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# Delphi Technique in Simulating Innovative Learning Practices: Moderating role of IT Artefacts

Journal of Electrical Systems

***Abstract:*** - Covid-19 turned many organisations' long-term wish lists into essential needs overnight. Therefore, innovative learning factors became an integral part of digital transformation that includes learning, learning to learn, which helps students develop a growth mindset belief system about their abilities. Therefore, the successful application of innovative learning practices depends on the students' readiness towards learning in a new norm. The Delphi technique is a widely used and accepted method for gathering data from respondents within their domain of expertise. The Delphi technique is well suited as a method for consensus-building by using a series of questionnaires delivered using multiple iterations to collect data from a panel of selected subjects. The aim is to collect expert-based judgments and often to use them to identify consensus. The application of Delphi techniques in digital transformation is to discuss the processes of the results. It is anticipated that this model can help institutions of higher education to identify and understand the technology aspects in terms of the right mix of artefacts when assessing the readiness in an e-learning platform. The findings of this research are summarized using systematic reviews of Delphi techniques and examined from a methodological perspective. Five systematic reviews show that Delphi studies are usually accomplished in two to three sets, monitored by the chosen panel of experts. Hence, several revisions to the Delphi technique have now been established. Based on the results, it is obvious that further research is needed to shed light on the methodological approaches and modifications of Delphi techniques. Apart from that, it is also necessary to explain what specific criteria are used to evaluate the quality of their implementation and reporting. The aim of this paper is to review the innovative approach among learners by performing the Delphi technique, and develop an initial conceptual model for design thinking and the technological impact towards innovative learning practices in higher education institutions in .This model is believed to be a future reference for institutions of higher learning education to help understand and appreciate the design thinking approach and the technological impact in terms of artefacts aspects when assessing the innovative learning practices .

***Keywords:*** Delphi techniques, digital transformation, artefacts, innovative learning, design thinking approach.

## I. INTRODUCTION

Covid-19 has pushed the whole globe to transform into a digitalisation process overnight. Therefore, an innovative learning process has become an integral part of the new norm of the education journey among teachers and students[1]. This form of learning has grown into an increasingly important element of the pedagogy implemented in higher education institutions (HEIs). Similarly, the teaching career has also observed a progressive change as it has helped teachers to conduct classes in hybrid or virtual mode instead of physically present in the classrooms.

The evolution of Information system (IS) has various definition. IS3 and IS4 defined IS as "any combination of active objects that deal only with symbolic objects" [2]. Therefore, many institutions thrive to design their learning platform to achieve innovative learning practices. With this, many organizations and learning institutions intend to simplify learning platforms with symbolic objects. Hence artefacts and symbolic objects to be in a smart leaning environment or innovative learning platform became an integral part of the learning environment. Due to technology advancement and pressure for HEI sustainability there is lack of agreement about the factors that shape the right mix of tools for effective learning environment [3]. Thus, there is a lack of consensus about the factors that shape the technological aspects of towards innovative learning practices. Delhi technique is conducted to narrow the gap that is identified in the knowledge on technological aspects particularity implementing IT artefacts as a moderator that as act a cushion between DT processes and innovative learning practices.

Previous study indicated future research needs in team cooperation and learning, as well as student-centered learning opportunities, to provide greater insights into innovation pedagogy [4] ,[5] .As a result, in this paper, experts' consensus is gathered to build an initial model that encompasses each of the identified factors on design thinking that promotes collaborative learning and think like a "designer concepts" by incorporating IT artefacts as a moderation variable to test whether IT artefacts improve innovative learning practices.

The attention of this review centred on applying and reporting the delphi technique. Despite highlighting the importance of measuring the impact of education technology, little has been stated on the factors that can be used as quality indicators to capture the impact of IT artefacts and design thinking approach. Those factors are expected

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to initiate innovative learning practices among students [6]. To this date, there are many types of research published on technological aspects innovative learning. However, no comprehensive review has summarised the available literature on which factors can be utilised to measure the impact of DT approaches which moderated by IT artefacts towards the improvement in innovative learning practices.

The aim of the Delphi Technique is to construct consensus forecasts from a group of experts in a structured iterative manner including the ability to determine the suitability of the application of instructional interventions, forecast trends, and interact with research subjects without being restricted by time and space. Even though the Delphi Technique was originally created for a business setting, it has been used in other environments including educational settings. Its methodology, that comes with numerous intrinsic qualities is believed to be beneficial to the field of educational technology. This study intends to investigate the Delphi Technique, its advantages, and how it could help educational technology researchers. The literature on digital transformation and its competencies in higher education is not extensive, though [7], [8]. Hence, in this research Delphi technique was adopted to review the DT approach towards testing IT artefacts as a moderator in accessing students that applies towards enhancing innovative learning practices.

