

DETERMINING HEUTAGOGY DESIGN ELEMENTS FOR ONLINE LEARNING MODEL USING FUZZY DELPHI METHODS

FAIRUZZA HAIRI^{1*}, SITI NURUL MAHFUZAH MOHAMAD², SAHRUDIN SAAD³, IBRAHIM AHMAD⁴,

¹Lecturer, Politeknik Merlimau Melaka, Jabatan Matematik, Sains dan Komputer, Malaysia

³Lecturer, Politeknik Merlimau Melaka, Jabatan Kejuruteraan Elektrik, Malaysia

²Senior Lecturer, ⁴Senior Lecturer, Universiti Teknikal Malaysia Melaka, Department of Interactive Media, Malaysia

Email : ¹fairuzza@pmm.edu.my, ²mahfuzah@utem.edu.my, ³sahrudin@pmm.edu.my, ⁴ibrahim@utem.edu.my

ABSTRACT

Teaching and learning in computer application courses are being improved by educators as technology continues to change the face of education. For the purpose to promote student participation and self-directed learning, this study investigates how the heutagogical online learning paradigm might be adapted to computer application instructions. The Heutagogy Online Learning Model (HeuLEM) is a model that this research proposes based on heutagogy principles, including the six design elements of heutagogy. It enables learners to take control of their educational process, make knowledgeable choices, and develop critical skills for the digital age. Incorporating self-determined learning, reflection, strong interpersonal skills, and collaborative online tools, instructors can design an engaging and dynamic online learning environment that fosters students' digital collaboration abilities. HeuLeM comprises the theoretical underpinnings of heutagogy and offers helpful implementation tactics for the model in computer application courses. This study is to identify whether the six heutagogy design elements can be adapted to Heutagogy Online Learning Model to enhance the digital collaboration skills of students. A total of 12 experts were selected to analyze the fuzziness consensus of experts. All of the data obtained will be analyzed using the Fuzzy Delphi method. The findings show that all the heutagogy design elements are suitable to be adapted Heutagogy Online Learning Model to enhance the digital collaboration skills of students. The six heutagogy elements that explore, create, connect, share, reflect, and collaborate have reached unity with the threshold value of $d \leq 0.2$ and the percentage of the expert group is more than 75%. Therefore, based on the consensus agreements, the development of Heutagogy Online Learning Model for enhancing the digital collaboration skills of students should be incorporated with the elements of heutagogy.

Keywords: *Heutagogy; Collaboration Skills; Online Learning Model; Fuzzy Delphi; Heutagogy Design*

1. INTRODUCTION

Literature review estimates that the growing complexity of jobs as a result of digitalization. [1]. The current workplace increasingly asks for workers with highly digitally skilled knowledge who produce and distribute ideas and information. The consequent growing demand for higher skilled people would necessarily lead towards an increase in the importance of continuous learning, training and education. A similar revolution needed in education to take advantage of the set of opportunities brought by advanced technology. [2]. Education 4.0 emerges as a response to Industry 4.0 in order to encourage the development of a school of thought committed to prepare qualified, trained and skilled people who are ready for a highly globalized

world and a digital-driven society. Education 4.0 is a desired learning strategy that emphasizes on digital literacy, effective communication, emotional intelligence, problem-solving, and teamwork, and is connected with the approaching fourth industrial revolution [3]. Graduates must have these talents in order to enter the workforce. As a result, graduates must be prepared with 21st-century learning skills. Scholars and policy-makers see educators as central to preparing students to gain the required 21st century skills for the work environment [4]. The competencies and skills of students should reflect the challenges of the society. The combination of information, professional skills, and soft skills, such as digital literacy, problem-solving, and critical thinking, that allows learners to develop lucrative careers in today's workforce is known as 21st

