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Utilizing Design Thinking to Enhance Wellbeing in Interdisciplinary Courses: A Positive Social Psychology Approach

Areej ElSayary
Zayed University, areej.elsayary@zu.ac.ae

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Utilizing Design Thinking to Enhance Wellbeing in Interdisciplinary Courses: A Positive Social Psychology Approach

Areej ELSAYARY
Zayed University
Abu Dhabi, United Arab Emirates

ABSTRACT[1]

Design thinking is considered to be a positive social psychology intervention. Students who practice using the design thinking process during their coursework will most likely solve personal problems that improve their well-being. This study investigates the impact of using the design thinking process in interdisciplinary courses to enhance students' well-being through developing mindsets that enable them to solve their problems and set personal goals unconsciously. A modified PERMA-PH model is used to guide this study. The PERMA included Positive Emotions, Negative Emotions, Engagement, Relationship, Meaning and Purpose, and Accomplishments, the "PH" (future plans and health) was added to the PE to ensure continuity of students' capability in improving their well-being. The participants (n=38) were undergraduate female students (preservice teachers) at a Federal University in the United Arab Emirates (UAE). A sequential mixed-method approach using quantitative and qualitative data was used. An online survey with closed-ended items was adopted to collect data from participants. The qualitative data were collected using semi-structured interviews with six students. The study's results reveal that students improved their well-being when engaged in the design thinking process during their reflection in the interdisciplinary courses, and expectations of continuing to improve their well-being occurred.

Keywords: Design Thinking, well-being, Intervention, Positive Social Psychology

1. INTRODUCTION

One of the main goals of the United Arab Emirates (UAE) government is to become one of the happiest nations in the world by the 50th anniversary of its nationhood in 2021. Accordingly, policies, programs, and partnerships at the local and international levels were initiated to improve the well-being of all public and private sector industries in the UAE. Within this context, the awareness and application of positive education have been implemented across the UAE's public and private schools. With the guidance of the Minister of State of Happiness and Wellbeing has undertaken a pilot project in 2018 to train public school teachers in positive education practices. However, an unexpected pandemic occurred in March of 2020, which caused the education and business sectors to shift toward online, and adjustments to the nature of work were made.

Many questions have been raised about life after COVID-19, competencies needed for the new demands of jobs that do not yet exist, social/emotional development of individuals, individuals' well-being, and people's engagements in online, blended, or face-to-face work. The unfortunate situation of the COVID-19 pandemic occurrence has negatively impacted the world economy, job markets, education, and mental health [1]. This is due to the government's decision to have mutual goals to prevent the virus's spread by maintaining social distance and avoiding face-to-face interactions [2]. One of the reports in the UAE stated that there are high-stress levels, long work hours, and more exposition to screen time among students, teachers, and administrators [3]. In the UAE, universities were constructed by the Ministry of Education (MOE) to reduce going to the campus and replace in-class teaching with distance learning.

In 2019, before the pandemic, it was reported in the Arab Youth Survey that 54% of young Arabs believe that it is difficult to access medical care for mental illnesses such as anxiety or depression [4]. The Economist Impact (2022) report stated that neuropsychiatric disorders contribute an estimated 19.9% of the burden of disease in the UAE, and 75% of these psychological conditions are associated with depression and anxiety [5]. A previous study mentioned that students are more likely to experience depression and anxiety than the general population [6]. World Health Organization WHO (2021) stated that 50% of mental health problems start by age 14 and 75% by age 24. Given that 34% of the UAE population is under the age of 25, mental health promotion, prevention, intervention, and treatment are on the agenda of government authorities [7].

The COVID-19 pandemic has compounded the mental health challenge, depriving people of social relationships and fostering feelings of loneliness and sadness [8]. In the future, mental health issues will be treated the same as medical issues. In addition, employers will start to realize that employees' mental well-being is critical for business continuity. More effective treatment strategies will be adopted when early identification of the problems and early interventions are facilitated [9]. Tedros Adhanom Ghebreyesus, the director-general of the World Health Organization (WHO), stated that one of the core elements of our response to the COVID-19 pandemic is the mental health needs where a failure to take individuals' emotional well-being seriously will lead to long-term social and economic costs to society [10].

