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## An experience of personalized learning hub initiative embedding BYOD for reflective engagement in higher education

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### ABSTRACT

The article shares an experience in the implementation of the “personalized learning hub” initiative embedding Bring Your Own Device (BYOD) on learners’ reflective engagement in flipped classrooms at a higher education institute. A reflective engagement framework was developed, consisting of three dimensions: intellectual, personal and social reflective engagement. Participants involved 26 in-service teachers for a teacher professional development programme on e-Learning. Participants were encouraged to bring and use their own portable computing devices as a “personalized learning hub” to support their reflective engagement. The analysis of qualitative and quantitative data collected provides evidence on learners’ attainment of reflective engagement in the three dimensions. The designed initiative enabled learners to achieve a significant knowledge gain for enhancing their understanding of e-Learning. The learners perceived that the initiative could help achieving their learning outcomes. They also perceived that group interaction and experience sharing with peers, teachers and related experts in this context could help advance their knowledge. These results imply that the designed initiative can promote learners to be engaged in reflective inquiry for deep learning and personal growth. Directions of future work are discussed regarding validating the developed framework through extending the use of the reflective engagement framework and the “personalized learning hub” initiative embedding BYOD to more learning scenarios, and enhancing the related teacher professional development.

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## 1. Introduction

Higher education currently emphasizes the goal of promoting reflective engagement among learners, in order to engage learners in active learning for knowledge construction with self-reflection on their learning process and learning outcomes. The advent of digital technology in the recent decade has driven the growth of e-Learning in higher education institutes over the world. The rich amount of digital learning resources and communication tools in the e-Learning process provide learners the opportunities to realize reflective engagement in subject learning. Higher education currently promotes Bring Your Own Device (BYOD) as a prevailing e-Learning initiative (Al-Qahtani & Higgins, 2013; Pegrum, Oakley, & Faulkner, 2013). Teachers

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in higher education need to master the BYOD initiative for supporting learners on accomplishing reflective engagement in their course work. This article aims to investigate current situations of implementing the BYOD initiative for reflective engagement in flipped classrooms in higher education, and thereby to identify future directions for teacher professional development on e-Learning for reflective engagement.

## 2. Background of study

Higher education in the twenty-first century is expected to meet three goals: to develop learners' mastery of expert knowledge specific for major disciplines; to foster learners' development of generic competencies essential for twenty-first century; and to stimulate learners' reflection on day-to-day pursuits, especially the learning pursuits (Njenga & Fourie, 2010; Schneckenberg, Ehlers, & Adelsberger, 2011). With the growing trend of paradigm shift to learner-centered learning, the higher education sector is therefore driven to promote learners' reflective engagement for their active development of domain knowledge and generic competencies, as well as their deep reflection on their process and outcomes of developing domain knowledge and generic competencies.

### 2.1. Reflective engagement for learner-centered learning

Reflective engagement refers to learners' continual and active participation in their problem inquiry with a continuous and critical judgment of inquiry process and inquiry outcomes for possible improvement (Farr & Riordan, 2012; Lyons, 2006; Rodman, 2010). In the field of education, engagement refers to an action or a set of behaviors in which learners devote time, energy and resources for enhancing learning; and it is often linked to particular learning behaviors or learning outcomes (Krause, 2005; Pittaway, 2012). Engagement is often linked to particular behaviors. Learners are more likely to be engaged if they are more active, autonomous in their learning (Brady, 2004). Engagement is also positively related to desired outcomes including high grades and learners' satisfaction (Chen, Gonyea, & Kuh, 2008). The process of engagement often leads learners to the reflection on their learning. Such reflection process involves a five-element cycle that learners review, rethink, reorganize, repair and/or reformulate their existing ideas of the learned topics (Farr & Riordan, 2012; Rodman, 2010). Learners are enabled to externalize their ideas of the learned topics, which, then, lead them to re-internalize and re-contextualize the understanding they have gained from this self-reflection, and finally restructure new ideas associated with the learned topics (Farr & Riordan, 2012; Gebre, Saroyan, & Bracewell, 2014).

Reflective engagement is considered favorable to deep learning, in which learners experience the learning process in touch with subject topics with rich resources from multiple channels in substantial period of time (Cifuentes, Alvarez Xochihua, & Edwards, 2011; Lai, Khaddage, & Knezek, 2013). Learners in this case select and integrate multiple views on the targeted topics for a self-regulated consolidation of critical components or elements to genuinely understand the subject topics (Chi, 2009; Cifuentes et al., 2011). Learners are not autonomous to achieve such self-regulated process for deep learning; and therefore need to make intellectual reflective engagement to foster their own motivation and direction to pursue learning.

In higher education, the promotion of reflective engagement among learners should be contextualized in the domain-expertise knowledge specific for study majors of individual learners, as well as the cross-domain competencies generic for learning pursuits in higher education (Atkinson, 2011; Gebre et al., 2014). In such reflective engagement, learners often focus on the cognitive dimension related to the intellectual idea with complexity at the domain-specific level (Atkinson, 2011; Gebre et al., 2014; Pittaway, 2012). The process of learning reflection is often initiated by learners on an individual basis, researchers suggest that learners should concern the personal dimension in their reflective engagement, with an awareness of learning intentions and expectations (Atkinson, 2011; Gebre et al., 2014; Pittaway, 2012). As learners can involve interactions with peers, teachers, related experts and resources during their process of learning reflection, researchers also suggest that learners should concern the social dimension in their reflective engagement, with an awareness of learning dialogs and interactions (Atkinson, 2011; Gebre et al., 2014; Pittaway, 2012).

### 2.2. BYOD as personalized learning hub and a tool for implementing flipped classroom strategy

With the development of mobile technology, learners can be engaged in their reflective inquiry across different spaces using BYOD. BYOD refers to a technology model which aims to foster learners to bring a personally owned device to learning institute for the purpose of learning, of which the personally owned device is any digital device brought into the learning institute and owned by a learner (Alberta Education, 2012; Thomas, O'Bannon, & Bolton, 2013). The practice of BYOD in digital classrooms is considered to be one of the prevailing e-Learning initiatives in the higher education sector, as learners at this stage in general can afford to procure and bring their own digital portable devices for campus learning, and are capable of manipulating the various functions of digital portable devices for multiple tasks (Osborne, Dunne, & Farrand, 2013; Pegrum et al., 2013).