century learning. Learners need these 21st-century skills now more than ever. They not only lay the groundwork for successful classroom learning, but they also ensure that all students can thrive in a world of constant change and never-ending learning. [5]. In light of the importance of these skills in today's world, the Partnership for 21st Century Learning (P21) (2007) and the OECD (2018) collaborated on Education 2030 to translate transcendent competencies and other key issues into a set of specific frameworks that educators can incorporate into their curricula. [6]. As a result, if residents and employees are to be adequately prepared for the twenty-first century, the "Four Cs" must be effectively implemented into courses, institutions, and regions across the country. [7]. Critical thinking, collaboration, creativity, and communication are all part of the "4C" philosophy. [8]. With a shift in perspective, a study discovered that universities should focus on teaching students how to learn rather than building work-related abilities [9]. The heutagogy ideas are based on this learning method.

Heutagogy, or self-determined learning, was developed as a supplement to andragogy, or self-directed learning [10]. Heutagogy, also known as self-determined learning, is a student-centered learning technique that emphasises empowerment, potential, and capacities. Blaschke (2012) proposed integrating the heutagogical approach into a formal learning programme through student-driven and flexible curricula, flexible and negotiated evaluations, and cooperation. Students are seen as active participants in their learning process, rather than passive educators [12](Hase, 2016). This benefit could be one of the key reasons why heutagogy should be used in university teaching and learning.

Heutagogy is a pedagogical strategy that, when considered in the context of Industry 4.0, is in compliance with the objectives and specifications of Education 4.0. For individuals to succeed in a technology environment that is rapidly changing, the Fourth Industrial Revolution emphasises the need for people to develop skills including adaptability, continuous learning, collaborative skills, critical thinking, and creativity.

Heutagogy helps reach these goals by promoting learner liberty and self-directed learning. In Education 4.0, students are urged to take charge of their own learning and get the skills they need to get around in the digital age. Heutagogical approaches

let learners take an active role in the learning process, make well-informed choices about what and how they learn, and change their learning strategies to fit their own needs and interests. In addition, heutagogical practises can be used when digital tools are a part of Education 4.0. Learners can get access to a huge amount of knowledge, work with others online, and use simulations and virtual environments to learn by doing. By analysing and evaluating digital materials, learners can take charge of their own learning, learn about new topics, and improve their critical thinking skills.

In short, heutagogy in Education 4.0 meets the needs of Industry 4.0 by giving students the tools they need to become self-directed, flexible, and lifelong learners. By using heutagogical concepts and digital tools, teachers can help students be successful in the Fourth Industrial Revolution, which is a time of rapid change.

Although the implementation of heutagogy has been documented in various academic settings, there remains a demand for theoretical knowledge. There is a lack of guidance and strategies for implementing the approach in research. [13]. Some of the elements of heutagogy - exploring, connecting, collaborating, creating, reflecting, and sharing that are rarely discussed in all strategies, form a gap in implementing heutagogy in teaching and learning. Therefore, a Heutagogy Online Learning Model (HeuLEM) is proposed and this study aims to see the suitable heutagogy design elements that can be adapted in to enhance digital collaboration skills of students in university with research question "What are the suitable digital design elements to adapt in Heutagogy Online Learning Model?"

2. LITERATURE REVIEW

2.1 Heutagogy Implementation at Universities

Previous studies show that heutagogy implementation at universities are categorized into five themes which are blended learning, ICT, Distance Learning, module/curriculum related and outside classroom activities. [14]. One method for implementing heutagogy at the institution is blended learning. Blended learning, according to N Sari et al. (2020), is a novel technique in the field of education [15]. It was also highlighted that blended learning is an innovative approach which combines face-to-face learning in the classroom with learning supported by ICT, such as offline and online learning. The three blended learning methodologies

are flipped classroom, andragogy, and effective tutoring. The flipped classroom was tested on nursing students, whereas heutagogy was tested on pre-service teachers. Both of these students are full-time university students. Effective tutoring tactics, on the other hand, were tested on adult learners who study part-time.