After the traumas of the pandemic, well-being has assumed greater importance in individuals' work and social lives, where solving personal problems could be the starting point. In order to navigate this changing world, there is a need for an intervention that tackles problems and generates successful outcomes. Some studies mentioned the importance of using the design thinking process as an intervention to solve individuals' problems [11, 12, 13]. However, not all individuals are trained to think or solve their problems using design thinking. Previous studies suggested that when the design thinking process is continuously used as an intervention to solve real-world problems within the coursework, students are most likely to use it in solving their problems [12, 14, 15]. Students must develop design thinking mindsets that enable them to solve their problems unconsciously and manage their mental health problems [15]. Therefore, one of the solutions is to start with students at an early age to integrate the design

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thinking process within their coursework. Accordingly, this study investigates the impact of using the design thinking process as a positive social psychology intervention on learners' well-being. The study seeks to answer the following questions that would fulfil the main purpose of the study:

1. How does using the design thinking process can impact learners' well-being?
2. What are the learners' perceptions of their well-being in applying the design thinking process in their courses?

2. INSTRUCTIONAL DESIGN FRAMEWORK

Theoretical Framework

Social psychology is defined as the scientific study of people's thinking, influencing, and relating to one another. In 1954, Gordon Allport stated that *social psychology* understands and explains how people's thoughts, feelings, and behaviours are influenced by other individuals' actual, imagined, or presence [16]. On the other hand, *positive psychology* is defined as the science and practice of improving well-being [17]. However, it has attracted criticism, among which it pays insufficient attention to the social context of well-being [18]. The field of positive psychology has focused mainly on creating individual interventions that are meant to have an emphasis on strategies and tools to develop psychological skills that fall within the compass of planned activities [19]. From an applied psychology perspective, there are increasing efforts to develop strategies that promote well-being at a social level, referred to as "Positive Social Psychology" [17].

Design Thinking (DT) is a human-centred approach to innovation and problem-solving. By applying design thinking principles, individuals will feel empowered to stretch creatively, understand problems and possibilities, and generate specific actions that have a real impact. The power of the design thinking process is influenced by positive social psychology in understanding the process's strengths and limitations, gaining greater insights into the individuals' needs, and impacting their well-being. This study sought to consider the positive social psychology intervention using design thinking that influences individuals' well-being. Previous studies suggested that when design thinking is continuously used as a process to solve real-world problems, students unconsciously use it in solving their own problems [12, 14, 15]. The design thinking process is used as a process of students' learning in interdisciplinary STEM courses in a federal university in the UAE to enhance their learning and develop mindsets that enable them to solve complex problems even on a personal level.

Design Thinking as Positive Social Psychology Intervention

Design thinking (DT) is a multidisciplinary human-centred innovation approach described by how design thinkers understand human needs, rapid prototyping, and generate creative ideas that will transform the way they develop products, services, processes, and organizations [20, 21]. It aims to transcend the problem's immediate boundaries to ensure that the right questions are being addressed. It employs divergent thinking to find many possible solutions to the problem and convergent thinking to narrow the focus to the best solution. The benefits of design thinking are viewing problems from multiple perspectives, diving deeper into a problem, innovating creative ideas, solving problems, and encouraging iteration and revisions. It is also used to find solutions for stress and burnout in the healthcare workforce [22].

The following steps are used within design thinking to solve complex real-world problems: empathize, define, ideate, prototype, and Evaluate [23]. Empathize is listening to as many voices as necessary to understand and gain a clear image of the problem's root causes or the stress and burnout. Define is to draft a clear statement of the problem where it can be shared with stakeholders to provide constructive feedback. Ideate is to propose ideas and create a broad range of potential solutions. The prototype is to ask a leading question, whittle down the large pool of proposed ideas, and test them to check their validity. Finally, evaluation is to report and share the tested ideas with stakeholders to receive constructive feedback where there is space for improvement if needed. This five-steps process is considered a highly creative problem-solving approach that requires a specific mindset. Fraser [24] describes the designer's mindset as openness, empathy, intrinsic motivation, mindfulness, adjustment, and optimism. It is described as the orientation toward the work with the mentality in which problems are approached. It is also defined by elements like being experimental and explorative, ambiguity tolerant, optimistic, and future-oriented. The novelty and intellectual merit of the design thinking intervention aim to positively impact Learners' well-being [12].

Elements of Wellbeing

Well-being is the combination of performing well and feeling well [25]. Well-being consists of three main components: emotional, social, and psychological [26]. Well-being is a psychological construct that operates through rewards, positive relationships with others, feeling good or confident, and believing that life is meaningful and purposeful. Furthermore, the cognitive and affective appraisal of one's life is considered to be his/her reference in being satisfied or not [11]. Thus, the perceptions of the extent of life satisfaction could be a valid measure to assess a person's subjective well-being [27]. The PERMA model introduced by Seligman [29] is one of the most popular models to measure well-being among children, adolescence, and adults. The model proposes five main elements derived from the essence of positive psychology that can be incorporated into schools' curricula and promote students' well-being.