The ready-to-hand personalized mobile devices in BYOD technology model provide a "learning hub" for individual learners to learn anywhere, anytime (Looi et al., 2009; Wong, 2012). Wong (2012) posits that the mobile device carried by a learner 24 h a day integrates all the personal learning tools, resources and self-created artefacts at one place. The device provides a host of affordances for learning support and documents the learners' learning trail. This study took BYOD as learners' "personalized learning hub" that supports their seamless social interaction among peers and teachers with the convenient retrieval and sharing of e-resources in the learning process. The individual hub usually connects the hubs of peers

and teachers through a social network platform. The use of portable computing devices in the BYOD initiative provides a transparent platform for individual learners to communicate with peers and teachers for just-in-time interactions, such as group discussions immediately after information search tasks, in subject learning without time and location constraints. The “personalized learning hub” serves as a nucleus in flipped classrooms to enhance learners’ reflective engagement.

E-Learning generally refers to the use of digital technology for learning and teaching (Stein, Shephard, & Harris, 2011). It concerns both the areas of technological issues and pedagogical issues. In this article, e-Learning concerns both the adoption of digital technology and pedagogy to enhance pedagogical practices. E-pedagogy is defined as the use of digital means to support learning (Al-Qahtani & Higgins, 2013; Gebre et al., 2014; Pegrum et al., 2013), promote communication (Pegrum et al., 2013; Thomas et al., 2013) and facilitate assessment (Al-Qahtani & Higgins, 2013; Osborne et al., 2013) in the process of subject learning. Flipped classroom strategy is one way of e-pedagogy for e-Learning. The introduction of flipped classrooms is favorable to the development of learners’ reflective engagement. The guiding principle of flipped classrooms is that work typically done as homework is better undertaken in class with the guidance of teachers. At the heart of flipped classrooms is moving teachers’ knowledge delivery outside of formal class time and using formal class time for learners to actively engage in knowledge construction through extensive interactions with peers and teachers (Bergmann & Sams, 2012; Missildine, Fountain, Summers, & Gosselin, 2013). The “personalized learning hub” initiative embedding BYOD facilitates learners’ reflective engagement in their knowledge construction in flipped classrooms. Formal class time is then dedicated to learning tasks in a collaborative manner, such as whole-class brainstorming, group-based hands-on assignments and peer reviews, feedback exchange and remedial help, etc. (Bergmann & Sams, 2012; Davies, Dean, & Ball, 2013). Learners in flipped classrooms are assumed to take control of their own pace, progress and responsibility in the learning process based on their own individual needs. Teachers in flipped classrooms are enabled to free up class time to make meaningful contact with learners for observing, guiding, commenting, and helping (Flumerfelt & Green, 2013; Fulton, 2012).

### 2.3. Framework of reflective engagement

Current discussions on reflective engagement in higher education face the discrepancies between the claims of the benefits of reflective engagement for learners and the lack of research to verify these claims partly due to the absence of an agreed-upon definition of reflection (e.g., Lyons, 2006; Rodgers, 2002). Rodgers (2002) draws on Dewey’s concept of reflective inquiry (Dewey, 1998) and attempts to interpret what reflection entails, but encounters challenges such as difficulty in assessing a skill that is vaguely defined and unclear picture of what reflection looks like. Thus, Lyons (2006), premised on Dewey’s work on reflective thinking and inquiry, tends to make the reflecting process tangible from a historic perspective using a reflective portfolio. The reflective interrogation of the portfolio process which spans from the past experiences to future ones is referred to as reflective engagement. Reflective engagement is a deliberate and intentional act of inquiry which involves in interrupting or suspending one’s practices to interrogate into learning objects systematically, and to increase one’s conscious awareness of practices that such consciousness will redirect or change one’s learning practices (Lyons, 2006; Rodman, 2010). A person may engage in this act of inquiry on an individual basis or in collaboration with others. Throughout the process of reflective engagement, learners increase their understanding of skills and knowledge, and may even bring construction of new knowledge by taking control of their learning and interacting with peers and teachers (Atkinson, 2011; Lyons, 2006; Pittaway, 2012). In other words, the realization of reflective engagement fosters learners to achieve active, constructive and interactive learning, where learners actively participate in the learning process and interact with their peers and teachers for knowledge construction (Cakir, 2013; Chi, 2009; Zengaro & Iran-Nejad, 2007).

Based on the literature, there is a common principle of reflective engagement — learners should have opportunities to review, rethink, reorganize, repair and/or reformulate their domain knowledge and generic skills with a reflective thinking associated with personal experience and social context, to interact with peers and teachers regardless of time and place, and to extend learning activities beyond classroom happenings with the access to information sources other than textbooks. The use of technology can help foster the capacity of learners in reflective engagement. One potential way is to adopt the “personalized learning hub” initiative embedding BYOD to enhance learners’ reflective engagement. This BYOD initiative can support learners to connect with tremendous e-resources on the Internet for learning purposes, as well as to make digital communication with classmates and teachers for social interaction without time and location constraints. This BYOD initiative can provide learners with opportunities to address two important needs in the process of knowledge construction—to sufficiently explore learning materials for idea formulation and to socially interact with learning peers for idea exchange and idea consolidation.

In this article, based on the literature by Atkinson (2011), Lyons (2006) and Pittaway (2012), we define reflective engagement as “learners’ continual, active and reflective participation in their problem inquiry across different spaces”. Building on this definition, we develop a reflective engagement framework that lays emphasis on enhancing learners’ progressive, active and reflective inquiry across virtual and physical and individual and social spaces in flipped classrooms leveraged by the “personalized learning hub” initiative embedding BYOD in higher education. Emerging from the reflective engagement literature, our reflective engagement framework includes three types of engagement to be examined over time in learners’ inquiry process throughout the course: intellectual, personal and social reflective engagement (see Fig. 1).