Data analysis was performed using a quantitative approach for Delphi (Rounds 1, 2, and 3). The Delphi technique is a communication construct utilised to critically review issues on a questionnaire [9]. Even though this technique is widely used for the qualitative survey method, it also has applications in the quantitative research area [10], [11]. This study has employed a quantitative research approach, with the Delphi technique aided in reaching a consensus on the configuration of the survey and research agendas. Expert consensus could help validate the subjective judgment of a quantitative researcher.

***Survey Questionnaire***

**Topic: Design Thinking and Innovative Learning Practices**

(Population: Higher Learning Institute students)

IV1: Empathy - Empathy is the first step in design thinking because it is a skill that allows us to understand and share the same feelings that others feel. Through empathy, we are able to put ourselves in other people's shoes and connect with how they might be feeling about their problem, circumstance, or situation.

1. I believed that my strength and weakness allow me to be creative and accomplish my task in the Learning Management System (LMS).
2. There is clear evaluation in the LMS that measure the differences between how much I know and how quickly I am able to master the subject.
3. I believe it is important to participate in my class in order to reflect and improve ourselves
4. I believe an active participation in the learning process and it has a sense of purpose in the learning environment.
5. I engage in a design thinking approach that helps me in my lessons the feeling of involvement becomes tangible and meaningful

IV2: Define - Define in Design thinking is a non-linear, iterative process that teams use to understand users, challenge assumptions, redefine problems and create innovative solutions to prototype and test.

1. I will define any problem constructively and be proactive to find innovative inspiration in my learning environment
2. It is easy to creatively draft the definition of a problem that I am working on case study /problem
3. The process will shape or change my learning environment that able to help me be more creative
4. I will be able to explicitly define or describe the creative process.
5. It is easy to redefine problems in my learning environment that help me to produce an innovative solution

IV 3: Ideate - Ideation is a creative process where designers generate ideas in sessions (e.g., brainstorming, worst possible idea). It is the third stage in the Design Thinking process. Participants gather with open minds to produce as many ideas as they can to address a problem statement in a facilitated, judgment-free environment.

1. I will be able to identify new ideas and ways to enhance my own creativity without any judgement.
2. I will try an approach to a problem that may not be the final or best solution.
3. Learning should be interactive and builds on new innovative idea for me to achieve my learning outcome
4. I have dialogues with peers that would help me construct my own knowledge on the subject being taught.
5. Using design thinking approach would enhance my idea and creative that improve my effectiveness in my subject

IV4: Prototype – The prototype is by trying to determine how and why specific solution are rejected, improved or accepted. Therefore, students develop a clarity of how the real user would behave, think and feel when interaction with a solution.

1. I continuously work on a problem until I am able to solve it
2. I am able to solve problems that my peers consider it as innovative practice.
3. I will identify the problems and solve constructively to enhance my own innovative learning practices.
4. I will approach my task as a real user and interact with the LMS to achieve a solution
5. In design thinking approach I believe the process of learning is as important as the product attained from learning.

Moderator (MV): IT Artefacts - The IT artefacts are the applications and innovations with technology to support learning task and concepts among students to students, students to teacher interaction (e.g. Multimedia, emojis, learning tools/Learning elements, Virtual Reality Googles, symbols, videos, serious games, mobile apps, and clickers devices)

1. IT artefacts linked lessons are simple and allows me to easily answer each question.
2. Using IT artifacts effectively can help integrate learning activities more effortlessly.
3. IT artefacts reduces rigidity of response by less reliance on rigid use of existing procedures to support my learning.
4. With the proper mix of IT artifacts requires less effort for accomplishing my task.
5. IT artefacts should increase my cognitive absorption with features that enable focused immersion in whatever I am doing

DV: Innovative Learning Practices - Leads to extraordinary improvements. That blend of tools and insight, applied to a learning process, can be thought of as a knowledge supported *technology.*

1. I believe that empathy plays an important role in enhancing innovative learning practices action in my learning journey.
2. I believe that define processes plays an important role in enhancing innovative learning practices and able to master the subject.
3. I believe that ideate plays an important role in enhancing innovative learning practices.
4. I believe that prototype plays an important role in enhancing innovative learning practices.
5. I believe that the integration of IT artefacts in the effort to enhancing innovate learning practices reduces silo mentality that is detrimental to my learning journey and courses.

This study aims to determine whether deploying IT artefacts using the Delphi technique leads to increased innovative learning practices among students in higher education institutions (HEI).

## II. Materials and Methods

To collect data from selected subjects, a series of questionnaires were delivered using multiple iterations with the Delphi technique method. This technique is seen as the most suitable method for consensus-building[8]. The Delphi process can be constantly repeated until it achieves theoretical saturation, reaches its consensus, or when there is adequate information exchanged [13]. In this study, the researcher has employed three rounds of Delphi to collect the needed information and reach a consensus, which normally takes an adequate amount of time [14]. The process of reviewing the moderating effect of IT artefacts using the DT approach helps towards achieving innovative learning practices among students. The initial step was to send a letter of invitation via email to the experts and this resumed until the completion of the analysis of experts' feedback.

