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Development of self-regulated lifelong learning (SR3Ls) model in the era of IR4.0 for post-pandemic economy

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Abstract

Purpose – To continue to stay relevant in the era of Industry Revolution 4.0 (IR4.0) alongside the unprecedented disruption of COVID-19, the importance of lifelong learning is indisputable though this concept has existed for decades. In this context, open and distance learning (ODL) institutions are urged to re-think and re-design their online learning support systems that inculcate self-regulated lifelong learning (SR3Ls) in their learners to be adaptable and resilient for the post-pandemic economy. The purpose of this paper is to develop a SR3Ls model, namely SR3Ls model by utilising the collective opinions of a panel of experts to determine the key domains and attributes.

Design/methodology/approach – A 2-round Delphi consensus study was conducted with 39 experts from five countries. The mean, standard deviation (SD), inter-quartile range (IQR) and the ratio of experts assigned score of 4 or greater were used as the basis of consensus assessment with criteria set at mean = 3.0, SD = 1.5, IQR = 1, ratio on score 4 or greater at = 75%. The questionnaire consisted of 5-point Likert-type scale rating the importance level of each attribute combined with open-ended questions.

Findings – This paper presented the findings of the first round of Delphi consensus study. For the first round, the experts were asked to evaluate 31 key attributes of SR3Ls model under five domains. The findings revealed that there were five key attributes to be eliminated from the list, while there were seven attributes identified as the key attributes with highest consensus. There were additional attributes suggested by the Delphi panel to be added in the second round of evaluation.

Originality/value – This international consensus-based SR3Ls model serves as an important benchmark for ODL institutions across the regions in developing meaningful and relevant online learning support systems for their learners to adopt SR3Ls attributes in order to meet the dynamic market demands.

Keywords Lifelong learning, IR4.0, Delphi technique, Consensus study, SR3Ls model

Paper type Research paper

1. Introduction

The COVID-19 pandemic has elevated the importance of individuals' adaptability and resilience in an unpredictable world. Self-regulated lifelong learning (SR3Ls) is seen as timely to enable people to explore their potential for multiple transitions. In addition, new technologies in the era of Industry Revolution 4.0 (IR4.0) pose significant pressures for transformation in the development of competencies for sustainable employability. Hence, the readiness for swift change that comes with SR3Ls attributes is an enormous asset.

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Based on the synergy between self-regulated and lifelong learning, the capacity and competency of individuals can be expanded and extended through comprehensive support of knowledge and skill acquisition processes. To continue to stay relevant in the era of IR4.0 and amid the tremendous upheaval of COVID-19, the importance of lifelong learning is indisputable, though this concept has existed for decades. The scope of lifelong learning broadly refers to any types of purposive learning with the objective to improve the quality of life through formal, non-formal and informal learnings. The concept of lifelong learning could be traced back to the 1970s, with the initial intention of providing adults with access to formal courses in educational institutions; while in 1996, the education ministers of the Organisation for Economic Cooperation and Development (OECD) decided to adopt "Lifelong Learning for All" as a policy framework. With this framework in place, lifelong learning encompasses all purposeful learning activities undertaken by anyone for the improvement of knowledge and skills. In a similar vein, international organisations such as the United Nations Educational, Scientific and Cultural Organisation (UNESCO) and the European Commission also followed to adopt the comprehensive perspective of lifelong learning which includes all intentional learning activities undertaken by anyone (OECD, 2001). Lifelong learning advocates people at various stages of life should continue to learn, and this is an opportunity for the realisation of human potential.

The study of Yap and Tan (2022, p. 62) encapsulates "the characteristics of lifelong learning in two broad dimensions:

(1) skills and abilities related to learning; and

(2) beliefs about learning and knowledge."

Lifelong learning at self-regulated pace ensures continued personal and professional development in the face of rapid technological advancement in the era of IR4.0 and socio-economic transformations (Volkova, 2019). The IR4.0 has caused the shift of fundamental variability of the global market and has shortened the life of products, while at the same time enhances digital interconnection that streamlines and innovates various economic models (Bauman and Haffner, 2017; Bauman, 2018; Chudy *et al.*, 2020).