The reflective engagement framework in Fig. 1 shows that learners’ reflective engagement regarding intellectual, personal and social engagement is fostered in flipped classrooms leveraged by the “personalized learning hub” initiative embedding BYOD. The portable computing device personally owned by a learner serves a “personalized learning hub”. The functions of portable computing devices on Internet access and digital storage enable each personalized learning hub to conveniently

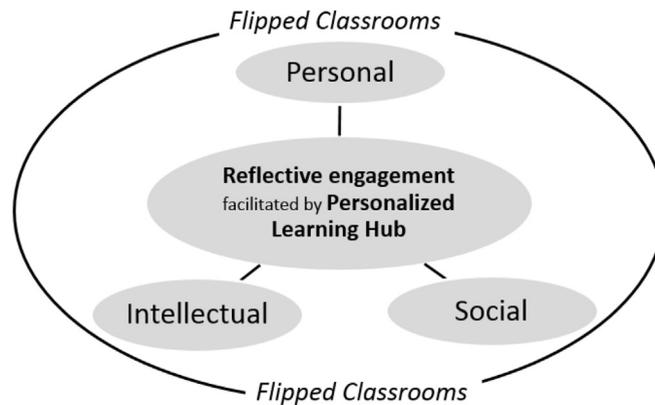


Fig. 1. Framework of reflective engagement.

retrieve and record e-resources for learning tasks. Each personalized learning hub is connected with other hubs by a social network platform. Learners are enabled to use the digital ways of communication supported by their personalized learning hubs to seamlessly interact with peers and teachers for sharing e-resources and discussing learning tasks. The reflective engagement framework is underpinned by the two principles: first, learners' reflection is a continual, active inquiry process across different spaces; and second, reflective engagement concerns three dimensions.

The first dimension is intellectual reflective engagement, in which learners show interest in the specific educational issues and confidence in solving the issues. It focuses on learners' engagement and reflection during the process of learning domain-specific knowledge. This type of reflective engagement is motivated by learners' self-regulated process which involves critical attention to existing values and knowledge by examining reflectively in order to lead improvement. It helps foster learners' own motivation and direction to pursue deep learning, as they are not autonomous to achieve such self-regulated process.

The second dimension is personal reflective engagement, in which learners demonstrate awareness of learning expectations and learning outcomes. Learners in this case need to go through the cycle of reviewing, rethinking, reorganizing, repairing and/or reformulating their existing ideas of the learned topics and linking this with their expectations and learning outcomes. This type of reflective engagement is motivated by learning artifacts which address both learners' individual life context and the non-course context of real-world activity as a source for learning and reflection.

The third dimension is social reflective engagement, in which learners make active interactions with peers and teachers for knowledge construction. This type of reflective engagement is motivated by learners' opportunities to interact with peers and teachers, including learning-related dialogs within and beyond class time, for social engagement in the learning community. This study investigated the research question: "To what extent has the "personalized learning hub" initiative embedding BYOD implemented in this study facilitated learners' intellectual, personal and social reflective engagement?"

### 3. Methodology and procedures

This study involved 26 participants who joined an in-service teacher professional development programme in Hong Kong. Both qualitative and quantitative methods were adopted to comprehensively investigate the impact the "personalized learning hub" initiative embedding BYOD on the reflective engagement among learners. The methods included content analysis, questionnaire survey, focus group discussion, semi-structured interview, and open-ended evaluation survey.

#### 3.1. Context

This study adopted convenient sampling (Creswell, 2009) to invite a cohort of 26 in-service teachers in Hong Kong (four from primary and 22 from secondary schools), who were learners of the professional development programme in this study, as participants. All of these 26 participants from 26 schools were interested in e-Learning and willing to join the programme opened for teachers in all 1080 primary and secondary schools in Hong Kong. The normal class size at 26 in the programme gave a reasonable sample size in the study. These participants are experienced teachers in general, with 17.269 years of experience in average (SD = 7.341). Most of these in-service teachers are ICT teachers, with some are majoring in the teaching of other subjects such as Mathematics and Arts. The learners were encouraged to use BYOD as a "personalized learning hub" to engage in the flipped classrooms. The individual learning hub was connected with the hub of peers and the teacher via the free educational social network platform – Edmodo.

#### 3.2. Pedagogical design of the seven-lesson flipped classroom

The in-service teacher professional development programme consisted of seven lessons in flipped classrooms. The objectives of the programme were to provide both theories and practices for learners to understand the issues, opportunities

and challenges related to e-Learning across major subject areas in school context. The programme was designed to equip learners who were in-service teachers with knowledge of “what” is e-Learning and then “how” to implement e-Learning. It was structured to lead learners to first develop the competency in “Using Digital Technology for Learning”; and then to learn about the types of digital resources, ways of digital communication, and ways of using digital technology to collect and analyze evidence of improvement and awareness of progress for e-Learning; and finally to develop the practices of using digital resources, digital communication and digital ways to collect and analyze evidence of improvement and awareness of progress to realize “Learning Facilitated by E-Pedagogy”.

The programme adopted the blended pedagogy and provided learners with immersion experience for deep understanding of sound knowledge and effective strategies to plan and implement e-Learning in school education. The learning tasks engaged learners in reading, discussion and sharing inside and outside of lesson time. Elements related to e-pedagogy were incorporated across seven lessons in flipped classrooms when introducing examples of e-Learning practices for four major subjects in Hong Kong school education sector, namely Chinese, English, Mathematics and General Studies. The seven-lesson flipped classroom was designed to foster learners’ reflective engagement in three dimensions through the learning activities inside and outside classroom. The pedagogical design of the seven-lesson flipped classroom is shown in [Table 1](#).

Firstly, the pedagogical designs in the programme addressed the domain-specific intellectual ideas important for the targeted topics, such as e-Learning framework, e-resources, digital ways of communication and digital ways of collecting learning data in e-Learning, and case studies of implementing and disseminating e-Learning practices across different subjects. In the real-time contact during the seven lessons, learners were engaged in lecturing, discussion and presentation activities. The learners were also arranged for the formative assessment tasks such as reading discussions, quizzes and presentations, as well as summative assessment tasks such as the essay-writing of school-based e-Learning plan. Guidance was provided from the tutor in the form of face-to-face immediate feedback on the preparation of group presentation and online feedback on group discussions. Secondly, the programme provided learners with an orientation for setting the goal of developing a school-based e-Learning plan, in order to raise their personal awareness of learning intentions and expectations. Thirdly, the programme integrated social elements into learning and teaching activities for learning dialogs and interactions among learners, experts and the tutor, including the online discussion tasks, classroom discussion tasks, dialog with invited experts and assignment presentations with whole-class discussions. These pedagogical designs intended to provide learners with multiple channels to access multiple perspectives of intellectual knowledge, and rich opportunities for social interaction with peers and experts. Learners were expected to be able to pursue a genuine understanding of the targeted topics under these pedagogical designs.

### 3.3. Data collection and analysis

Data collection included learners’ pre- and post-reflections about their understanding of e-Learning, learner expectations before the professional development programme and their perceived achievements after the programme, questionnaire on perceptions of the BYOD initiative on reflective engagement in flipped classrooms, learner focus group discussions, a teacher interview, and an open-ended evaluation survey of the in-service teacher professional development programme. The qualitative data on comparing participants’ pre- and post-reflections as well as their learning expectation and perceived achievements were analyzed by two content analyses, respectively. The quantitative data collected from the questionnaire survey was analyzed with the assistance of SPSS software. The qualitative feedback collected from focus group discussions, teacher interview and open-ended evaluation survey were analyzed and summarized systematically.