The Delphi method is a process that requires a group of experts' decisions or opinions on particular topics that usually involve several rounds of questionnaires, and the accumulated responses are shared and commented on in the group after each round[15]. In this study, the experts have been focusing on the moderating effect of IT artefacts between DT approach and innovative learning.

The experts chosen for this research were based on their: (i) knowledge & familiarity with the subject examined; (ii) capacity & readiness to participate; and (iii) availability to take part in the Delphi process [16]. This study's experts comprised one expert in learning and development specialist from Digital Learning Specialist Sdn Bhd, a research associate (in learning sciences and assessment) from Nanyang Tech University, a director of digital learning experience from Taylor's Digital), a digital learning specialist from Alef Education and consultant from Public Investment Fund (PIF), Saudi Arabia. The central tendency measurement: Medium and Interquartile Range (IQR) was employed to analyse the data.

*Analysis of Delphi Round 1*

The Delphi method involves a series of rounds to achieve consensus in which different activities will occur at each round. Care and attention are crucial to developing the initial broad question that is the Delphi's focus since if respondents fail to comprehend the question, they can give unsuitable answers and/or become irritated [17]. Therefore, in this research, Delphi Round 1 was conducted to brainstorm the process. The experts were asked to suggest rephrasing and provide any rationale for their choices. The proposed changes by the experts are listed in Table 1. The questionnaires, which were distributed to them, were completed and returned to the researcher. The findings of Round 1 are illustrated in Table 2 and round 2 are illustrated in Table 3 below.

**Table 1:** Tracked changes for Design Thinking, IT Artefacts and description

| No | DT, IT artefacts and Innovative learning Practices Factors | Justification from Experts |
|---|---|---|
| 1 | Empathy<br>(Independent Variable) | i) My own strengths and weaknesses are important, hence why I believe it is vital to take into consideration on our own creative work accomplishment.<br>E1: suggested rephrase the sentence by removing the word "why" it's confusing by including the word Why. Double barrel question.<br>***Changed to - I believed that my strength and weakness allow me to be creative and accomplish my task in the Learning Management System(LMS).***<br>ii) There are differences between how much a I know and how quickly I am able to master the subject.<br>E2: Suggest to Include the word LMS or in my learning environment. So, respondent will be able to relate to the research<br>***Changed to: There is clear evaluation in the LMS that measure the differences between how much I know and how quickly I am able to master the subject.***<br>iii) I believe a strong voice in the learning process as well as a sense of purpose.<br>E1, E2, E3, E4, E5 - all suggested to rephrase the question or remove the question. The word voice misleads the question, is it in the classroom or in the LMS<br>***Changed to: I believe an active participation in the learning process and it has a sense of purpose in the learning environment.*** |
| 2 | Define<br>(Independent Variable) | i) I will find sources of creative inspiration not obviously related to a given problem.<br>E1: Rephrased the question relevant to DT approach and Learning environment<br>E3: Remove this question and change to: I am creative to define any problem and solve it easily<br>***Changed to: I will define any problem constructively and be proactive to find innovative inspiration in my learning environment.*** |
| 3. | Ideate<br>(Independent Variable) | i) No issues with the questions all experts agreed with the questions except some grammar errors were corrected |
| 4. | Prototype<br>(Independent Variable) | i) I continue to work on a problem after experiencing a significant failure<br>E1, E3 suggested to remove this question as it reflects negative question.<br>E2, E4 and E5 Suggested to do minor rephrase to the questions as its an important criterion to test. |

| No | DT, IT artefacts and Innovative learning Practices Factors | Justification from Experts |
|---|---|---|
| | | Changed to: I continuously work on a problem until I am able to solve it<br>ii) I solve problems in ways that others would consider creative.<br>E1, E3 and E5 suggest to rephrase this question<br>Changed to:<br>I am able to solve problems that my peers consider it as innovative practice.<br>iii) I will identify and implement ways to enhance my own creativity.<br>E2, E4 and E5 suggest to rephrase this question<br>Changed to: I will identify the problems and solve constructively to enhance my own innovative learning practices. |
| 5. | IT artefacts (Moderator) | All experts agreed to these constructs, provided some grammar suggestions only |
| 6. | Innovative Learning Practices (Dependent Variable) | All experts agreed to these constructs, provided some grammar suggestions only |
| | | E5 – Suggested to have only one language in the surveys questions because it was in English and Arabic. His concern was there cramp with words and it may lead to less respondent, and moreover university students are good in English.<br>So I changed to ONLY English |