With this shift of industry revolution taking full advantage of connectivity and mass customisation, the greatest challenge arisen is the disruption of workforce. New technologies with improved digitalisation are able to perform increasingly complicated tasks. It is estimated that 40% of existing jobs will be taken up by artificial intelligence with the next 15 years (Reisinger, 2021). Nonetheless, the new industrial revolution also creates countless of new jobs in blockchain, cybersecurity, big data, nanotechnology, 3D configuration technology and many more. It is projected that individuals with SR3Ls attributes will be adaptable and resilient to capitalise on the exciting new technologies.

Lifelong learning has been the focus of attention for policymakers, education providers, administrators and educators. Specifically, this study focuses on how open and distance learning (ODL) institutions should develop their online learning support systems to uphold SR3Ls. In fact, ODL institutions are in the ideal position to lead SR3Ls in the era of IR4.0 because ODL can take place anywhere, anytime and by anyone. But, are the current systems effective and ready to meet the needs of global demand for sustainable development? The concepts of self-regulated learning and lifelong learning are common, but models developed for these concepts have been scant. Furthermore, the available concepts at present cater more for individual needs. This study primarily aims to develop a model for ODL institutions to re-vitalise their online learning support systems for sustainable growth. The current scenario clearly reveals that SR3Ls is undeniably essential to survive or even flourish in the post-pandemic economy. Therefore, ODL institutions are urged to re-think and re-design their

online learning support systems. The purpose of this paper is to utilise the collective opinions of a panel of experts to determine the key domains and attributes for the development of a SR3Ls model, namely SR3Ls model so that ODL institutions may use this model to design and develop compatible online learning support systems.

2. Methods

The Delphi technique employed in this study is a widely accepted and extensively used "research methodology to achieve consensus concerning real-world knowledge solicited from experts" for predictive study (Hsu and Sandford, 2007, p. 2). When a "phenomenon is not fully understood", the Delphi technique is an appropriate methodology to garner a collective opinion and perception from the "panel of experts based on the premise that pooled intelligence" is more appropriate than individual judgement (de Villiers *et al.*, 2005, p. 639). Research related to the development of SR3Ls model in the era of IR4.0 for post-pandemic economy is scarce, thus this study adopted the Delphi technique to explore the key attributes for the development of SR3Ls model.

According to Dalkey and Helmer (1963), the Delphi technique is a method to obtain the most reliable possible consensus from a group of experts through a series of questionnaires organised in various rounds. At the end of each round, the results are summarised so that they can be evaluated by the expert panel. The number of rounds usually ranges between two and four, depending on the consensus reached. In the present study, to reach consensus among the experts and to select the key attributes of SR3Ls model in the era of IR4.0, there were two rounds of expert-opinion collection and the Delphi iteration process stopped when all the consensus criteria were met. This paper discusses the findings obtained from the first round of the Delphi process.

The anonymous nature of Delphi technique is advantageous to ensure "the genuine views of individuals are expressed, by eliminating the possibility of peer pressure or influence of personality and/or professional hierarchy clashes, which could result from a face-to-face, non-confidential method" (Ormshaw *et al.*, 2016, p. 375).

2.1 Expert panel

Under the Delphi technique, the selection of appropriate experts is essential as the consensus reached is solely dependent on the experts. The experts are required to possess accredited knowledge and professional experience in the relevant areas, and have the willingness and time to participate in the Delphi iteration process. Therefore, the experts in this study were chosen purposefully using snowball sampling based on recommendations.

The following criteria were considered for the nomination of experts:

(1) For nominee from tertiary academic institution, he/she is to be active in the field of research, teaching and curriculum development with teaching experience of more than 5 years;

(2) For nominee from manufacturing industry, his/her work is to be related to the use of IR4.0 technologies who is an engineer for at least 3 years.

Based on an expected response rate of 50% with the aim of including a minimum of 25 experts, 57 experts were initially invited to participate in this Delphi consensus study. Invitation letters were emailed to the experts and they were informed that their participation would be on a voluntary basis and their responses would be anonymised. There were 47 experts gave their consent by filling in the online consent form. However, there were only 39 experts participated in the first round of Delphi process. In the second round, the participation was reduced to 35 experts. The expert panel from five different countries provided diverse

representative opinions. As this paper focuses on round 1 of the Delphi consensus study, the demographic profiles of the expert panel participated in the first round were illustrated in Table 1.