Content analysis is a research method commonly used for studying recorded human communication in various forms, including text-based entries in electronic textual databases. Researchers need to objectively code and carefully calculate the frequencies and percentages of items of communication in terms of specified characteristics ([Strijbos, Martens, Prins, & Jochems, 2006](#)). Data from a content analysis can be quantified for a quantitative summary of the investigation subjects ([Newby, 2014](#)). In this study, the two content analyses quantified the qualitative codes to give quantitative summaries of participants’ pre- and post-reflections about the target learning topic, as well as their perceived achievement of learning expectations.

#### 3.3.1. Analysis of intellectual reflective engagement

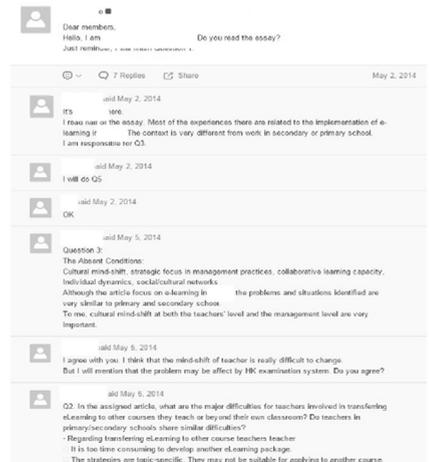
The investigation of learners’ intellectual reflective engagement focused on examining learners’ reformulation of their understanding e-Learning. As mentioned earlier, the term “e-Learning” concerns the deployment of both digital technology and pedagogy for learning support, promoting communication and facilitating assessment in the process of subject learning under the learner-centered paradigm of learning and teaching. Adopting the views of [Haythornthwaite, de Laat, and Dawson \(2013\)](#) and [Kong et al. \(2014\)](#), learners in e-Learning environments usually need to use technology for accessing and sharing resource for learning, teaching and building knowledge; for interacting with learners for communication and collaboration in the learning process; and for using digital tools to capture learning data which are analyzed and presented to understand how learning happens on, with, and through the Internet. In the light of the literature about e-Learning, e-Learning is defined in the following framework that is shown in [Table 2](#).

A rubric was developed for assigning quantitative scores for the learners’ pre- and post-reflections about their understanding of e-Learning. [Appendix I](#) presents the rubric for evaluating learners’ understanding of e-Learning in terms of the dimensions “Using digital technology for learning” and “Learning facilitated by e-pedagogy”. All the learners’ reflections were

**Table 1**

Pedagogical design of the seven-lesson flipped classroom.

Session	In class activity	Outside class activity
1. Setting learning goal and kick off operations in a social learning platform	<ul style="list-style-type: none"> <li>• Orientation: The goal of developing a school-based e-Learning plan</li> <li>• Form learner groups of 4</li> <li>• Assign group presentation/individual presentation/reflection notes</li> <li>• Introduce social network platform - Edmodo to learners and online groups</li> </ul>	<ul style="list-style-type: none"> <li>• Learners submit their pre-reflections about their understanding of e-Learning on Edmodo after class</li> </ul>
2. Introduction to an e-Learning framework and accessing library resources through personal digital devices	<ul style="list-style-type: none"> <li>• Introduction to an e-Learning framework</li> <li>• Introduce learners to available resources in library database and share library database link to [Reading Article-1]</li> <li>• Experience e-Learning in teaching English</li> <li>• A guest speaker who was a frontline teacher shared his experience of BYOD in primary school classrooms</li> </ul>	<ul style="list-style-type: none"> <li>• Learners read [Reading Article-1] on an e-Learning case study and discuss reading questions among groups on Edmodo</li> <li>• Learners to write down their expectation on the course and submit to Edmodo after class</li> </ul>
3. Introduction to school-based planning on e-Learning and browsing e-Learning case studies video	<ul style="list-style-type: none"> <li>• In-class quiz for [Reading Article-1]</li> <li>• Discuss [Reading Article-1] &amp; reading questions with feedback from tutor</li> <li>• Introduction to school-based planning on e-Learning</li> <li>• Review a case on YouTube videos on British Columbia's education plan empowered by technology</li> <li>• Experience e-Learning in teaching Chinese</li> <li>• Share on s Edmodo the citation of [Reading Article-2]</li> <li>• A guest speaker who was the Chairman of Hong Kong Digital Game-based Learning Association shared his experience of game-based learning</li> </ul>	<ul style="list-style-type: none"> <li>• Learners read [Reading Article-2] on dissemination theory and discuss reading questions among groups on Edmodo</li> </ul>
4. Discussion on dissemination theory on diffusion of innovations and pedagogical practices in e-Learning environment	<ul style="list-style-type: none"> <li>• Discuss [Reading Article-2] &amp; reading questions with feedback from tutor</li> <li>• In-class quiz for [Reading Article-2]</li> <li>• Experience e-Learning in teaching General Studies</li> <li>• Share on Edmodo the citation of [Reading Article-3]</li> <li>• Work in groups on group presentations and discuss ideas with tutor</li> <li>• A guest speaker who was an IT in education expert shared his experience of augmented reality in education</li> </ul>	<ul style="list-style-type: none"> <li>• Learners read [Reading Article-3] on technology trend and educational use and discuss reading questions among groups on Edmodo</li> <li>• Learners prepare in groups for a virtual school e-Learning plan</li> </ul>
5. Group presentation on a virtual school-based plan and discussion on bridging the gap between technology and education	<ul style="list-style-type: none"> <li>• Group presentations on a virtual school-based plan on e-Learning</li> <li>• Feedback from tutor and peers</li> <li>• Experience e-Learning in teaching mathematics</li> <li>• Discuss bridging the gap between technology and education</li> <li>• A guest speaker who was an IT in education expert shared his experience of a LMS (Schoolology) for learning and teaching</li> </ul>	<ul style="list-style-type: none"> <li>• Learners read [Reading Article-4] on historical development of e-Learning and discuss reading questions among groups on Edmodo</li> </ul>
6. E-resources for teaching and learning in e-Learning environment	<ul style="list-style-type: none"> <li>• Discussion [Reading Article-4] &amp; reading questions with feedback from tutor</li> <li>• Discuss e-resources for teaching and learning in e-Learning environment</li> <li>• A guest speaker who was a frontline teacher shared his experience of BYOD in secondary school classrooms</li> </ul>	<ul style="list-style-type: none"> <li>• Learners submit their post-reflections about their understanding of e-Learning to Edmodo after class</li> <li>• Learners prepare for their individual school-based plan on e-Learning</li> </ul>



**Table 1** (continued)

Session	In class activity	Outside class activity
7. Individual presentation on a school-based e-Learning plan	<ul style="list-style-type: none"> <li>• Individual presentations</li> <li>• Provide feedback from tutor and peers</li> </ul>	<ul style="list-style-type: none"> <li>• Learners submit reflective note about their learning outcomes onto Edmodo either inside or outside class</li> </ul>

**Table 2**

A framework of defining e-Learning.