*Analysis of Delphi Round 2*

The responses from Round 1 were aggregated and analysed. All the experts were requested to answer the questionnaire, which was arranged on a 7-point Likert scale. This scale was used in this research for several reasons. Firstly, reliability was optimised with seven response categories [18]. Next, Miller (1956) contended that the human mind has a span of total judgement capable of distinguishing around seven different categories. Other studies have stated that a 7-point scale resulted in a stronger correlation with t-test outcomes [19]. In this research, the questionnaire was distributed only via email; therefore, a 7-point Likert scale also appeared to be suitable for electronic distribution (Finstad, 2010). While for Delphi Round 2, data were analysed using central tendency measurement: Medium and Interquartile Range (IQR), whereby the latter was utilised by every item to determine the level of consensus amongst the panel of experts. Finally, items with a lack of consensus were identified. In the present research, the consensus level was divided into three while the importance level had two. The consensus level was recorded as (i) high if the quartile deviation was lower or equal to 1; (ii) medium if the quartile deviation was between 1 and 2; and (iii) no consensus if the quartile deviation was above 2. On the other hand, the importance level was considered very high when the median value was above 6 and low when the median value was 5 or below. In this research, items categorised as highly important levels and with significant consensus levels were utilised to develop innovative learning practices assessment criteria.

Further, the standard deviation (SD) for all the new technology factors were less than 1.00; thus, all the IT Artefacts received a high level of consensus with the mean scores amongst the experts' panel.

In this part of R2, the experts could modify the description some independent variables of design thinking factors, and none of the factors was removed. Only two experts suggested checking the language structure of the description of technological factors; hence, we have reviewed the language structure by proof-reader result.

*Analysis of Delphi Round 3*

The questionnaire of Delphi Round 3 was having a resemblance to Round 2. The consensus was reached in Round 2 and it was agreeable that Round 3 was not necessary. Thus, the outcome of Round 2 was taken as the outcome of Round 3.

**Table 2:** Round 1 of Delphi techniques (Responses from the experts)

The impact of IT Artefacts as a moderator between design thinking factors and innovative learning practices
Analysis of Delphi Round 1
Total Expert Panel is 5