The five elements of well-being are positive emotions, engagement, relationship, meaning, and accomplishments. *Positive emotions* such as happiness, gratitude, contentment, and joy are connected to greater life satisfaction and well-being [28] [29]. Positive emotions bring remarkable resilience and a broader viewpoint of possibility and even help us sleep better [28]. In other words, the positive emotions element of well-being is about having a pleasurable life [29, 30]. *Engagement* is an activity in which we all are involved and are "in the zone" [29, 31]. Although the engagement activities seemed effortless, they contributed to the well-being. *Relationships* are essential to human thriving. Research has demonstrated that living and working in social isolation increases someone's chances of early mortality at a much higher rate than smoking, alcoholism, or obesity [32]. From the perspective of human-centred designers (design thinkers), it is imperative to focus attention on others to have a life worth living [33]. In the long run, some sense of *meaning* is vital as it involves living one's values of meaning where one's life makes sense, matters, and has a purpose even during the struggle [34]. *Accomplishment* is significant for human beings to flourish as individuals; they need to have goals, the motivation to pursue them, and the ability to generate pathways to reach them [35]. The goals do not need to be long-term, but individuals need to be

willing to try something new and risk failure to innovate [36]. This is because when people experience personal achievement, greater well-being occurs when they can capitalize on and savour the achievement, not just move on to the next project [37, 38]. That sense of achievement ultimately leads to a happier life and satisfaction.

A lot of research evidence demonstrated the positive impact of the PERMA model in promoting well-being in emotions, relationships, academic motivation, and skills [29, 39]. In addition, the PERMA model has demonstrated its applicability in genuine schools and classroom settings [11, 40, 41]. There are numerous ways of categorizing the primary elements of well-being. In this study, the five-model domain of well-being (positive emotions, engagements, relationships, meaning, and accomplishments) created by the father of this field Martin Seligman [29], will be used to measure students' well-being. In addition, two more elements (Future plans and Health) were added where the researcher seeks to investigate students' continuity in improving their well-being, as shown in figure 1.

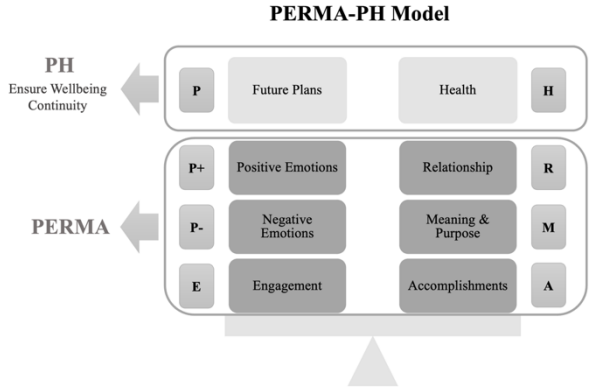


Figure 1. A modified PERMA-PH model

3. METHODS

The study sought to consider the positive social-psychological intervention of using design thinking in improving learners' well-being. Creswell [42] stated that the mixed-method design is an advanced design that uses several data collection that examines the same phenomena. This study adopted an explanatory sequential mixed-method design, starting with a quantitative method (students' survey) and then followed by a qualitative method (semi-structured interviews). The rationale of this study is to seek the development of the results from one method with other methods' results, including sampling and implementation.

Participants

The study's participants are undergraduate students in the College of Education at a Federal University in UAE. The intended sample size is randomly selected from 50 undergraduate students from two campuses in the UAE. The criteria set for the participants are defined as: (i) should be enrolled in the interdisciplinary education courses (STEM), (ii) registered in practicum courses, and (iii) willing to participate in the study. All participants were female students with an age range of 18-25 years old. As per Cohen's [43] power table for effect size *d,* an average was estimated of [*d*=] 1.0 with alpha set at .05 and power (1-beta) set at .08; a sample size of at least 30 participants was needed. In order to confirm the study's participant selection, the sample power was measured using the Statistical Package of Social Sciences (SPSS) to be 1.00 using a sample size of 38 participants and $p<0.5$. the power analysis is greater than 0.8, considered high, as per Cohen [43].