2.2 Development of attributes and domains

Self-regulated lifelong learning is a growing concern in this versatile era that needs to be appropriately addressed in relevance to the context of IR4.0. More constructive and comprehensive attributes in the aspects of self-regulated, lifelong learning and technologies of IR4.0 are essential to articulate the dimensions in-depth in order to develop a model that could be employed by ODL institutions to sustain SR3Ls by tapping the potentials of IR4.0 technologies, which is the ultimate purpose of this study.

To develop the key attributes and domains of SR3Ls model in this study, the method of Walker and Avant (2011) was used as the framework for the concept analysis. The significance of the concept is delineated based on the following eight steps:

(1) Selecting a concept;

(2) Determining the aims or purposes of analysis;

(3) Identifying all the uses of the concept;

(4) Determining the defining attributes;

(5) Identifying a model case;

(6) Identifying a borderline case;

(7) Identifying antecedents and consequences;

(8) Defining empirical referents.

This method allows improved clarity and defined attributes of SR3Ls and will provide direction for the development of SR3Ls model in the context of IR4.0.

To retrieve relevant journal articles, conference papers, reports, books, dissertations and theses, a literature search was performed with combining keywords of "lifelong learning", "Industry Revolution 4.0", using Boolean operator "AND" in title or text. All full text references in English language between 2020 and 2022 archived in Emerald Insight, ProQuest and ScienceDirect databases were extracted.

The search and selection processes are illustrated in Figure 1 and it shows that 1,386 documents were retrieved in the first stage. The 492 duplicate documents were removed,

Delphi expert panel	*n*	%
Expertise Background		
Academic	32	82
Engineering	7	18
Country		
Malaysia	22	56
India	11	28
Germany	1	3
Philippines	4	10
Indonesia	1	3

Source(s): Table by authors

Table 1. Demographic profiles of the Delphi expert panel in round 1

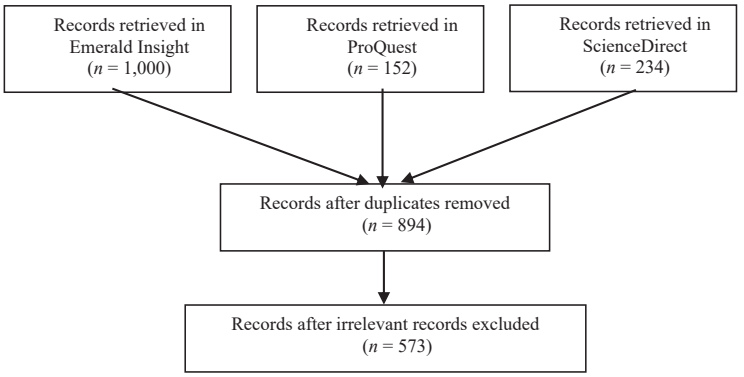


Figure 1.
Literature search flowchart

Source(s): Figure by authors

leaving 894. In the second stage, the remaining documents were reviewed for relevance, and 321 records were excluded. Finally, there were 573 records appeared to be more relevant to the purpose of this study.

To perform a concept analysis according to Walker and Avant's method, the researchers should choose a concept which plays an important role in the discipline. Thus, lifelong learning and IR4.0 were selected to study the attributes, to classify into domains and to further develop into SR3Ls model in relation to IR4.0. Lifelong learning is a common concept but its attributes have rarely been analysed particularly in the context of IR4.0.

The principle aim of this concept analysis is to delineate the attributes of lifelong learning with the integration of IR4.0 technologies that can be adopted by ODL institutions to sustain continuous growth.

Bedford *et al.* (2017) described learning is lifelong as it begins from the beginning of life till the end of life. The concept of lifelong learning is a generous term that can be used to refer to informal or recreational learning, part-time outreach programmes offered by institutions and workplace learning for professional development (Bedford *et al.*, 2017).

Attributes are the characteristics of a concept that keep appearing in the literature and they are frequently associated with the similar concept (Walker and Avant, 2011). From the synthesis of literature review, defining attributes of this study were formulated and interpreted from identified domains based on the recurring characteristics. The possible domains were initially generated inductively based on the recurring characteristics. There were 17 domains gathered in the initial stage with interrelated characteristics. Domains with similar characteristics were grouped and re-named to discern distinctive elements respectively and minimise overlap. With the inductive approach, the domains were derived from the literature review. This is especially practical for exploratory analysis when new domains for a self-regulated lifelong model in the context of IR4.0 were to be developed. The domains are then reviewed and finalised. After further contemplation, there are five domains defined in this study, namely digital contents, online pedagogy, assessment, virtual mentorship and hosting platform.