| No | Element/Factor /Item Code | Expert 1 | Expert 2 | Expert 3 | Expert 4 | Expert 5 | Total answer 2 | Total answer 3 | Total answer 4 | Total answer 5 | Total answer 6 | Total answer 7 | Answer "6" and "7" > 50% | Mean scale range 1 to 7 | Median | Q1 | Q3 | IQR (Q3-Q1) | Standard deviation | QD (IQR/2) | Level of Importance (based on Median) | Level of Consensus (Based on QD) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | EX1 | EX2 | EX3 | EX4 | EX5 | | | | | | | | | | | | | | | | |
| | EMPTHY | | | | | | | | | | | | | | | | | | | | | |
| 1 | EMP1 | 2 | 6 | 4 | 7 | 6 | 1 | 0 | 1 | 0 | 2 | 1 | 42.86 | 3.57 | 6.00 | 4 | 6 | 2 | 2.00 | 1.00 | Very High | Moderate Consensus |
| 2 | EMP2 | 6 | 7 | 4 | 7 | 5 | 0 | 0 | 1 | 0 | 1 | 2 | 42.86 | 4.14 | 6.00 | 5 | 7 | 2 | 1.30 | 1.00 | Very High | Moderate Consensus |
| 3 | EMP3 | 5 | 6 | 3 | 6 | 4 | 0 | 1 | 0 | 1 | 2 | 0 | 28.57 | 3.43 | 5.00 | 4 | 6 | 2 | 1.30 | 1.00 | Low | Moderate Consensus |
| 4 | EMP4 | 7 | 3 | 6 | 7 | 4 | 0 | 1 | 1 | 0 | 1 | 2 | 42.86 | 3.86 | 6.00 | 4 | 7 | 3 | 1.82 | 1.50 | Very High | No Consensus |
| 5 | EMP5 | 2 | 2 | 3 | 3 | 6 | 2 | 2 | 0 | 0 | 1 | 0 | 14.29 | 2.29 | 3.00 | 2 | 3 | 1 | 1.64 | 0.50 | Low | High Consensus |
| | DEFINE | | | | | | | | | | | | | | | | | | | | | |
| 6 | DEF1 | 3 | 5 | 3 | 6 | 7 | 0 | 2 | 0 | 0 | 1 | 2 | 42.86 | 3.43 | 5.00 | 3 | 6 | 3 | 1.79 | 1.50 | Low | No Consensus |
| 7 | DEF2 | 2 | 5 | 6 | 3 | 6 | 1 | 1 | 0 | 0 | 3 | 0 | 42.86 | 3.14 | 5.00 | 3 | 6 | 3 | 1.82 | 1.50 | Low | No Consensus |
| 8 | DEF3 | 3 | 6 | 2 | 6 | 7 | 1 | 1 | 0 | 0 | 2 | 1 | 42.86 | 3.43 | 6.00 | 3 | 6 | 3 | 2.17 | 1.50 | Very High | No Consensus |
| 9 | DEF4 | 2 | 5 | 2 | 6 | 6 | 2 | 0 | 0 | 0 | 3 | 0 | 42.86 | 3.00 | 5.00 | 2 | 6 | 4 | 2.05 | 2.00 | Low | No Consensus |
| 10 | DEF5 | 2 | 6 | 3 | 6 | 6 | 1 | 1 | 0 | 0 | 3 | 0 | 42.86 | 3.29 | 6.00 | 3 | 6 | 3 | 1.95 | 1.50 | Very High | No Consensus |
| | IDEATE | | | | | | | | | | | | | | | | | | | | | |
| 11 | IDE1 | 6 | 7 | 3 | 6 | 7 | 0 | 1 | 0 | 0 | 2 | 2 | 57.14 | 4.14 | 6.00 | 6 | 7 | 1 | 1.64 | 0.50 | Very High | High Consensus |
| 12 | IDE2 | 7 | 7 | 6 | 3 | 7 | 0 | 1 | 0 | 0 | 1 | 3 | 57.14 | 4.29 | 7.00 | 6 | 7 | 1 | 1.73 | 0.50 | Very High | High Consensus |
| 13 | IDE3 | 6 | 6 | 3 | 6 | 7 | 0 | 1 | 0 | 0 | 2 | 1 | 42.86 | 4.00 | 6.00 | 6 | 6 | 0 | 1.52 | 0.00 | Very High | High Consensus |