Dimensions	Components
Using Digital Technology for Learning	<ul style="list-style-type: none"> <li>✓ Digital resources and digital ways of communication for learning</li> <li>✓ Digital ways to support collection of evidence of improvement and building awareness of progress</li> </ul>
Learning Facilitated by E-Pedagogy	<ul style="list-style-type: none"> <li>✓ Use digital resources and digital ways of communication for pedagogical design and practices to facilitate principles/models/theories for active, constructive and interactive ways of learning in synchronous and asynchronous manner without time and location constraints</li> <li>✓ Use digital ways/means such as learning analytics to facilitate pedagogical decision making in the learning and teaching process</li> </ul>

coded and scored by two research team members as coders. Two research team members who were familiar with the above rubric scored learners' pre-reflections about their understanding of e-Learning given in Session 1 and their post-reflections given in Session 6 for reflective engagement. They individually assigned a score according to the rubrics in [Appendix I](#) for reflections related to each e-Learning component in each reflection given. Then, the coders discussed discrepancies in their scoring results in order to reach a consensus on the final scores that were assigned differently (see [Table 3](#)). The Cronbach's alpha reliability coefficient of this scoring step was 0.865.

### 3.3.2. Analysis of personal reflective engagement

Learner personal reflective engagement was investigated via learner expectations before the professional development programme and their perceived achievements after the programme. The research team scored the coincidence level of learners' expectation toward the professional development programme and their perceived achievement according to a scoring rubric with three levels: score "0" for the Not Match coincidence degree was assigned when the learner's expectation toward the course did not match with his or her perceived achievement; score "1" for the Partially Match coincidence degree

**Table 3**

Examples of the coding process on learners' reflections about their understanding of e-Learning.

#### Scoring of "Use digital resources and digital ways of communication" for learning

"E-Learning is a new type of education via internet, other networks, or with computing devices. It is essentially a network-enabled skill and knowledge transfer process. E-Learning also refers to the adoption of electronic applications and practices like flipping classroom and digital collaboration. The content is delivered via the Internet, intranet, QR code or other types of media."

#### Scoring results

- Coder 1: Score "3"
- Coder 2: Score "4"
- ✓ Final consensus: The version of Coder 1 was adopted because the learner did not explicitly cover the aspect of using digital resources in e-Learning.

#### Scoring of "Use digital resources and digital ways of communication for pedagogical design and practices to facilitate principles/models/theories for active, constructive and interactive ways of learning in synchronous and asynchronous manner without time and location constraints"

"Technology changes rapidly, students behaviors are also affected. However, the education system is not yet changed. Many scholars observe this and propose a revolutionary method, which highly depends on the benefit of using technology to assist teaching and learning. This is the foundation of e-Learning. It will bring a huge impact on the education system. With suitable pedagogy, it can fit with many teaching theories or models, for example, student-directed learning, collaborative learning, self-discovery method and etc. However, there are still obstacles to overcome and it takes time for teachers to integrate new technologies in their conventional teaching practices."

#### Scoring results

- Coder 1: Score "3"
- Coder 2: Score "4"
- ✓ Final consensus: The version of Coder 1 was adopted because the reflection only mentions the application of technology in various pedagogical models; it does not specifically cover the use of digital resources to facilitate learning.

#### Scoring of "Use digital ways/means to collect and analyze learning related data such as learning analytics to facilitate pedagogical decision making in learning and teaching process"

"E-learning is one of the trendy mode of learning though a comprehensive package of e-resources, e-communication, new methodology of teaching, educational stakeholder's passion and expectations, school and social culture. We cannot resist the change of learning from happening in daily life. The key of effective learning must involve "learning at all time, at anywhere with the right tools".

#### Scoring results

- Coder 1: Score "0"
- Coder 2: Score "1"
- ✓ Final consensus: The version of Coder 1 was adopted because the reflection does not mention anything related to the use of digital ways or tools to collect and analyze learning related data in the learning and teaching process.

**Table 4**  
Results of learners' pre- and post-reflection about their understanding of e-Learning.

Score of pre-reflections about their understanding of e-Learning (Max. score = 12)		Score of post-reflections about their understanding of e-Learning (Max. score = 12)		t-test
Mean	SD	Mean	SD	
3.000	1.095	5.577	2.043	5.626***

\*\*\*p < 0.001.

was assigned when the learner's expectation toward the course partially matched with his or her perceived achievement; and score "2" for the Match coincidence degree was assigned when the learner's expectation toward the course matched with his or her perceived achievement.

In addition, an eight-question survey on a 5-likert scale (from 1 = strongly disagree to 5 = strongly agree) was carried out to understand learner perceptions about their reflective engagement (see Table 6). The Cronbach's alpha reliability coefficient of this survey was 0.805.

### 3.3.3. Analysis of social reflective engagement

Learner personal reflective engagement was explored using a six-question survey on a 5-likert scale (from 1 = strongly disagree to 5 = strongly agree) and learner focus group interviews and teacher interview (see Table 8). The Cronbach's alpha reliability coefficient of this survey was 0.765.

### 3.3.4. Analysis of the overall results of reflective engagement

The overall results of reflective engagement among learners were investigated by an anonymous open-ended evaluation survey at the end of the in-service teacher professional development programme. Among the 26 learners, there were 18 responses made regarding the impact of the in-service teacher professional development programme.

## 4. Results and discussions

This section presents the results of learners' reflective engagement in three dimensions regarding intellectual, personal and social reflective engagement. The overall results on reflective engagement are also discussed.