In addition to efficient tutoring, distant learning with a learner-centric approach to education can be used as a tool to enhance adult learning in distance-learning colleges [16]. Peers were utilised by Green & Schlairet (2017) to elucidate the notion since they claim that flipped classrooms are a case study that is group-based and problem-based [17]. Team teaching was another method used to integrate blended learning techniques in Andragogy by Preece & Hamed (2020) [18]. Heutagogy and the flipped classroom both run counter to effective tutoring, which is done one-on-one by Youde (2019) [19]. These three blended learning approaches demonstrate that, depending on the subject matter and target audience, blended learning with heutagogy can be implemented both individually and in groups. This is due to the fact that blended learning allows students to study at their own pace while also making the learning process more interactive and self-directed through the usage of a heutagogy approach.

ICT strategies are commonly used to implement heutagogy. These include MOOCs, social media, e-learning, and mobile learning. A study by N. A. Kamrozzaman et al. [20] demonstrates the effectiveness of m-learning, which is based on heutagogy approaches to lifelong education. Mobile learning can be done while playing, working, or at home and is not restricted to a classroom setting. Due to the time constraints between teachers and students, the recently launched m-learning facilities are specifically designed to help students in distant education.

M-learning can be used to collaborate on learning with full-time students via social media in addition to lifetime learning. The most popular social media sites with heutagogy techniques include YouTube, Facebook, Google Docs, Twitter, and LinkedIn. According to the paper by Alvarez et al., (2016), cyber education is another term for e-learning. One term for online learning (OLL), web-based training (WBT), web-based learning (WBL), distributed learning (DL), mobile learning (m-learning), and others is "e-learning." Adaptive learning and MOOC are two types of online learning (OLL). Adaptive

learning involves gamification components, according to a study by Mahfuzah Mohamad et al. (2019). Students gain knowledge of adaptive learning through the heutagogy design process, which involves exploration, creation, collaboration, connections, reflection, and sharing.

The subsequent heutagogy implementation at the university level is to incorporate it into the curriculum. This implementation is frequently challenging because curriculum and module enhancements cannot be modified arbitrarily within a subject or discipline. It necessitates deliberation and approval from a variety of parties, including curriculum designers, subject matter experts, and management. Therefore, a student requirements analysis must be conducted in order to determine the rationale and necessity for modifying the current curriculum and modules. According to the research conducted by Putra et al., (2020), he and his collaborators conducted a needs analysis study before committing to a heutagogy-based training module, and the findings were published in his article Putra et al., (2020). Likewise, Mohamad et al. (2019) devised and proposed the heutagogy framework for structural steel design in the curriculum for civil engineering.

Heutagogy is used in four tasks that take place outside of the classroom. One of them is Business Challenge Competition. It is a business game between universities. It is also called the University Business Challenge (UBC). Since its start in 1998, more than 25,000 students from all over the world have taken part in the UBC, which is the UK's longest-running (competitive) inter-university recreation of business. During the first part of the competition, this activity was just an online business simulation based on self-managed and team-led student-centered learning [24]. The Edcamp is a local event that takes place outside of the classroom. Edcamps are usually free, one-day events that anyone can join and can be run by any willing academic. They are built on the ideas of Open Space Technology (OST), which says that people in groups with similar goals can self-organize, talk to each other, and solve hard problems if they are given the right setting. Andragogy and heutagogy are two theories about Edcamps that are tied to each other. The andragogy and heutagogy concepts that define the professional learning experience at Edcamp could have an effect on teaching and learning [25]. In addition to being part of a group, the outside classroom is also made up of a small number of self-

learning students and uses an integrated method to coaching. Nkuyubwatsi (2016) did research with self-study math and physics students who used their own notes to hunt and learn from the field [26]. Students finished with degrees in Physics and Applied Mathematics, respectively. Gillaspay, (2019) showed that an inclusive approach to coaching in educational growth could help professors understand how their roles in teaching, research, leadership, and daily life fit together [27]. This method is suggested because there is more pressure to improve the student experience in higher education (HE) while the number of students is growing, and because quality research needs to be published all the time. This integrated method to coaching is based on three main ideas: lifelong learning, heutagogy, and coaching that focuses on the person's strengths. Based on the heutagogy approach to tasks outside of the classroom, this strategy can be used with either students or teachers. It works well in both groups and one-on-one situations. Heutagogy can be used in learning through tasks outside of the classroom. These activities can be thought of as "pioneer" or "add-on" activities.