Instrumentation

Learners' Survey

The undergraduate students' survey was used to collect quantitative data. The survey has two main sections: demographic information, where the selection criteria were decided, and their perceptions about their well-being in the interdisciplinary STEM courses where they used the design thinking process. In the first section, multiple-choice questions were used to ask participants about their age, STEM courses enrolled, and practicum courses registered. The second section asks participants about their perceptions of the well-being elements (PERMA-PH) with five items in each category to include 40 items distributed on the following: positive emotions, negative emotions, engagement, relationship, meaning and purpose, accomplishments, action plans, and health. A five-point Likert scale was used as the following: 5-Strongly agree, 4-Agree, 3-Neutral, 2-Disagree, 1-Strongly disagree.

Regarding the content validity, the survey was sent to two educational experts in positive psychology to share their feedback on; (i) the suitability of the instrument for the purpose of the study, (ii) the appropriateness of the items to which they belong, each category; (iii) accuracy of the language used. The suggestions received from the reviewers were about rewording a few items, splitting the emotions into positive and negative categories, and adding two sections (action plans and health). Accordingly, the survey was edited to use a modified model of PERMA to be PERMA-PH, where the action plans and health were added to form eight categories in total, with five items in each category. After changes were done, the final version was sent again to the experts to give final feedback. Then, the survey was sent to participants with no further changes done.

The internal consistency coefficient (Cronbach's Alpha) was used regarding reliability. The reliability coefficient for all the survey sections was α=.911, with the following values in each category: positive emotions (α=.772), negative emotions (α=.877), engagement (α=.701), relationship (α=.818), meaning and purpose (α=.862), accomplishments (α=.849), action plans (α=.876), and health (α=.919). Although the engagement category is considered the lowest value, the overall and other categories' values are high. Accordingly, the survey is considered to be suitable for the study and was administered to the students through a web survey.

Semi-structured Interviews

The interviews were conducted after collecting the survey data. Six interviews were held online, with participants selected randomly. Open-ended semi-structured questions were used in the interviews to narrow the lens and investigate the participants' perceptions in more depth. The interviews were conducted online using Zoom conference meetings ranging between 30 – 45 minutes with an average of 40 minutes. The questions were sent to two educational experts to determine the face validity and clarity. The experts compared the questions to the purpose of the study and commended them. The questions were listed as follows:

Q1: What was the most satisfying moment you had during your study in the interdisciplinary courses?

Q2: What challenges did you face during your study in the interdisciplinary courses, specifically the last two years?

Q3: What lessons did you learn from this experience?

Q4: What actions will you plan for in the coming years?

Procedure

This study is designed to use an explanatory sequential mixed method, in which quantitative data is collected first, and qualitative data is collected at the end of the second semester. The quantitative approach is used to collect data from undergraduate students using a web survey to address question 1 (How does the use of the design thinking process impact learners' well-being?). Then, the semi-structured interviews are used to address research question 2 (What are the learners' perceptions of their well-being in applying the design thinking process in their courses?).

Participants received consent forms at the beginning of the semester, and a full explanation of the study's purpose was shared. Participants received a web-survey link at the end of the second semester of the academic year. The descriptive statistics were used to present each group's mean and standard deviation and a one-sample t-test. The Shapiro-Wilk test of normality was run to determine if the study sample's size (n=38) is sampled from a population that follows a normal distribution. After confirming the normality test of the sample, a one-sample t-test is used to compare participants' mean scores to a specific value identified by [44] questionnaire score range. The hypothesized value identified in the one-sample t-test is the average score (i.e., 3-neutral) to determine if the participants' mean score is significantly high after using design thinking as a process of learning in interdisciplinary courses.

Six semi-structured interviews were conducted through Zoom meetings with an average of 40 minutes duration. The participants' responses were interpreted to provide rich textual data clarification based on the questions asked during the interview. The main purpose of conducting interviews was to let participants freely express themselves by reflecting on their experiences. In addition, the results were analyzed and integrated with the quantitative results to avoid any bias in collecting one type of data. The Research Ethical Committee has approved the study of Zayed University. The Ethics Application Number: ZU22_069_F.