### 4.1. Results and discussions of intellectual reflective engagement

The results of content analysis of learners' understanding of e-Learning before and after the in-service teacher professional development programme show that the BYOD initiative implemented in this study could facilitate learner intellectual

**Table 5**  
Examples of the results of learners' pre- and post-reflections about their understanding of e-Learning.

Pre-reflections	Post-reflections
<p><i>Example 1: From Score 3 to Score 10</i> "E-Learning means students learn knowledge and skills by themselves with internet media, e-books and etc."</p>	<p>"E-Learning is one of the approaches to drive the transformation of pedagogies and facilitate paradigm shift in teaching and learning. Teacher-centered learning gradually becomes more student-centered and learning is no longer restricted to time and location. Students can get online and use teaching materials prepared by the teacher to learn systematically. With computers, internet, e-books and other electronic media, students can learn knowledge and various skills. It can facilitate students to do self-learning and equip them with 21st century skills."</p>
<p><i>Example 2: From Score 3 to Score 7</i> "E-Learning includes any learning activity that involves the use of electronic devices or media."</p>	<p>"E-Learning is one of the trendy mode of learning with an integrative use of e-resources, e-communication and new methodology of teaching. It concerns with school stakeholders' passion, expectation and the school's culture. It also means a new form of learning supported by the right kind of tools that could happen anytime, anywhere."</p>
<p><i>Example 3: From Score 3 to Score 6</i> "E-Learning is about using digital devices for teaching and learning, it also involves the use of internet and digital tools. It is a new mode of learning."</p>	<p>"E-learning is a new type of education with the use of internet, social networks and computing devices. It is essentially the transfer of skills and knowledge through a network supported by technology. It involves adopting different applications and pedagogical practices, including web-based learning, flipping classroom and collaborative learning supported by digital tools. E-Learning course content is delivered online and in various forms."</p>

**Table 6**  
Survey results of learner personal reflective engagement (n = 24).

Question: I Think the implementation of the BYOD initiative	Mean <sup>a</sup>	SD
Empowers my control over learning	4.042	0.464
Stores my learning outcomes efficiently	3.958	0.550
Improves learning motivation in class	3.917	0.584
Facilitates understanding of the topics by getting access to course-related e-resources	3.833	0.637
Enlightens me to have effective study methods and skills	3.792	0.779
Fosters self-reflection of learning after class	3.750	0.442
Keeps track of my learning progress	3.750	0.676
Arouses my attention to the lecture	3.667	0.565

<sup>a</sup> 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree.

**Table 7**  
Examples of learners' expectation of the professional development programme and their perceived achievement.

Score/Degree	Example of expectation	Example of achievement
1/Partially Match	"To learn the possibilities and the latest development of e-Learning and see if it is appropriate to implement in my school and in the subject I teach."	"In this course I got to know about many useful digital tools and e-resources. I also got to see experiences of other schools in adopting e-Learning. What's more, this course introduced me to the future development of e-Learning and provided abundant information in this area. I could bring these materials back and help explore the possibility of implementing e-Learning in my school."
2/Match	"I expect to learn what is e-Learning and what are the appropriate resources and pedagogies. I also expect to experience what is e-Learning through practice, discussion and sharing."	"I have learned why/how/what/when to implement e-Learning in school and the experiences as well as pedagogies to make e-Learning effective in the process of teaching and learning. In the process of coming up with our own e-Learning plan, we learned through tutorial, discussion, sharing and exploration. Reflectively speaking I think a mix of teaching strategies might be the key to minimize learning differences among learners."
2/Match	"Firstly, I expect to learn what is e-Learning and how to implement e-Learning in school. Secondly I also look forward to school visit and sharing from other teachers."	"I have learned what is e-Learning, how to make use of various e-Learning applications to increase learners' learning motivation, how to implement e-Learning in schools and how to select e-resources. I think experience sharing from fellow learners working at various schools, their plans for implementing e-Learning, the school visit and also the journal articles on e-Learning were all helpful for me."

reflective engagement. From Table 4, the statistical comparison of learners' scores on the pre- and post-reflections about their understanding of e-Learning found that the learners had a significant increase in the depth in defining e-Learning. In general, among the 26 learners in this study, 22 learners made a score increase in defining e-Learning, in the range from 1 to 7 scores, after the programme.

By comparing the details in their reflections, the learners are found to have limited their understanding of e-Learning on the technological issue before the programme; and deepened their understanding of e-Learning by addressing both the technological and pedagogical issues after the programme, as the examples shown in Table 5.

Before the programme, almost all the 26 learners defined e-Learning with the only emphasis on the dimension of "Using Digital Technology for Learning", focusing on the aspect of "digital resources for learning". After the programme, the learners could deepen their understanding of e-Learning by covering more aspects under the two dimensions of e-Learning. The learners' reflections could show their growth of understanding in two major areas: first, e-Learning not only emphasizes the use of digital resources for learning, but also the use of digital ways of communication for learning; and second, e-Learning implementation considers both technological and pedagogical issues for learning, in order to use digital resources, digital ways of communication, and digital ways to collect and analyze evidence of improvement and awareness of progress for facilitating active, constructive and interactive ways of learning.

**Table 8**  
Survey results of learner social reflective engagement (n = 24).

Question: I Think the implementation of the BYOD initiative	Mean <sup>a</sup>	SD
Enhances course-related interaction with lecturers	4.000	0.600
Enhances course-related interaction with peers	3.958	0.550
Stimulates my desire of exploring course-related e-resources	3.958	0.690
Fosters collaboration in course work	3.917	0.408
Provides instant feedback from peers	3.750	0.532
Provides instant feedback from lecturers	3.750	0.608

<sup>a</sup> 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree.

The above results indicate that the “personalized learning hub” initiative embedding BYOD could facilitate learners' intellectual reflective engagement. The learners were promoted to reflectively examine their original thoughts of e-Learning with much emphasis on the technological elements in teaching process; and then critically incorporated the new ideas learned from the programme to improve their understanding of e-Learning; and finally developed a wider perspective of various technological and pedagogical concerns on e-Learning for knowledge construction and skills development.

#### 4.2. Results and discussions of personal reflective engagement

Table 6 shows that learners in general perceived the enactment of BYOD initiative positively impacted on their personal reflective engagement with the average mean above 3.6 for all items. The learners recognized most the impact of the designed initiative on empowering their control over learning. The learners also considered the designed initiative could facilitate them to store their learning outcomes efficiently, improve their learning motivation in class, and develop understanding of the topics with an access to course-related e-resources.