Antecedents are elements that are present prior to the occurrence of the concept of lifelong learning; while consequences are the elements that occur as a result of the concept of lifelong learning. In the review of the literature, several antecedents and consequences of lifelong learning emerged (Walker and Avant, 2011).

Lifelong learning occurs when there is a goal to achieve and the individual is aware of the resources available. It is aimed that the model developed in this study with relevant key

attributes and domains could be utilised by ODL institutions to sustain SR3Ls with the integration of IR4.0 technologies.

The intent of the concept analysis is to provide clarity surrounding the concept of SR3Ls in the era of IR4.0. Self-regulated lifelong learning is rather a broad and versatile concept penetrates across various disciplines, from business to healthcare. With a concrete understanding of the concept, a new integrative SR3Ls model could be developed so that ODL institutions have clearer directions to move forward.

According to the definitions, IR4.0 is a product of automation and a fully digitised enterprise. Human factor is not in the intention to be eliminated but it requires the transformation of human positions to collaborate with robots. The collaboration is built upon the basis of both parties complementing and enhancing each other's strengths. Thus, the autonomy of human still remains (Chudy *et al.*, 2020).

While the concept analysis presented in this study proposes the scope of lifelong learning in the era of IR4.0, limitations of the analysis do exist. As the literature search was restricted to English language and publication dates between 2020 and 2022, "the data included may not constitute all possible relevant data related to the proposed concept. Since the concept was examined within the context of education and included primarily education related literature, the richness of the meaning of the concept for use in other disciplines may be limited. In addition, this analysis does not address the specific" needs of any identified target group (Hansen and Bratt, 2015, p. 106).

3. Results

Specifically, in this study, the quantifiable attributes are gathered from the 5-point Likert-type scale to support statistical aggregation of group responses. Measures of central tendency and level of dispersion are computed to analyse the collective evaluation of experts (Sosnytskyi *et al.*, 2021). The consensus of Delphi technique in this study is achieved within a certain percentage in agreement or a certain ratio of scores within a designated range. The mean scores, standard deviation (SD), inter-quartile range (IQR) and the ratio of score is equal or greater than 4 on the 5-point Likert-type scale questionnaires are used as the basis of consensus assessment (Wang *et al.*, 2022). "An IQR of less than 1 indicates that over 50% of the expert opinions are focused on a certain point. An IQR of zero indicates that the experts are in complete agreement. The SD is an indicator of the level of opinion dispersion. An SD value of less than 1.5 indicates that the experts have reached a consensus" assessment (Wang *et al.*, 2022, p. 2). The mean score of individual key attribute is to be equal or greater than 3.0. Higher mean score indicates higher level of importance rated. Another consensus criterion is set at the ratio of equal to or greater than 4 points (≥4 ratio) by more than 75% of expert panel. With more than 75% of the experts assigned a score between 4 and 5, it is an indication that experts view the key attribute being evaluated as highly important and should be included in the SR3Ls model. Therefore, the consensus criteria in this Delphi study are summarised in Table 2. Key attributes that meet all the consensus criteria would be included in the SR3Ls model.

In this study, the Delphi process consisted of two iterative rounds in which the links to access questionnaire containing the key attributes of SR3Ls model were emailed to the expert

Mean	≥3.0
SD	≤1.5
IQR	≤1
≥4 ratio	≥75%

Note(s): ≥4 ratio: (total number of scale 4 points and above/total number of experts) X 100
Source(s): Table by authors

Table 2.
Consensus criteria

panel. This paper focuses on discussing the results of round 1 Delphi study. In round 1, the experts were invited to rate the importance level of 31 key attributes using the Likert five-point scale, whereby scale 1 indicated not at all important; while scale 5 indicated extremely important. The expert panel was also given the options to add any other key attributes that they considered relevant to the model with justification provided. The key attributes that failed to meet all the consensus criteria were eliminated.

In the Round 1 questionnaire, there were five domains identified for the model based on concept analysis: digital contents, online pedagogy, assessment, virtual mentorship, hosting platform and under each domain there were proposed attributes for the experts to rate the importance level. Section 1 is about brief demographic profiles, while Sections 2 to 6 used a combination of Likert-type scale rating and opportunities for open comments. Each expert was asked to independently rate the attributes according to a 5-point Likert-type scale in which 5 indicated extremely important and 1 indicated not at all important.