ICT, blended learning, outside classroom activities, module or curriculum, and remote learning use heutagogy, according to the review. The study makes several important contributions to practice and understanding. The results showed that heutagogy is an appropriate strategy for this era. Despite university heutagogy implementation, various challenges have arisen. Heutagogy's elements—exploring, connecting, collaborating, producing, reflecting, and sharing—are rarely mentioned in all methodologies, leaving a gap in its implementation in teaching and learning.

3. HEUTAGOGY FRAMEWORK

Blaschke and Hase (2016) define learner-determined learning as having six design elements: "explore, create, collaborate, connect, reflect, and share" [12]. To begin, "exploration" is deemed critical since learners require the freedom to investigate various types of knowledge. During exploration, students will gather as much information as possible about the subject they wish to study. Learners will be encouraged to develop a personal hypothesis and then test it, as well as to ask and answer questions about the linked learning process, during inquiry. Second, in learner-determined learning, "developing" alternative learning techniques through written expression of

thoughts is critical. empower learners to design, construct, or generate models, products, or content based on previous exploration study. Following that, "collaboration" is required to foster an environment conducive to peer-to-peer learning. They may collaborate or work with other groups or peers for the purpose of additional conversation and knowledge sharing. The following part, connect, enables learners to connect with their network in order to share the content or goods they have created. Connecting and sharing are critical concepts of heutagogic design. By interacting with people from all around the world, a student can exchange information and knowledge and discover new ideas for personal learning growth. Finally, "reflection" provides valuable time for learners to build ideas intellectually through analysis and synthesis of prior and present knowledge. According to McCarthy and Stoszowski (2018), education has recognised that the heutagogy approach employed in education has the capacity to generate a variety of traits desired by educators [28].

Table 1: Heutagogy Design Elements Descriptions

Elements	Descriptions
Explore	On their journey, learners must be given the freedom and chance to discover alternative routes and sources of knowledge.
Create	Utilize a variety of tools to create something and present information creatively. For instance, the creation of a mind map using Coggle.
Collaborate	Create fresh knowledge and content by working with others.
Connect	Learners are encouraged to utilise accessible media and networks in order to engage with others in their field.
Share	By exchanging knowledge and connecting with others who share common interests, learners can benefit from one another's discoveries and experiences, which can result in new chances for future collaboration.
Reflect	Students should reflect on their learning results to ensure that heutagogy is successful for them. This process of reflection will aid in the continuance of heutagogy education.

4. CONCEPTUAL MODEL

A conceptual model is a framework that is initially used in research to outline the possible courses of action or to present an idea or thought. [29]. In this study, heutagogy of Blaschke is referred. They are adaptable to teaching and learning based on the description of the six heutagogy design principles. According to Blaschke, 2017, three primary roles are engaged in implementing heutagogy in learning and teaching: teacher, learner, and institution. According to this conceptual framework, the instructor or lecturer serves as a guide or facilitator, while the institutions serve as a support system. The six design principles of heutagogy are altered to accommodate students' use of technology in their learning. Figure 1 shows the heutagogy conceptual model referred in this research.