The study also compared learner expectations before the professional development programme and their perceived achievements after the programme for investigating learner personal reflective engagement. The comparison results indicate that the 26 learners perceived they could achieve their expectations after the professional development programme. The average score of coincidence degree among the 26 learners is 1.692 (SD = 0.471), with score “2” (Match coincidence degree) was assigned to 18 learners and score “1” (Partially Match coincidence degree) was assigned to 8 learners. Table 7 shows some examples of learners' expectations before the professional development programme and their perceived achievements after the participation in the programme.

As shown in Table 7, the learners agreed that their achievements in the in-service teacher professional development programme could meet their expectations for the opportunities to reach appropriate resources and pedagogies for e-Learning, experience e-Learning through practice, discussion and sharing, deepen understanding of e-Learning implementation in school, and join school visits for sharing e-Learning experience.

The above results indicate that the in-service teacher professional development programme could facilitate learners' personal reflective engagement. The learners expected to understand more the theoretical definition, development trends, appropriate resources, useful practices and experience sharing of e-Learning. At the end of the programme, the learners were aware of their learning outcomes meeting their learning expectations, as they were provided with many opportunities to explore the related issues for their informed decisions on e-Learning planning.

#### 4.3. Results and discussions of social reflective engagement

The learners were found to demonstrate social reflective engagement under the designed initiative. Table 8 shows the survey results of learner social reflective engagement with the average mean above 3.7 for all items. The learners agreed that the designed initiative could help enhance their course-related interactions with lecturers and with peers. They also recognized the positive impact of the designed initiative on stimulating their desire of exploring course-related e-resources and fostering collaboration in their course work. It is observed that learners' language ability affected their level of engagement in face-to-face interaction and online interaction respectively. Learners who had good language ability participated in online interactions more actively. These results reveal that the learners valued the good mix of online interactions and face-to-face interactions in the “personalized learning hub” initiative embedding BYOD for a better learning experience.

The results of learner focus group discussions (see Table 9) and teacher interview (see Table 10) provide further evidence on the social reflective engagement made by the learners under the BYOD initiative in flipped classrooms. In the focus group discussions, the learners indicated that the designed initiative could support them to experience more interactions in the learning process both inside and outside classroom. They pointed out that there were in-class learning tasks which required the

**Table 9**

Changes brought about by the implementation of the BYOD initiative in learner reflective engagement.

Major feedback from learner focus group discussions	
Changes in learning in the classroom	By replying to questions posted online, a whole class of learners got to respond to the teacher. Provided with an alternative way of communication, quiet learners were more engaged in sharing ideas, giving comments and participating in discussion. Learners were able to take more control over their learning, in terms of the pace of learning, the use of learning materials and the time for learning. Since more online resources and new tools were available, learners could learn from completing interactive tasks in class, through researching and exploring on their own or in collaboration with others and they no longer relied on teacher's lecturing. Learners' motivation in learning is higher.
Changes in learning outside the classroom	With use of online social networking platform and learning management system, teaching and learning could be extended from inside classroom to outside of classroom and be more learner-centered. Learners could use their mobile devices to learn anywhere, anytime. The use of online platforms enabled learners to reply to questions posted by the teacher, view responses from peers and discuss with them whenever and wherever convenient after class, which provided learners with inspiring thoughts, suggestions for improvement and chances to reflect.

**Table 10**  
Changes brought about by the implementation of the BYOD initiative on teaching practices.

	Major feedback from teacher interview
Changes in teaching in the classroom	Class management was different as the teacher's responsibility was to stimulate learners' thoughts, providing them with opportunities to be engaged in learning activities and to explore, instead of regulating learners in class.
Changes in teaching outside the classroom	Online platforms and other ways of digital communication channels enabled the teacher to connect with learners outside classroom, which in a way helped the teacher to better facilitate learners who had busy schedules on their own. The use of social networking platform and learning management system had enabled the teacher to better monitor and document learners' progress in study as in this way assignments, quiz results, discussion and other interaction records could all be recorded. With more feedback on learners' learning, the teacher could evaluate the effectiveness of his teaching and refine course design and teaching materials in a timely manner. Additionally, he could again respond to learners' need and further stimulate their thought with comments, feedback and etc. Since the teacher was presented a variety of materials and new tools to be used in teaching, he needed more preparation for selecting appropriate resources and tools, as well as re-designing his course. As learners were using their own devices, in addition to preparing for teaching, the teacher also need to handle technical problems and prepare backup plans for learners when their devices did not work well.

whole class to respond to online postings; and this prompted all learners, including the quiet ones, to interact with peers and the teacher for sharing ideas, giving comments and participating in discussion. The learners also pointed out that these online discussions were extended after class time; and this encouraged them to think deeply and reflect more on the learned topic.

The results of teacher interview concur with the perception of learners that the BYOD initiative could enhance learners' social reflective engagement in the learning process. The teacher especially agreed with the role of the designed initiative in enhancing teacher–learner interaction outside the classroom. The teacher pointed out that he could better facilitate learners who had busy schedules on their own to keep learning progress via the ways of digital communication. The teacher could also better monitor and document learners' learning progress through the use of social networking platform and learning management system for storing learning outputs and recoding discussion tracks.

The above results indicate that the “personalized learning hub” initiative embedding BYOD in the in-service teacher professional development programme could facilitate learners' social reflective engagement. The learners found the increased opportunities to interact with peers and teachers for knowledge construction. The learners appreciated the rich experiences and practical ideas shared by peers and teachers in group presentation and course lecturing, which widened their perspectives in planning e-Learning initiatives in their own schools.

#### 4.4. Overall results and discussions of reflective engagement

In summary, the BYOD initiative could facilitate learners to accomplish the intellectual, personal and social reflective engagement in flipped classrooms in the higher education sector. According to the 18 additional responses from the learners in the programme evaluation survey (see Table 11), the BYOD initiative had an evenly positive impact on learners' reflective engagement in the intellectual, personal and social dimensions.

The learners highly recognized the impact of the BYOD initiative on supporting them to understand and reflect on e-Learning, such as the basic rationale, central focus, holistic definition, development trends, implementation ways and future expectations. This fostered their intellectual and personal reflective engagement of e-Learning.

**Table 11**  
Overall impact of the BYOD initiative on reflective engagement (learners' responses in the open-ended question on the programme evaluation survey).