The results of round 1 Delphi study are summarised in Table 3. The key attributes highlighted in red with italic font were to be eliminated from the model as they failed to meet the consensus criteria set; while the key attributes highlighted in green with bold font were the key attributes with the highest ratings in the respective domains. In essence, there were five attributes to be eliminated from the model, while there were seven attributes identified as the key attributes with the highest ratings.

The additional attributes suggested to be added by the Delphi panel comprising User Experience/User Interface (UX/UI) Design, connectivist learning, inquiry-based learning, community-based evaluation, on-time feedback, monitoring mechanism, e-resources, digital citizenship, flexible technological architecture of learning management system, cloud content database and online demonstrations. These attributes will be included in the subsequent round of questionnaire. The inputs of the Delphi experts from diverse backgrounds are significant in acquiring and creating knowledge for rich data sharing which lead to the achievement of developing a relevant and practical SR3Ls model in IR4.0 for post-pandemic economy.

4. Discussions

The Delphi technique is especially effective in obtaining subjective judgements on a collective basis. The consensus is reached through structured communication involving feedback over several iterations. The objective of the iterations is to achieve the desired level of consensus among the expert panel (Lindeman, 1975). With the multiple indicators employed in reaching consensus through mean scores, SD, IQR and the ratio of score equal or greater than 4, it is therefore convincing to justify the reliability of the consensus obtained. Based on the Delphi expert panel's evaluation in Round 1, there are seven key attributes with the highest ratings, namely smart search functionality, cognitive presence, authentic assessment, professional training, technology proficiency, learning analytics and digital trust. These are the attributes rated with highest importance level based on the consensus reached. In contrast, the five attributes to be eliminated are: didactic approach, written exam, audio-based assignment guide, assignment guide with Avatar character and face-to-face mentoring. These attributes did not reach consensus based on the criteria set. In the 5-point Likert-type scale questionnaire sent to the Delphi expert panel, there was a section in each domain for the experts to fill out their inputs about the listed attributes for further justification needed. The inputs of the experts are descriptive in nature to provide descriptions of experiences and perceptions. This descriptive design is deemed appropriate to recognise the subjective nature of the problem and the different experiences the experts (Chafe, 2017). The inputs of the Delphi experts were used as baseline for deliberation with the support of relevant literature.

Domains	Attributes	M	SD	IQR	≥4 ratio
Digital contents	Cloud-based contents	4.54	0.64	1	92.31%
	Contents contain motivational scaffolds	4.64	0.58	1	94.87%
	Gamification with rewards given (e.g. level up, badges, e-cert, etc)	4.13	0.98	1	82.05%
	Intelligent search functionality	*4.56*	*0.55*	*1*	*97.44%*
Online pedagogy	Instructor presence	4.46	0.72	1	87.18%
	Social presence	4.23	0.78	1	84.62%
	Cognitive presence	*4.72*	*0.69*	*0*	*92.31%*
	Didactic approach	*4.13*	*0.89*	*2*	*71.79%*
	Productive failure learning design	4.38	0.81	1	84.62%
	Online community of learners	4.33	0.84	1	89.74%
Assessment	Written exam	*3.54*	*1.14*	*1*	*53.85%*
	Authentic assessment	*4.67*	*0.70*	*0*	*92.31%*
	Marker's comments are provided	4.31	0.95	1	84.62%
	Text written assignment guide is provided	4.08	0.90	1	76.92%
	Audio-based assignment guide is provided	*3.92*	*0.87*	*2*	*69.23%*
	Assignment guide with Avatar character is integrated	*3.51*	*1.12*	*1*	*51.28%*
	Assignment guide with human instructor's video is integrated	4.13	0.98	1	76.92%
Virtual mentorship	Face-to-face mentoring	*4.00*	*1.00*	*2*	*66.67%*
	Digital mentoring	4.13	0.73	1	84.62%
	Professional training	*4.62*	*0.59*	*1*	*94.87%*
	Technology proficiency	*4.64*	*0.67*	*1*	*94.87%*
	Consistent schedule	4.36	0.90	1	89.74%
	Answering question about the course	4.33	0.87	1	87.18%
Hosting platform	**Learning analytics**	*4.79*	*0.57*	*0*	*97.44%*
	Digital trust	*4.82*	*0.45*	*0*	*97.44%*
	The learning analytics are accessible by learners	4.62	0.78	1	94.87%
	Smart alert to remind learners of the contents/ assessments that are missed out	4.51	0.68	1	89.74%
	Smart alert to recommend appropriate courses to be taken in future based on learning analytics	4.41	0.82	1	89.74%
	Smart alert to inform learners about their progression pathway	4.64	0.71	0.5	92.31%
	Ability to analyse learners' achievement of course learning outcomes	4.64	0.67	1	94.87%
	Availability of video library (e.g. recordings of trainings, webinars, public talks, etc)	4.56	0.68	1	89.74%