| 14 | IDE4 | 6 | 7 | 2 | 6 | 7 | 1 | 1 | 0 | 0 | 1 | 2 | 42.86 | 4.00 | 6.00 | 6 | 7 | 1 | 2.07 | 0.50 | Very High | High Consensus |
| 15 | IDE5 | 6 | 6 | 3 | 6 | 7 | 0 | 1 | 0 | 0 | 3 | 1 | 57.14 | 4.00 | 6.00 | 6 | 6 | 0 | 1.52 | 0.00 | Very High | High Consensus |
| | PROTOTYPE | | | | | | | | | | | | | | | | | | | | | |
| 16 | PRO1 | 2 | 7 | 4 | 7 | 6 | 0 | 1 | 1 | 0 | 1 | 2 | 42.86 | 3.71 | 6.00 | 4 | 7 | 3 | 2.17 | 1.50 | Very High | No Consensus |
| 17 | PRO2 | 2 | 6 | 3 | 5 | 6 | 1 | 1 | 0 | 0 | 2 | 1 | 42.86 | 3.14 | 5.00 | 3 | 6 | 3 | 1.82 | 1.50 | Low | No Consensus |
| 18 | PRO3 | 3 | 6 | 2 | 5 | 7 | 0 | 2 | 0 | 0 | 1 | 2 | 42.86 | 3.29 | 5.00 | 3 | 6 | 3 | 2.07 | 1.50 | Low | No Consensus |
| 19 | PRO4 | 3 | 6 | 2 | 5 | 7 | 2 | 0 | 0 | 1 | 1 | 1 | 28.57 | 3.29 | 5.00 | 3 | 6 | 3 | 2.07 | 1.50 | Low | No Consensus |
| 20 | PRO5 | 4 | 6 | 3 | 7 | 7 | 0 | 0 | 0 | 0 | 2 | 3 | 71.43 | 3.86 | 6.00 | 4 | 7 | 3 | 1.82 | 1.50 | Very High | No Consensus |
| | IT Artefacts as prescibing action, Practical reasons and as Perception | | | | | | | | | | | | | | | | | | | | | |
| 21 | ITA1 | 6 | 7 | 6 | 6 | 6 | 0 | 0 | 0 | 0 | 4 | 1 | 71.43 | 4.43 | 6.00 | 6 | 6 | 0 | 0.45 | 0.00 | Very High | High Consensus |
| 22 | ITA2 | 7 | 7 | 6 | 6 | 7 | 0 | 0 | 0 | 0 | 2 | 3 | 71.43 | 4.71 | 7.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| 23 | ITA3 | 7 | 6 | 7 | 7 | 6 | 0 | 0 | 0 | 0 | 2 | 3 | 71.43 | 4.71 | 7.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| 24 | ITA4 | 6 | 7 | 6 | 7 | 6 | 0 | 0 | 0 | 0 | 3 | 2 | 71.43 | 4.57 | 6.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| 25 | ITA5 | 6 | 6 | 7 | 7 | 6 | 0 | 0 | 0 | 0 | 3 | 2 | 71.43 | 4.57 | 6.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| | INNOVATIVE LEARNING PRACTICES | | | | | | | | | | | | | | | | | | | | | |
| 26 | ILP1 | 7 | 7 | 6 | 7 | 6 | 0 | 0 | 0 | 0 | 2 | 3 | 71.43 | 4.71 | 7.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| 27 | ILP2 | 7 | 7 | 6 | 7 | 7 | 0 | 0 | 0 | 0 | 1 | 4 | 71.43 | 4.86 | 7.00 | 7 | 7 | 0 | 0.45 | 0.00 | Very High | High Consensus |
| 28 | ILP3 | 6 | 7 | 6 | 6 | 7 | 0 | 0 | 0 | 0 | 3 | 2 | 71.43 | 4.57 | 6.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| 29 | ILP4 | 6 | 6 | 7 | 7 | 6 | 0 | 0 | 0 | 0 | 3 | 2 | 71.43 | 4.57 | 6.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| 30 | ILP5 | 7 | 6 | 6 | 7 | 7 | 0 | 0 | 0 | 0 | 2 | 3 | 71.43 | 4.71 | 7.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |