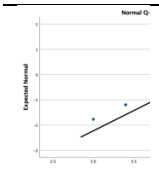
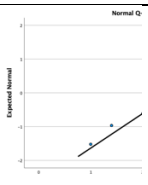
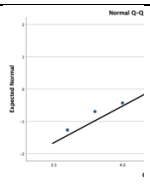
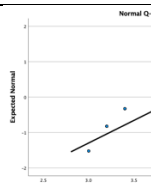
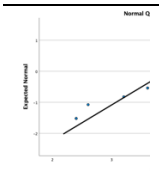
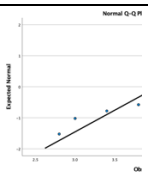
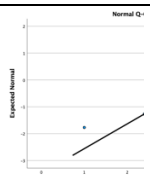
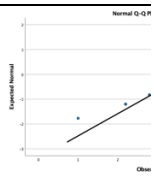
4. RESULTS

Survey Analysis

In order to determine the significant differences in students' perceptions about their wellbeing, a one-sample t-test was used. Since the Likert-scale was used in this study, the predicted point was set as the midpoint of the range of data (i.e., 3-neutral) [42]. The data sets must be independent of each other and show a normal distribution in order to be able to perform the one-sample t-test. The *q-q plot* for all data and factors (positive emotions, negative emotion, engagement, relationship, meaning, achievements, future plans, and health) are presented in table 1.

Table 1

Normality tests of PERMA-PH model and total *(q-q Plot tests).*

Positive Emotions	Negative Emotion	Engagement	Relationship
			
Meaning	**Achievements**	**Future Plans**	**Health**
			

In table 2, the one-sample t-test shows that the null hypothesis (no significant difference between the expected mean and the realized mean) is rejected with a confidence interval of 95%. In examining the difference between the averages, it was observed that there is a significant difference of more than one item choice of positive emotions, engagement, relationship, and achievement with a value of 1.39, 1.23, 1.01, and 1.04, respectively. Furthermore, there was a difference of over a half of an item choice between the means of each of the following categories: meaning, plans, and health, with a value of 0.93, 0.77, and 0.77, respectively. However, one item shows less than one, which is negative emotion, with a value of -0.40.

Table 2

One-sample t-test of the overall PERMA-PH

One-Sample Test							
	Test Value = 3						
			Significance		Mean Difference	95% Confidence Interval of the Difference	
	t	df	One-Sided p	Two-Sided p		Lower	Upper
Positive Emotions	13.725	37	<.001	<.001	1.394	1.188	1.600
Negative Emotions	-2.563	37	.007	.015	-.405	-.725	-.084
Engagement	17.256	37	<.001	<.001	1.231	1.087	1.376
Relationship	7.985	37	<.001	<.001	1.015	.758	1.273
Meaning	6.657	37	<.001	<.001	.936	.651	1.222
Achievement	8.952	37	<.001	<.001	1.042	.806	1.278
Future Plans	4.397	37	<.001	<.001	.773	.417	1.130
Health	4.262	37	<.001	<.001	.773	.405	1.141

Students' opinions about "Positive Emotions"

The one-sample t-test results for the positive emotions were examined to determine that all values were above the forecasted point (3) and were significantly different. As a result, the mean of participants' positive emotions category (M=4.39, SD=0.62) was significantly higher than the forecasted mean (M=3), t (37) = 13.725, p<.001 (d=.626). These results suggested that positive emotions significantly impact students' wellbeing.

Students' opinions about "Negative Emotions"
The one-sample t-test results for the negative emotions were examined to determine that all values were below the forecasted point (3) and were not all significantly different. The mean of participants' negative emotions category (M=2.59, SD=0.97) was significantly higher than the forecasted mean (M=3), t (37) = -2.563, p<.05 (d=.974). These results suggested that not all items in negative emotions significantly impact students' wellbeing.

Students' opinions about "Engagement"
The one-sample t-test results for the engagement were examined to determine that all values were significantly different and above the forecasted point (3). The mean of participants' engagement category (M=4.23, SD=0.43) was significantly higher than the forecasted mean (M=3), t (37) = 17.256, p<.001 (d=.439). These results suggested that engagement has a significant impact on students' wellbeing.

Students' opinions about "Relationship"
The one-sample t-test results for items were examined to determine that all values were above the forecasted point (3) and were significantly different. The mean of the participants' relationship category (M=4.05, SD=0.78) was significantly higher than the forecasted mean (M=3), t (37) = 7.985, p<.001 (d=.784). These results suggested that relationship has a significant impact on students' wellbeing.

Students' opinions about "Meaning"
The one-sample t-test results for the meaning items were examined to determine that all values were above the forecasted point (3) and were significantly different. The mean of participants' meaning category (M=3.93, SD=0.86) was significantly higher than the forecasted mean (M=3), t (37) = 6.657, p<.001 (d=.867). These results suggested that meaning has a significant impact on students' wellbeing.

Students' opinions about "Achievement"
The one-sample t-test results for the achievement items were examined to determine that all values were significantly different and above the forecasted point (3). The mean of participants' achievement category (M=4.04, SD=0.71) was significantly higher than the forecasted mean (M=3), t (37) = 8.952, p<.001 (d=.717). These results suggested that achievement has a significant impact on students' wellbeing.