Source(s): Table by authors

Table 3. Results of round 1 Delphi consensus study

4.1 Key attributes with the highest ratings

New pedagogical methods are being developed in response to the availability of IR4.0 technologies in education. The affordances of technologies enable transformative learning in adult learning contexts for lifelong learning. Therefore, the seven key attributes with highest ratings of importance are closely related to technologies and adult learning theory, such as intelligent search functionality, cognitive presence, authentic assessment, professional training, technology proficiency, learning analytics and digital trust.

4.1.1 Intelligent search functionality. The experts consented that the dynamic functionality of intelligent search integrated with artificial intelligence technology is especially needed to support SR3Ls . Lifelong learners study independently and they need systems with intelligent search to enable them to conduct comprehensive search for enhanced learning, assignment preparation and professional development. The searching algorithm is expected

to eliminate data silos, create customised searches and locate data regardless of the formats (IBM Cloud Education, 2021). This attribute is adequately needed for SR3Ls model so that lifelong learners can optimise their efforts and time when navigating relevant contents. Content is the vehicle that drives the cognitive development of the leaners.

4.1.2 Cognitive presence. Corresponding to the profiles of lifelong learners who are usually working adults, the online pedagogy domain of cognitive presence is essentially needed. With the highest consent presented among the experts, cognitive presence is an important indicator of quality learning that drives learners to keep exploring and discovering new knowledge and skills. Learners of this category who are working adults have commonly reached certain maturity and they are keen to acquire new knowledge and skills with more intellectually demanding resolution (Sadaf *et al.*, 2021).

4.1.3 Authentic assessment. Authentic assessments refer to types of assessment which are closely related to real world contexts and meaningful to the learners' daily tasks (Khaira and Yambo, 2005). High consensus was obtained to attest this attribute as relevant and practical to the lifelong learners as they can apply the new knowledge and skills learnt to actual tasks which contain realistic purposes. They are given the opportunity to investigate and converse about these problems which are more practical and meaningful compared to surface learning assessments where the learners simply need to memorise new ideas.

4.1.4 Professional training. Mentoring is not only a process of providing guidance; it is also more about building trusting relationship. Lifelong learners juggle with the challenges of time constraints, heavy workloads, financial responsibility and other challenges. A mentor must be professionally prepared to establish meaningful connections with the learners in order to support their personal and professional development (Lamm and Harder, 2021), while avoiding being directive or authoritarian. Therefore, to establish relationship that uphold mutual trust and respect for lifelong learning, professional training in mentorship is vitally an important attribute, as consented by the experts.

4.1.5 Technology proficiency. It is evident from the experts' evaluation that to optimise the impact of mentoring, technology proficiency is essential so that mentoring can be done anywhere and anytime to bridge the gap. Technology proficiency is a key attribute to ensure mentors are competent users of technology in using various platforms or tools to create dynamic opportunities for mentoring. Technology is no longer an option but a must, particularly in this era of IR4.0. On the one hand, technology could be used to harvest resources for detailed information that mentors need to carry out their roles effectively; on the other, the ubiquitous nature of technology seamlessly connects mentors with the lifelong learners by enhancing flexible, innovative and boundary-less mentoring process (Bennett, 2010).

4.1.6 Learning analytics. A culture of data-driven decision making has been cultivated via the roll out of learning analytics. The experts strongly agreed that the attribute of learning analytics embedded in the hosting platforms has broader institutional impacts on supporting learners' progress. Information on the quality of the digital contents, learning activities and assessment processes can be furnished to enable continual enhancement. Additionally, personalised intervention can be taken when at-risk learners are identified. As for the lifelong learners, learning analytics enable them to take control of their own learning by knowing how they are progressing and what they need to do to meet the learning outcomes (Sclater *et al.*, 2016).