Legend

Indicators

| Median and interquatile range (IQR) | |
|---|---|
| QD<=0.5 | High Consensus |
| 0.5<=QD<=1 | Medium Consensus |
| QD>=1 | No consensus |

Table 3: Round 2 of Delphi techniques (Responses from the experts)

The impact of IT Artefacts as a moderator between design thinking factors and innovative learning practices
Analysis of Delphi Round 2
Total Expert Panel is 5

| No | Element/Factor/ Item Code | Expert 1 | Expert 2 | Expert 3 | Expert 4 | Expert 5 | Total answer 2 | Total answer 3 | Total answer 4 | Total answer 5 | Total answer 6 | Total answer 7 | Answer "6" and "7" > 51% | Mean scale range 1 to 7 | Median | Q1 | Q3 | IQR (Q3-Q1) | Standard deviation | QD (IQR/2) | Level of Importance (based on Median) | Level of Consensus (Based on QD) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | EX1 | EX2 | EX3 | EX4 | EX5 | | | | | | | | | | | | | | | | |
| | EMPATHY | | | | | | | | | | | | | | | | | | | | | |
| 1 | EMP1 | 6 | 6 | 6 | 6 | 6 | 0 | 0 | 0 | 0 | 5 | 0 | 71.43 | 4.29 | 6.00 | 6 | 6 | 0 | 0.00 | 0.00 | Very High | High Consensus |
| 2 | EMP2 | 6 | 7 | 6 | 6 | 7 | 0 | 0 | 0 | 0 | 3 | 2 | 71.43 | 4.57 | 6.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| 3 | EMP3 | 6 | 6 | 6 | 7 | 7 | 0 | 0 | 0 | 0 | 3 | 2 | 71.43 | 4.57 | 6.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| 4 | EMP4 | 6 | 6 | 7 | 7 | 6 | 0 | 0 | 0 | 0 | 3 | 2 | 71.43 | 4.57 | 6.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| 5 | EMP5 | 7 | 7 | 6 | 6 | 7 | 0 | 0 | 0 | 0 | 2 | 3 | 71.43 | 4.71 | 7.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| | DEFINE | | | | | | | | | | | | | | | | | | | | | |
| 6 | DEF1 | 7 | 6 | 6 | 7 | 7 | 0 | 0 | 0 | 0 | 2 | 3 | 71.43 | 4.71 | 7.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| 7 | DEF2 | 7 | 7 | 6 | 6 | 7 | 0 | 0 | 0 | 0 | 2 | 3 | 71.43 | 4.71 | 7.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| 8 | DEF3 | 7 | 6 | 7 | 7 | 7 | 0 | 0 | 0 | 0 | 1 | 4 | 71.43 | 4.86 | 7.00 | 7 | 7 | 0 | 0.45 | 0.00 | Very High | High Consensus |
| 9 | DEF4 | 7 | 5 | 6 | 6 | 7 | 1 | 1 | 0 | 0 | 3 | 0 | 42.86 | 4.43 | 6.00 | 6 | 7 | 1 | 0.84 | 0.50 | Very High | High Consensus |
| 10 | DEF5 | 7 | 6 | 6 | 7 | 7 | 0 | 0 | 0 | 0 | 2 | 3 | 71.43 | 4.71 | 7.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| | IDEATE | | | | | | | | | | | | | | | | | | | | | |
| 11 | IDE1 | 6 | 6 | 6 | 7 | 7 | 0 | 0 | 0 | 0 | 3 | 2 | 71.43 | 4.57 | 6.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| 12 | IDE2 | 6 | 7 | 6 | 6 | 7 | 0 | 0 | 0 | 0 | 3 | 2 | 71.43 | 4.57 | 6.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| 13 | IDE3 | 5 | 7 | 6 | 7 | 7 | 0 | 0 | 0 | 1 | 1 | 3 | 57.14 | 4.57 | 7.00 | 6 | 7 | 1 | 0.89 | 0.50 | Very High | High Consensus |
| 14 | IDE4 | 6 | 7 | 7 | 7 | 6 | 0 | 0 | 0 | 0 | 2 | 3 | 71.43 | 4.71 | 7.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| 15 | IDE5 | 6 | 7 | 6 | 6 | 7 | 0 | 0 | 0 | 0 | 3 | 2 | 71.43 | 4.57 | 6.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| | PROTOTYPE | | | | | | | | | | | | | | | | | | | | | |
| 16 | PRO1 | 6 | 6 | 5 | 6 | 7 | 0 | 0 | 0 | 1 | 3 | 1 | 57.14 | 4.29 | 6.00 | 6 | 6 | 0 | 0.71 | 0.00 | Very High | High Consensus |
| 17 | PRO2 | 6 | 6 | 6 | 7 | 7 | 0 | 0 | 0 | 0 | 3 | 2 | 71.43 | 4.57 | 6.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| 18 | PRO3 | 7 | 7 | 6 | 7 | 6 | 0 | 0 | 0 | 0 | 2 | 3 | 71.43 | 4.71 | 7.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| 19 | PRO4 | 6 | 5 | 6 | 7 | 6 | 0 | 0 | 0 | 1 | 3 | 1 | 57.14 | 4.29 | 6.00 | 6 | 6 | 0 | 0.71 | 0.00 | Very High | High Consensus |
| 20 | PRO5 | 7 | 7 | 6 | 6 | 6 | 0 | 0 | 0 | 0 | 3 | 2 | 71.43 | 4.57 | 6.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| | IT Artefacts as prescibing action, Practical reasons and as Perception | | | | | | | | | | | | | | | | | | | | | |
| 21 | ITA1 | 6 | 7 | 7 | 6 | 7 | 0 | 0 | 0 | 0 | 2 | 3 | 71.43 | 4.71 | 7.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| 22 | ITA2 | 7 | 7 | 6 | 6 | 7 | 0 | 0 | 0 | 0 | 2 | 3 | 71.43 | 4.71 | 7.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| 23 | ITA3 | 7 | 6 | 6 | 7 | 7 | 0 | 0 | 0 | 0 | 2 | 3 | 71.43 | 4.71 | 7.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| 24 | ITA4 | 6 | 7 | 6 | 7 | 6 | 0 | 0 | 0 | 0 | 3 | 2 | 71.43 | 4.57 | 6.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| 25 | ITA5 | 7 | 6 | 6 | 7 | 7 | 0 | 0 | 0 | 0 | 2 | 3 | 71.43 | 4.71 | 7.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| | INNOVATIVE LEARNING | | | | | | | | | | | | | | | | | | | | | |
| 26 | ILP1 | 7 | 6 | 7 | 6 | 6 | 0 | 0 | 0 | 0 | 3 | 2 | 71.43 | 4.57 | 6.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| 27 | ILP2 | 7 | 6 | 6 | 7 | 7 | 0 | 0 | 0 | 0 | 2 | 3 | 71.43 | 4.71 | 7.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| 28 | ILP3 | 6 | 7 | 6 | 6 | 7 | 0 | 0 | 0 | 0 | 3 | 2 | 71.43 | 4.57 | 6.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |
| 29 | ILP4 | 7 | 7 | 7 | 6 | 7 | 0 | 0 | 0 | 0 | 1 | 4 | 71.43 | 4.86 | 7.00 | 7 | 7 | 0 | 0.45 | 0.00 | Very High | High Consensus |
| 30 | ILP5 | 6 | 6 | 7 | 7 | 6 | 0 | 0 | 0 | 0 | 2 | 3 | 71.43 | 4.57 | 6.00 | 6 | 7 | 1 | 0.55 | 0.50 | Very High | High Consensus |

**Legend**

Quartile deviations (QD) for each item. The QDs are used to identify the level of consensus among experts and based on :

Indicators

| Median and interquatile range (IQR) | |
|---|---|
| QD<=0.5 | High Consensus |
| 0.5<=QD<=1 | Medium Consensus |
| QD>=1 | No consensus |

## III. Results and Discussion

Thirty indicators recorded a high importance rating and no consensus/medium consensus level. These were proposed under two key categories: (i) design thinking factors such as empathy, define, ideate and prototype (ii) IT artefacts towards innovative learning practices. The experts had stated the need to modify the indicators to increase the response rate because it was essential for greater understanding during the data collection process (Table 1). The indicators for IT artefacts and innovative learning practices showed very high importance and high consensus; hence, no changes were required.