Students' opinions about "Future Plans"
The one-sample t-test results for the future plans were examined to determine that all values were above the forecasted point (3) and were significantly different. As a result, the mean of participants' future plans category (M=3.77, SD=1.08) was significantly higher than the forecasted mean (M=3), t (37) = 4.39, p<.001 (d=1.084). These results suggested that future plans significantly impact students' wellbeing.

Students' opinions about "Health"
The one-sample t-test results for the health were examined to determine that all values were significantly different and above the forecasted point (3). The mean of participants' health category (M=3.77, SD=1.11) was significantly higher than the forecasted mean (M=3), t (37) = 4.262, p<.001 (d=1.11). These results suggested that health has a significant impact on students' wellbeing.

Interview Discussion
The interviews were conducted online using Zoom conference meetings. The responses were stated below and categorized based on the questions presented. Students mentioned that they had positive experiences using the design thinking process and how this reflected how they thought of themselves and solved their problems.

Q1: What was the most satisfying moment during the interdisciplinary STEM courses?
Students shared their experiences in the STEM courses. They mentioned how the design thinking process helped them accomplish their projects and solve complex problems. They also stated that the continuous use of the design thinking process impacted how they think and act. Some of the responses are stated below:
Student 1: *"Every day is a brand-new experience full of satisfying moments for me. I enjoyed every moment in the class and could communicate with peers even after the class to think loudly with them, support them, and feel supported."*
Student 2: *"Seeing my grades at the end of the semester was a great achievement for me. It was overwhelming during the semester. However, sometimes I felt that I was challenged and excited to solve the problems we had. I am keen to set new goals for myself and aim to achieve them."*
Student 3: *"I thought that I would not get higher grades, but I was able to increase my GPA. I was not expecting to achieve well during learning…..My interests in life and hobbies have changed, and I found myself analyzing my own problems the same way we solved problems."*

Q2: What challenges did you face during your study in the interdisciplinary courses, specifically the last two years?
Students shared some challenges during their studies in the last two years. They mentioned how the quarantine impacted them negatively, but they were able to overcome these challenges through the support received from their instructors. Some of the responses are stated below:
Student 1: *"Having different assignments to submit simultaneously was overwhelming, especially at the beginning of the quarantine, where there was no organization in the assignments."*
Student 2: *"I had a sense of isolation and couldn't communicate with peers. I do not know everyone in my class, as I am somehow introverted. During the quarantine, I felt lost and couldn't find support."*
Student 3: *"There was a time when I had to be a perfectionist, I didn't really achieve my goal of getting "A" grades, and this really affected my mental health; I felt that I was not confident enough to achieve my goals…. It led me to have a type of eating disorder, "Bulimia," I also felt that I didn't have a purpose in life."*
Student 4: *"When we were studying online, sometimes I couldn't understand my instructors' instructions, and it was hard to do my work and follow the requirements. The moment I asked for support, I received it and got feedback to improve my work, which relieved me."*

Q3: What lessons did you learn from this experience?
Students shared some learned lessons during this experience. The most important lesson repeated by most students is that they became independent, and they learned that they have to set measurable and achievable goals and set new plans to follow. Other students mentioned the importance of time management in

planning their tasks and work. Some of the responses are stated below:

Student 1: *"Live each day to the fullest and feel the beauty of what I do, even if it is small tasks… Being engaged in work and achieving something at the end motivates me to set new targets to achieve and think of future plans."*

Student 2: *"I learned that I must do my work as early as possible and not delay it to the last minute. This will allow me to receive the support I need when receiving feedback from others to improve my work…. In addition, the stress level is reduced when I start working early and review my work to improve it when needed."*

Student 3: *"I learned that being engaged in work is enjoyable and motivating; however, I believe that I need to set plans for my personal hobbies and goals. Interestingly, I think in that way….I wasn't organized in the way I do my work, but I feel like I need it and enjoy setting goals."*

Q4: What actions will you plan for in the coming years?