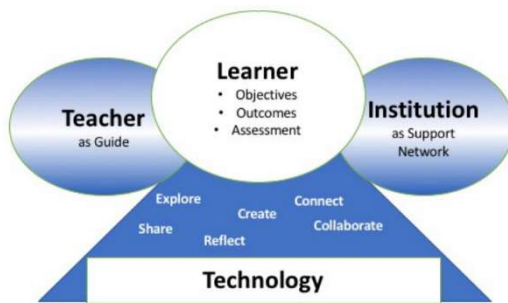


Figure 1 Heutagogy Conceptual Model

5. RESEARCH METHODOLOGY

5.1 Research Design

This study applied the Fuzzy Delphi method (FDM) to gain expert consensus in the heutagogy design elements for the development of Heutagogy Online Learning Model. These design elements will be adapted in the learning activities to enhance the collaboration skills of the students. Fuzzy Delphi Method is a combination of the fuzzy numbering set and the best suited for the creation of a model or guidelines. (JamelaaA. & SitiM.Y, 2018). The rationale for applying the Fuzzy Delphi technique compared to the Delphi technique is that it saves time and cost in handling questionnaires. It also allows experts to consistently provide their views (Mohd. Jamil et al., 2013). Besides, FDM enhances the completeness and consistency of opinion without jeopardizing their original opinion and by giving their real reaction towards the questions.

5.2 Fuzzy Delphi Technique

In using the Fuzzy Delphi technique, there are some steps that need to be followed. Here are the steps of the Fuzzy Delphi technique [31]. Twelve experts were chosen for this study. Experts are chosen for this research based on their competence and practical experience in respective domains, with a minimum of five years of conscious experience in their fields. Berliner (2004) claimed that if a someone has more than five years of experience in a field, he is deemed skilled in that field. [32]. According to Adler and Ziglio (1996), the optimal number of experts in the Fuzzy technique is between 10 and 15 in order to achieve good expert homogeneity. [28]. Educational technology, instructional design, heutagogy, education, learning, and teaching (TVET), and human resource and management professionals comprise the experts.

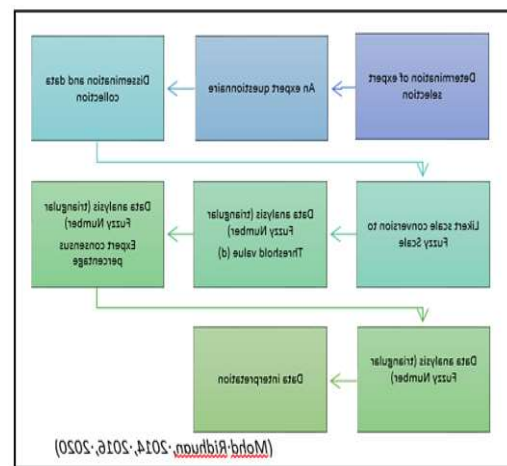


Figure 2: Fuzzy Delphi Technique

This research used questionnaire as the research instrument. Firstly, the questionnaire was developed by analysing the literature to identify the appropriate heutagogy design elements that will be adapt in the learning model. The development of questionnaire items can be done based on literature review, pilot studies, and experiences within the study's scope (Skulmoski J et al., 2007; Okoli & Pawlowski, 2004). After identifying the elements, the researchers formed a 7-point Likert scale questionnaire. The 7-point Likert scale was chosen because the evidence show that higher scale is able to reduce the value of ambiguity, therefore more accurate data obtained (Mohd Jamil, M. R., & Mat Noh, N. (2020). Next, this questionnaire then been validated by three experts. After some

amendments, the questionnaire is distributed to the experts.

First step after the data collection, researcher converted the 7-point likert scale to the Fuzzy Scale. The Fuzzy scale is used to translate linguistic variables into Fuzzy numbers. The conversion scale in Table 1.

Table 1: 7-point Linguistic Scale

Scale	Level of Agreement	Fuzzy Scale
7	Strongly Agree	(0.9,1.0,1.0)
6	Agree	(0.7,0.9,1.0)
5	Somewhat Agree	(0.5,0.7,0.9)
4	Neither Agree nor Disagree	(0.3,0.5,0.7)
3	Somewhat Disagree	(0.1,0.3,0.5)
2	Disagree	(0.0,0.1,0.3)
1	Strongly Disagree	(0.0,0.0,0.1)