4.1.7 Digital trust. With the aggressive penetration of technology, data breach and misuse of data are the threats that challenge the trust between individuals and institutions. Digital trust is key to protect and safeguard individual and institutional data. The Delphi experts in this study had a high degree of support to integrate digital trust in SR3Ls model as one of the key attributes to reduce friction between lifelong learners and institutions. This friction may be caused by infrastructural or poor design of functionality, regulatory or legal requirements,

identification and data security measures (Arizona State University, 2021). Hence, this attribute is highly rated by the Delphi experts.

4.2 Key attributes to be eliminated

The conventional learning methods are gradually deemed irrelevant in this digital revolution. The IR4.0 technologies have empowered learners to seek knowledge on their own, especially for adult learners to upgrade their skills for continuous growth. Regrettably, the conventional learning methods confine learning to prescribed sources, the teachers and the four walls. Based on the Delphi consensus study, the attributes associated with conventional learning methods have to be eliminated from the SR3Ls model, including didactic approach, written exam, audio-based assignment guide, assignment guide with Avatar character and face-to-face mentoring.

4.2.1 Didactic approach. Didactic approach is a teaching discipline that is instructor-centred in which information is transferred directly from instructor to learners. Looking at its conventional mode of one-way communication, didactic approach did not achieve the consensus criteria. Contents are given higher emphasis compared to pedagogy. It is more knowledge-oriented than process-oriented (Indeed Career Guide, 2022), which is not suitable for learners who pursue lifelong learning on own initiative at their self-regulated pace. According to Knowles' theory of andragogy, a theory of adult learning (Knowles *et al.*, 2020), lifelong learners who are adults expect to understand why they need to learn certain topics and how they are learning them. Hence, didactic approach is not appropriate to be incorporated into the SR3Ls model.

4.2.2 Written exam. Written examination is usually a form of summative assessment used for measuring learners' learning performance at the end of the course. The experts found that it is not appropriate to include written examination as one of the key attributes of SR3Ls model because written examination focuses more on theoretical content knowledge. Besides, the restricted time characteristic of examination limits the possibility for learners to relate what they have learnt to the outside world. The practical application of knowledge and skills in the form of problem analysis and problem-solving (University World News, 2021) which are vital for SR3Ls is not measured. Knowles' theory of andragogy emphasised that the experiences of adult learners are to be put into consideration when designing teaching and learning for them (Knowles *et al.*, 2020). The emphasis in the written examination on factual knowledge lacks the depth to relate the assessment to the lifelong learners' wealth of experiences in respect of their backgrounds, lifestyles, age and profession.

4.2.3 Audio-based assignment guide. Assignment guide is central to elevate learners' comprehension and achievement. However, the experts concurred that audio-based assignment guide without visual support is less effective to facilitate understanding of lifelong learners who learn in an isolated environment under asynchronous mode. To be able to comprehend the assignment guide in audio form without visual elements, learners must have sufficient listening ability. More cognitive processes are involved when the assignment guide is solely based on audio form. Video-based assignment guide with demonstration is alternatively more personalised and easier to comprehend. The matching of intonation with facial expressions and gestures aids comprehension. Correspondingly, Folley (2015) found that learners who were exposed to an audio-based assignment guide accompanied by visual elements possessed higher chances to recall details to meet the needs of assignments.

4.2.4 Assignment guide with avatar character. An avatar is a photo-realistic animated character. The integration of avatar in the assignment guide may add interest and motivation for learners. This attribute, however, is to be eliminated from the SR3Ls model based on the first round of Delphi expert panel's evaluation. In comparison, assignment guide with real human instructor is more preferred. This seemingly is due to the lifelong learners who are

adults require more trusted guide than someone hide behind an avatar character which is cartoony (Beresford, 2013). Lifelong learners demand more from the people they interact with. They desire to engage with a real person. Bonding and trust can be established with a real human instructor when natural social interaction happens. Being adults, lifelong learners juggle multiple commitments apart from studies. They need a human instructor who they can share with and understand their difficulties. Though much work has been done to improve photographic and behavioural realism of the animated avatar faces, the realistic facial expressions are still superficial and less likely to establish humanlike dynamic engagement. The characters of avatars available are also limited to few identities (Grewe *et al.*, 2021).

