, converging the idea, and move to other walls (online) (Ford, Piccolo, & Ford (2017). Visualization will help sense-making for information become meaningful. Visual aid serves as a tool in grouping pieces together a myriad of unorganized explicit artifacts in a memory for logically compare and contrast. It will spark a mental connections through a various perspectives of members (Glen, Suciu, Baughn and Anson, 2015). One best practice similar to the "Sharing space" that displays ideas to be mended together. An example of "InnoCentive" website, non-profit and business company involvement, allows currently more than two-hundred-thousands of members with multi-disciplines around the world to challenge and reward effective design solutions.

4. Competing Prototyping

Seven design outputs from the process of thinking from multi-disciplinary team found to be provocative as the thinking had been through the divergent and convergent thinking. Prototype is a step to make a convergent idea to be concrete. It is an iterative generation of artifacts intended to answer questions that getting closer to the final product/solution (Stanford, 2012). Competing Prototype elicit useful opinions from team to be refined and improved.

5. Pilot Testing

This stage could be a pre-execution to the vision and trial by end-users. The pilot/testing mode is beneficial for feedback about the prototype. It is literally opportunity to gain empathy for targeted end-users. An electronic assessment system could embarrassed a direct report from all perspectives of users and other teams (Kirkman, 2002). At this point, the design could iteratively to the prototyping or either bounced back to the Sharing Empathy process, acquired insightful of the end-users and redefined the problems, and work again through the ideate cycle. If the prototype could go far further than the testing of idea but interaction with users, elicit questions should remain "how" and "why" end-users have trouble with. The testing requires more than technical rationality of the courseware.

It could also a group reflection in action with other professions (Glen, Suciu, Baughn & Anson, 2015). The testing process is a reflective practice and should be continuous to promote a professional skills and resilience (Gachago,et.al.,2017; Lawson, 2015). This pilot testing could help minimizing the so-called by Taheri et.al. (2016) "creative overconfidence" caused by a lack of competence skills, overemphasis on technologies and tools rather than practices. Roles of team leaders facilitate members to genuinely and positively contribute towards the success of the team. Brown (2008) mentioned the "Design Thinking" is never ending cycle thought, thinkers (Multi-disciplinary) will never stop generating and competing idea.

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