6 DATA ANALYSIS

The data were analysed systematically by using Microsoft Excel software named FDM Template Analysis v2. Mohd Jamil, M. R., & Mat Noh, N. (2020). The main process in this data analysis is to obtain the threshold value "d". Thresholds are used to determine the level of agreement or consensus among expert respondents on all of the items that have been presented to them. Individual experts do not agree with other experts for threshold values with 'd' values greater than or equal to 0.2 ($d > 0.2$). (Cheng and Lin 2002). However, the item can be allowed if the percentage of expert consensus is greater than 75%, according to (Chu & Hwang, 2008; Murry and Hammons 1995). As a result, the item can be approved if either value meets the required condition. The formula below can be used to calculate the value of d:

$$d(\tilde{m}, \tilde{n}) = \sqrt{\frac{1}{3} [(m_1 - n_1)^2 + (m_2 - n_2)^2 + (m_3 - n_3)^2]}$$

Figure 3: Formula of threshold value, d

According to the findings in Table 2, all items had a Threshold (d) value of 0.2. This result implies that expert consensus has been reached on all of these points. (Chen & Lin, 2002). The expert agreement percentage indicates that all items are greater than 75% and that all defuzzification values for items are greater than - cut = 0.5. The outcome indicates that the six heutagogy design elements for an online learning model aimed at enhancing students' collaborative skills have received approval among experts.

Table 2: Findings of Expert Consensus on Heutagogy Design Elements

Element	Threshold Value, d	Percentage of Expert Consensus (%)	Skor Fuzzy (A)	Expert Consensus
Explore	0.141	100.0%	0.875	ACCEPT
Create	0.186	91.7%	0.856	ACCEPT
Collaborate	0.087	91.7%	0.928	ACCEPT
Connect	0.042	100.00%	0.950	ACCEPT
Share	0.057	100.00%	0.942	ACCEPT
Reflect	0.097	100.00%	0.903	ACCEPT

7 DISCUSSION AND CONCLUSION

Based on the above findings, it is proven that each of heutagogy design elements has been agreed by experts will help in teaching and learning to improve students' digital collaboration skills at the university. Lecturers are recommended to adapt these six design elements in the teaching and learning. However, there is a lack of guidance and strategies for implementing the approach in research. [13].

Previously, heutagogy-related studies are about the heutagogy implementation in a teaching and learning. There is limited study on the heutagogy design elements itself and how they are used in teaching and learning to improve specific skills of the students. Therefore, this study is to identify whether the six heutagogy design elements are suitable to be adapted to Heutagogy Online Learning Model to enhance the digital collaboration skills of students. This study is the first phase of developing HeuLEM. This phase is to determine the six design elements that will be applied in HeuLEM to improve the student's digital collaboration skills.

The next phase will be identifying the components and elements to be included in the HeuLEM with the adaption of the six heutagogy design elements determined in this study. It is suggested that the learning model used should be clear of its learning objectives, have content and end with an assessment. According to a study by Bagus et al., (2020), each component of the heutagogy model has different levels of implementation, depending on the objectives and content of learning. In order to construct a systematic system of learning, lecturers must comprehend the six components of heutagogy. Every aspect of heutagogy can be used to a variety

of learning strategies and processes. The six design element of heutagogy can be adapted in the content of learning by undergoing activities with the students such as group presentation, peer mentoring or team-based problem solving.

Problem solving, concept mapping, and experiment are just a few of the activities suggested for element explore. Public speaking, presentation, peer evaluation, and discussion are other examples of element sharing [22]. In theory, teachers in heutagogy do not require a great deal of control over their students. As a result, the majority of activities in heutagogy learning are handled by the students, with the professor acting as a facilitator. When most tasks demand students to handle themselves, this will encourage them to communicate more and require them to cooperate with other students; as a result, their cooperation abilities will increase.

In conclusion, the purpose of this paper was to investigate the idea of heutagogy and its potential for improving the quality of learning and teaching environments. Six essential heutagogy design elements have been recognised as ideal for adaption in educational contexts, as a result of an in-depth review of a variety of research papers and pieces of published literature.

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