4.2.5 Face-to-face mentoring. Time constraints, scheduling conflicts and transportation issues are the common barriers faced by lifelong learners who need to juggle multiple commitments. Amid the busyness of coping with a heavy workload, family responsibilities and financial burden, the learners can use the time freed up in between for online mentoring. Hence, face-to-face mentoring is not an ideal attribute in this context to be included in SR3Ls model upon the experts' evaluation. Online mentoring allows learners to choose a time, pace and place appropriate and convenient for both parties to have mentoring sessions. The flexibility of online mentoring is especially important for the lifelong learners to seek support and advice no matter where they are.

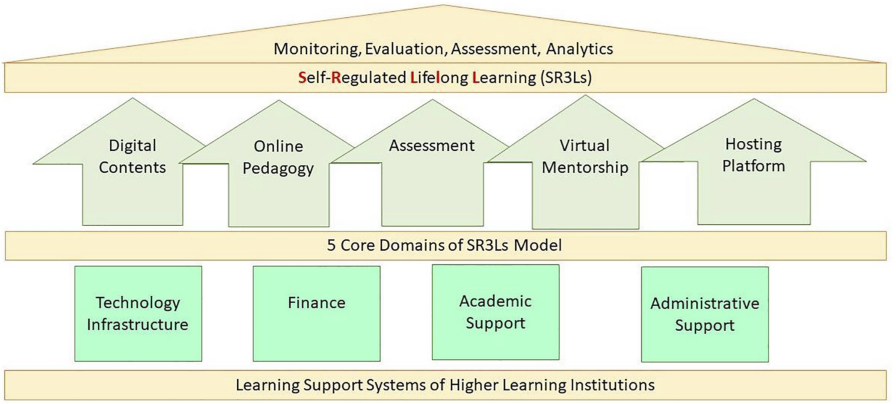
5. Implications and conclusion

Aggressive penetration of technology is causing people to learn, unlearn and re-learn at many intervals throughout their lives in order to stay relevant. ODL institutions should not provide a fixed syllabus of contents to serve a person for life. Learners need to keep upgrading and upscaling themselves to meet the demands of society. In line with this context, how should ODL institutions enhance the culture of SR3Ls involving learners' choice, engagement and differentiation? How should ODL institutions ensure they are meeting the needs of their learners for comparative employability? Increasing competitive environment is prompting ODL institutions to adopt compatible online learning support systems through SR3Ls model by focussing on the five empirical-based domains with the key attributes to formulate implementation strategies.

A detailed roadmap to reach critical milestones within the initiatives is to prepare by examining the available resources and the gaps to fill in. The implementation strategies include the evaluation of long-term and short-term objectives, standards integration, division of responsibilities and resources encompassing human, financial and time.

With the empirical-based SR3Ls model that support SR3Ls, ODL institutions are urged to re-assess and re-design their online learning support systems by focussing on the five domains of digital contents, online pedagogy, assessment, virtual mentorship and hosting platform. Do their existing online learning support systems incorporate these five domains? Do their existing online learning support systems acquire the key attributes incorporated in SR3Ls model? How should they improve and upgrade their online learning support systems if these attributes are missing? To re-assess and re-design their online learning support systems, ODL institutions are called to imply the implementation framework presented in Figure 2.

In conclusion, the findings of the first round of the Delphi consensus study revealed the initial stage of evaluation done on the key domains and attributes of SR3Ls model. The study demonstrated that the Delphi expert panel prioritises the integration of IR4.0 technologies into the online learning support systems provided by ODL institutions for sustainable SR3Ls. In identifying the level of importance of each key attribute, the experts chose to highlight more currently pertinent attributes over more traditional attributes. The Delphi expert panel demonstrated a passion to develop truly empowered self-regulated lifelong learners with the



Source(s): Figure by authors

Figure 2. Implementation framework

online support systems of ODL institutions. Self-regulated lifelong learning does not stop at acquiring knowledge but more importantly, the concept of lifelong learning is expanded and extended to include essential life skills, attitudes and motivation, which will serve the learners throughout their adult life in fluid environments.

This international consensus-based SR3Ls model serves as an important benchmark for ODL institutions across the regions in developing meaningful and relevant online learning support systems for their learners to adopt SR3Ls attributes in order to meet the dynamic market demands.

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