Students shared some action plans to be achieved in the coming years. In addition, they were excited about setting personal goals for their careers or hobbies they wanted to develop. Some of the responses are stated below:

Student 1: *"I will continue learning and enjoy everything I learn. I will think of the purpose of everything I want to learn and how to benefit from it and support others as well."*

Student 2: *"Doing my best and doing whatever I am capable of because it will be my last semester in university, and I want to do the impossible before I graduate. Also, I look forward to working as soon as possible after I finish my internship."*

Student 3: *"It might be weird to share what I am planning for, but I feel interested in designing online courses using the design thinking process and letting students from everywhere communicate and share experiences…..I am interested in art and can teach others how to mix visual art and video production….I know it is something away from my study, but I believe I can combine my study and my hobby."*

5. DISCUSSION

Impact on Learners' Well-being

The first question of the study (How does the use of the design thinking process impact learners' well-being?) was addressed where the use of the design thinking process in the interdisciplinary courses shows a significant difference in students' well-being. In calculating the mean difference, it was mentioned that all PERMA-PH have a significant positive difference except the negative emotions, which showed a significant negative difference, and three out of five items are insignificant.

For positive emotions, all students agreed that they feel joyful, positive, challenged, excited, and satisfied during their course study and positive toward spending time in their courses. This agrees with previous studies that emphasized that positive emotions such as happiness, gratitude, contentment, and joy are all connected to greater life satisfaction and well-being [27, 28].

Regarding negative emotions, some students felt anxious about their work. However, few mentioned that they felt overwhelmed by the tasks they had to do and with the demands of everyday life. It has been evident in a previous study that students are more likely to experience depression and anxiety as compared to the general population [6]. However, most students stated that they did not feel any loneliness or isolation and did not struggle during their studies.

In the engagement category, all students stated that they felt excited and interested in their work and were highly engaged, where they lost track of time during their class time. *Engagement* is defined previously as an activity where learners are entirely involved in and in the zone of engagement [28]. They were interested in activities that expanded their horizons and saw life as a continuous process of learning, changing, and growth. Engaging in interesting activities improves students' well-being [30].

For the relationship category, students stated that they receive help and support from others when they need it and feel loved and appreciated by others. They were also encouraged and supportive toward others and had trust in their friends. Overall, they mentioned that they are satisfied with their relationships. This type of interaction between students and others improves students' well-being and avoids being in social isolation, increasing someone's chances of early mortality at a much higher rate than smoking, alcoholism, or obesity [31].

In the meaning category, students mentioned that they lead a purposeful and meaningful life where they feel that what they do is valuable and worthwhile. Some students felt that they had a sense of direction in their lives and were clear about the purpose of their work. As a result, they felt safe analyzing problems and finding meaningful solutions. These results agree with previous research results that stated the importance of living one's values of meaning where one's life makes sense, matters, and has a purpose even during the struggle [33].

Regarding accomplishment, students felt they were making progress toward their goals. Synder (1994) stated the importance of accomplishments for human beings to flourish as individuals need to have goals, the motivation to pursue them, and the ability to generate pathways to reach them. Most students felt that they had achieved important goals they set for themselves. It was stated that students who try to achieve their goals are more willing to try something new and take a risk to innovate [35]. They were able to handle responsibilities and performed well in their work. They stated that they sought feedback about their work.

In asking about their future plans, students mentioned that they felt motivated to care for and manage their well-being. Most students stated that they have daily habits supporting their well-being. All students were able to change their behaviours to improve their well-being and enjoy making plans for the future and working to make them a reality. It was stated in previous studies that students who experienced personal achievements are more able to set future plans where greater well-being occurs when they can capitalize on and savour the achievement and think of their new projects [36, 37].

Finally, when students were asked about their health, they stated that they were mindful of their actions and felt that they were in good health compared to others of their age. Some students stated that they physically felt strong and healthy and could regulate their emotions. Overall, they mentioned that they were satisfied with their current health. As mentioned by Shoshani et al. [41], well-being is a combination of performing well and feeling well, where the combination of the three main components (emotional, social, and psychological) occurs [25].

Learners' Perceptions

The second question of the study (What are the learners' perceptions of their well-being in applying the design thinking process in their courses?) was addressed when students shared their perceptions and experiences about using the design thinking process in the interdisciplinary courses. Students admitted that the continuous use of the design thinking process in their courses

has impacted the way they think and solve their own problems. This confirms the previous studies' suggestion that when design thinking is continuously used as a process to solve real-world problems, students unconsciously use it to solve their own problems [12, 14, 15]. They expressed how they enjoyed the time spent during their courses and felt that every day was a new experience for them. This is considered to be proof of the presence of positive emotions where gratitude, contentment, and joy are all connected to greater life satisfaction and well-being [27, 28]. Furthermore, they were excited about completing their work in collaboration, where the positive relationship they had allowed them to receive the support they needed and offer support to their peers. Research has demonstrated that living and working in social isolation increases someone's chances of early mortality [31], while positive relationships are essential for learners to have a life worth living [32].