Responses from learners	Count	Intellectual	Personal	Social
The programme could enhance my understanding of e-Learning (e.g. basic rationale, central focus, development trends, etc.).	4	✓	✓	
The programme could stimulate my reflection on e-Learning (e.g. holistic definition, implementation ways, future expectations, etc.).	3	✓	✓	
The programme could change my mindset and steps for e-Learning implementation.	1		✓	
The course lecturer and course materials helped me to better understand e-Learning (e.g. theoretical background, pedagogical demonstrations, latest development, etc.).	4	✓		✓
The practical implementation examples and interactive lesson tasks helped me to better implement e-Learning (e.g. useful tools, pedagogical practices, etc.).	2			✓
The experience sharing from guest speakers and other classmates helped me to think deeper about e-Learning.	4			✓
Total	18	11	8	10

The learners also highly appropriated the increased interactions with teachers and peers under the BYOD initiative. They thought the course contents delivered by the lecturer and the experience sharing provided by the guest speakers and other classmates could promote them to understand better and think more deeply about various issues related to e-Learning, such as the theoretical background, pedagogical demonstrations and latest development of e-Learning.

## 5. Conclusion and implications

The article reports on a study of investigating the impact of the “personalized learning hub” initiative embedding BYOD on learners’ reflective engagement at a higher education institute. Emerging from the literature, a reflective engagement framework was developed with three dimensions. The BYOD initiative underpinned by the reflective engagement framework was investigated through its implementation in a teacher professional development programme with 26 in-service teachers as participants. The designed initiative is found to be able to support learners to attain intellectual, personal and social reflective engagement. There are three implications from this study.

Firstly, the results imply that the use of a reflective engagement framework with the “personalized learning hub” initiative embedding BYOD can support learners in the higher education sector to access sufficient e-resources for learning exploration and to conveniently make social interactions with peers and teachers anytime, anywhere. These can enrich learners’ experience in interactive learning for knowledge construction with self-reflection, and therefore promote the achievement of deep learning.

Secondly, this study found that the reflective framework was able to guide the teacher to design learning tasks that made learners aware of the domain-specific intellectual ideas important for the targeted topics, the link between their personal learning intentions and expectations, and the support from social interactions with peers in the learning process. It reveals the need of a framework to guide pedagogical designs for reflective engagement. Learners seldom make reflective engagement automatically during the learning process. Personal learning hub is a means for achieving the goal of reflective engagement in the learning process which has to be guided by a framework.

Thirdly, this study had a successful experience in the effective integration of flipped classrooms strategy with the “personalized learning hub” initiative embedding BYOD. It is attributed to the interlocking relationship between the vigorous interpersonal interactions inside the classrooms which triggered and extended the learning activities related to the role of “personalized learning hub” outside the classroom as discussed above. There were three types of vigorous interpersonal interactions happened inside the flipped classroom in this study, as indicated in the overall evaluation results of the professional development programme: the sufficient and professional inputs from course lecturer, the unique expert sharing from guest speakers, and the dynamic and supportive contributions from all learning peers in the classrooms. These vigorous interpersonal interactions inside the flipped classrooms contributed to learners’ active access to online readings, just-in-time discussions for constructing a deep understanding of domain knowledge, and critical reflection on the learned knowledge outside classrooms. It reveals the importance of opportunities for learners to have social interactions and personal reflections to achieve active, constructive and interactive learning inside and outside classroom with the support of “personalized learning hub”.

The integration of the reflective engagement framework with the “personalized learning hub” initiative embedding BYOD can benefit learners to enrich face-to-face learning inside classroom and extend learning discussions outside classroom. There are two directions for future research in this area. First, future research should validate the designed framework, through extending the use of the reflective engagement framework and the “personalized learning hub” initiative embedding BYOD to more learning scenarios. Second, future research should enhance the related teacher professional development, through adopting the reflective engagement framework and the “personalized learning hub” initiative embedding BYOD for teacher professional development in higher education, and exploring the impact of such professional development on teaching effectiveness.

## Appendix I. A rubric for evaluating learners’ understanding of e-learning

Dimension	Score	Description
<b>Component A</b> Use digital resources and digital ways of communication for learning	4	The answer covers explicitly both the aspect of using digital resources for learning and the aspect of digital ways of communication for learning includes wordings like “using digital resources ... for learning” and “using communication tools ... to support learning”.
	3	The answer touches upon implicitly using digital resources or electronic devices to support learning and communication, and mentions examples of digital resources or digital ways of communication to support learning and teaching, includes wordings like “using ICT ... to support learning and enhance communication”.
	2	The answer covers examples on both using digital resources and using digital ways of communication for learning” includes example such as “using internet and e-books to support learning”.

(continued)

Dimension	Score	Description
	1	The answer covers only either one example of digital resources OR digital ways of communication for learning with examples such as “using e-books for learning”.
	0	The answer does not cover any wordings related to using digital resources for learning or using digital ways of communication for learning.
<b>Component B</b> Use digital resources and digital ways of communication for pedagogical design and practices to facilitate principles/models/theories for active, constructive and interactive ways of learning in synchronous and asynchronous manner without time and location constraints	4	The answer covers both the ways of learning and teaching supported by using digital resources and using digital ways of communication for pedagogical design and practices to facilitate principles/models/theories for active, constructive and interactive ways of learning in synchronous and asynchronous manner without time limitation and location constraints.
	3	The answer covers the ways of learning and teaching supported by either using digital resources OR using digital ways of communication for pedagogical design and practices to facilitate principles/models/theories for active, constructive and interactive ways of learning in synchronous and asynchronous manner without time and location constraints.
	2	The answer covers examples of pedagogical design and practices on both using digital resources and digital ways of communication to support learning and teaching without elaboration.
	1	The answer covers only examples of pedagogical design and practices on either using digital resources OR digital ways of communication to support learning and teaching without elaboration.
	0	The answer does not cover any ways or examples of pedagogical design and practices on learning and teaching supported by using digital resources and digital ways of communication.
<b>Component C</b> Use digital ways to support collection and analysis of evidence of improvement and building awareness of progress	2	The answer covers the discussion of using digital ways to support collection and analysis of evidence of improvement and building awareness of progress.
	1	The answer covers examples of using digital ways to support collection and analysis of evidence of improvement and building awareness of progress.
	0	The answer does not cover any uses of digital ways or tools to support collection and analysis of evidence of improvement and building awareness of progress.
<b>Component D</b> Use digital ways to collect and analyze learning related data such as learning analytics to facilitate pedagogical decision making in the learning and teaching process	2	The answer covers discussion on digital ways to collect and analyze learning related data such as learning analytics to facilitate pedagogical decision making in the learning and teaching process.
	1	The answer covers examples of using digital ways to collect and analyze learning related data such as learning analytics to facilitate pedagogical decision making in the learning and teaching process.
	0	The answer does not mention anything related to the use of digital ways or tools to collect and analyze learning related data in the learning and teaching process.

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