After Delphi round 3, the list of design thinking factors and IT artefacts, the hypotheses have been defined as follows:

**H1**: There is a positive relationship between empathy and IT artefacts

**H2**: There is a positive relationship between define and IT artefacts

**H3**: There is a positive relationship between ideate and IT artefacts

**H4**: There is a positive relationship between prototype and IT artefacts

**H5**: IT artefacts leads to an enhance the effectiveness of Innovative learning practices

**H6a:** IT artefacts moderates the relationship between empathy and innovative learning practices

**H6b:** IT artefacts moderates the relationship between define and innovative learning practices

**H6c:** IT artefacts moderates the relationship between ideate and innovative learning practices

**H6d:** IT artefacts moderates the relationship between prototype and innovative learning practices

The initial model concerning the hypothesis is presented in Fig 1. It is still in the preliminary stage, which needs to go through some tests, hence it is called 'the initial model'.

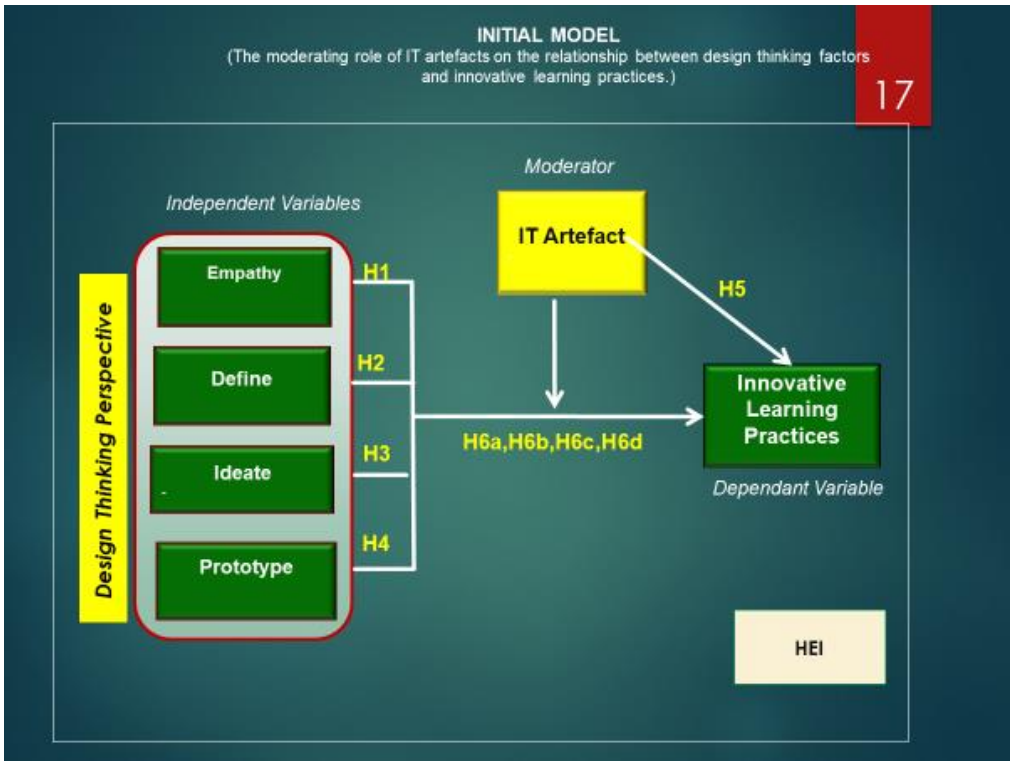


**Fig 1:** Initial model

## IV. Conclusion

The objective of this study is to evaluate the design thinking factors and the mediating impact on innovative learning practices using the Delphi technique. Three rounds of Delphi questionnaires were conducted and 5 experts from the digital transformation and E-learning field were involved in the analysis of the questionnaires. Upon finalizing experts' inputs from the Delphi technique, the findings are discovered that there is high consensus on IT artefacts and it is categorised as an important criterion in towards the contribution to innovative learning practices among students. Therefore, the expert's outcome proves that this model needs to be further analysed empirically and thus it will be a guideline towards improving learning experiences and positively improve the innovative learning practices. It is believed that many higher learning institutions may refer to this model to learn the factors of design thinking and IT artefacts for innovative learning practices. Furthermore, designers and developers can use

this model as a guideline for identifying the requisite IS/IT requirements for innovative learning. Therefore, it is important to develop an instrument for the survey and test the research model for future research. Consequently, this research will be further extended using Smart PLS or SPSS to produce measurement and structural model.

## ACKNOWLEDGEMENT

I would like to express my heartfelt gratitude to the experts' panel of Delphi techniques for their participation and contribution in this study. The feedback and Delphi excel sheet is uploaded in fig share, https://doi.org/10.6084/m9.figshare.27692304

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