Regarding the challenges faced, some students expressed that the quarantine has impacted them negatively, where they felt isolated in communicating with others and receiving the support needed. This was also highlighted by Thompson & Schonthal [45], who explained how people's thoughts, feelings, and behaviours §are influenced by the actual, imagined or presence of other individuals. Lomas et al. [17] referred to the support and influence received from the presence of others as positive social psychology that promotes well-being. Another challenge shared by students is they were overwhelmed with the number of assignments that needed to be accomplished during the quarantine, and they could not manage the time in order to submit their work on time. In addition, one of the students stated that being perfect in all courses was very difficult, affecting her mental health and causing some depression. Thompson & Schonthal [45] emphasized that developing students' design thinking mindset through proper intervention can enable them to solve their own problems unconsciously and avoid depression.

Students have learned lessons during the last two years where the changes in the way courses were taught have been applied in using the design thinking process in interdisciplinary courses. The lessons shared by students indicated an improvement in their well-being. These results are in agreement with previous studies that mentioned the importance of using design thinking as an intervention to solve individuals' problems [11, 12, 13]. Students shared that they were motivated to set goals and plans to be achieved as they felt the value of being engaged in something they like and the sense of accomplishment. The same results were highlighted by Synder [35], who emphasized the importance of accomplishments for human beings to flourish as individuals need to have goals, motivation to pursue those goals, and the ability to generate pathways to reach them. Other students added that they would not delay their work as they appreciated the feedback received from others when they started working earlier and shared their ideas to improve their work. Kreitzer [14] emphasized that one of the most crucial aspects of the process is to draft a clear statement of the problem where it can be shared with stakeholders to provide constructive feedback. In addition, they emphasized how their stress level was reduced when they started to work on their tasks early. It was noted that when students used the design thinking process, it helped them solve complex problems [23] and find solutions to reduce stress and burnout in the healthcare workforce [24].

Students shared some interesting action plans for their careers and hobbies in the coming years. The results showed how students became mindful of the purpose, meaning, and value of their work, where they stated that they think about the purpose of every task they do. It was stated in previous research that the goals do not need to be long-term, but individuals need to be willing to try something new and risk failure to innovate [36]. Students were motivated and shared how they think out of the box in sharing their ideas. Some students stated that she could make impossible tasks possible to be done, while others shared new ideas of creating and publishing online courses where she combines her hobby and learning. This is considered a development of their design thinking mindsets, where they use the same way of thinking to set personal goals, solve their own problems, and have a purpose, value, and meaning for what they do [37, 38].

6. CONCLUSIONS

The quarantine of COVID-19 has led to a rise in fear, anxiety, stress, and depression among learners. In order to navigate this changing world, there is a need for an approach that tackles problems and generates successful outcomes where learners' well-being is the focus. It has been mentioned previously that students are more than six times more likely to experience depression and anxiety than the general population [6]. Thus, to manage mental health problems, students need to develop mindsets that enable them to solve their problems unconsciously [15]. Design thinking was referred to as an intervention to solve individuals' problems [11, 12, 13]. Therefore, it is significant for learners to learn how to use design thinking from an early age as it will develop mindsets that enable them to cope and overcome challenges that might occur.

This study used the design thinking process as an intervention to be integrated within interdisciplinary STEM courses to solve complex real-world problems in an experiential learning environment. The study aims to investigate the impact of using this intervention on learners' well-being. The PERMA-PH modified model was used to measure students' well-being. It includes eight categories: positive emotions, negative emotions, engagement, relationships, meaning and purposes, achievements, action plans, and health. The study results revealed that students had positively developed design thinking mindsets reflected in their way of thinking and actions to solve their own problems and set personal goals to be achieved. Learners shared some challenges they faced, and it was interesting to understand how the design thinking process helped them overcome these challenges, which led to life satisfaction and improved their well-being.

It is highly recommended to repeat the study with k-12 students as students need to develop their design thinking mindsets from an early age to ensure their well-being development over time. It is also recommended to consider the changes that occurred after the pandemic and how to overcome them to ensure that students receive positive education that can improve their well-being. For future research, it is recommended to include measuring the development of students' design thinking mindsets and their relationship with the well-being elements.

One of the study's limitations is the use of the sequential mixed method, as it required that one method follow the other, and this was challenging for the researcher to determine the point of interference at which the results from the first phase would become the focus of investigation in the second phase. Another limitation of the study was the selected sample, where all learners were female students in this program. Therefore, it is highly recommended to repeat the study considering both genders.

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