Co-creating with students to promote science of learning in higher education: An international pioneer collaborative effort for asynchronous teaching

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ABSTRACT

Recent insights from Science of Learning (SoL) are informing instruction, training, and curriculum. Here, we present a project on promoting SoL-related content through co-creating online asynchronous learning resources. By building a 7-person cross-institution team, we strategically harnessed (1) student-faculty partnerships as a *mechanism* to promote training and professional development, (2) co-creation as a *model* to curricula development, (3) blended asynchronous learning as a *modality* for content delivery, and (4) *internationalization* as a strategy to embrace globalization. This co-creation of curricula project included three stages—literature review, design and production, and evaluation. The project evaluation deployed a mixed methods approach with 6 student evaluators across both participating institutions, who explored the effectiveness of the learning resources. In addition, student partners contributed reflective statements on their co-creation experience. This paper reports on the procedural pipeline to co-creation and the project evaluation, as well as on new insights emerging for curriculum development. We conclude that project's co-created learning resources may enhance effectiveness of instructional design and students' learning experience. Further, we demonstrate that student partners acquire new knowledge and research, design and delivery skills, futureproofing their academic progression.

1. Introduction

A recent working definition by Privitera et al. (p.13, [1]) describes Science of Learning (SoL) as "the scientific study of the underlying bases of learning with the goal of describing, understanding, or improving learning across developmental stages and diverse contexts." In higher education, the demand for certificates, diplomas, degrees, and research centres in SoL has increased considerably during the last years [2]. This is because the purpose of many SoL programs is to elaborate on pedagogical approaches that faculty and students can use to enhance teaching and learning [3]. As a result, new conceptualizations congruent

with SoL are emerging to instruction, training, and curriculum [4].

Globally, the dominant educational model in higher education is the *student as customer or client* [5]. This model, however, has been challenged by other approaches that position the student as an active learner [6]. Among these, the *student as partner* model has gained traction during the last years as it promotes different levels of synergy with faculty [7]. Accordingly, *student-faculty partnerships* are defined as "a collaborative, reciprocal process through which all participants have the opportunity to contribute equally, although not necessarily in the same ways, to curricular or pedagogical conceptualization, decision making, implementation, investigation, or analysis" (p.7, [8]). As this approach

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deliberately emphasizes the importance of student engagement [9], the evidence shows that they largely benefit from these partnerships. For instance, after engaging students as teaching and learning consultants, Jensen and Bennett [10] reported improvements in their confidence, communication skills, and self-awareness.

Overall, the literature indicates that student-faculty partnerships have numerous positive outcomes by enhancing student engagement; motivation and learning; metacognitive awareness; sense of identity; self-efficacy; teaching and learning skills; and student-staff relationships [11,12]. For example, Amdal and Endresen-Maharaj [13] published findings from a thematic analysis of 38 reflections from pre-service teachers who had participated in the planning of learning resources alongside faculty during their degree studies. Here, the student partners reported on increased feelings of being valued and empowered, while their perspectives aligned with an overarching framework of educational 'democracy' through direct engagement with the learning design and content selection process.

Under the umbrella of student-faculty partnerships, the concept of *co-creation* emerges to enhance the quality of teaching and learning. Co-creation was originally proposed in business and marketing to offer experiences for customers to actively co-construct personalized experiences that best suit them and that can result in innovations [14]. Dollinger and colleagues [13] adopted some of these assumptions and proposed the first conceptual model of co-creation in higher education, suggesting that students, faculty, and their institutions can benefit in various ways. Such ways include quality student–faculty interactions; student satisfaction; graduate capabilities; student loyalty; university image; and student-university identification. An interesting example of such successful co-creation comes from the work of Chandanarana et al. [16], who reported on the relative effectiveness of student-faculty co-creation of digital learning curricula. In this study, the authors examined the student partners' positive response to being equal participants in the design process, particularly in terms of gaining a better understanding on the role of educators, and developing solid interpersonal skills [16]. Another example of successful co-creation is described in a recent paper by Tsui et al. [17], whereby their case study of whole-class curricular co-creation reports on the benefits of working collaboratively with faculty, with the students specifically reflecting on enhanced ownership of the learning process facilitated by the meaning-making processes. Therefore, co-creation is clearly relevant for the student as partner model by allowing for authentic engagement experiences, with curriculum co-creation gaining traction during recent years [19]. Beyond the student perspective, the broader curricular co-creation literature also includes evidence of the benefits to participating faculty. In one such example, Nunes and colleagues report that faculty reflected on the increased capacity for proactivity and positive increase of a sense of connection between taught content and its wider embedded context [18].

In higher education, developments in blended learning curriculum, assessment, and practice remain of special interest [20,21]. Blended learning—a combination of online and the traditional face-to-face on-campus format [22]—has greatly facilitated education worldwide. The educational literature has several examples of practice and research findings on the relative effectiveness of blended learning environments. Prior to the COVID-19 pandemic, such findings relayed that blended learning served to connect geographically distant students for collaborative learning. During the pandemic, however, blended learning became drastically and massively utilized within institutions in an effort to continue with a 'business as usual' approach in implementing educational programs during restrictive times [23]. A substantial body of research on best practices to enhance students' experiences in online environments has been conducted. The evidence points to the importance of a well-balanced instructional design [24], as well as the incorporation of multiple strategies that target three levels of engagements: student-to-student, student-to-instructor, and student-to-content [25]. Recent investigations have showcased the types of online activities

that may effectively complement the face-to-face learning dynamic more explicitly. For instance, Vermeulen and Volman suggest that engagement is most effective when three types of learning activities are experienced: those aligning with behavioural engagement, those tapping into affective engagement, and those recruiting suitable levels of cognitive engagement [26]. In a recent literature review by Meylani [27], a collection of online learning environment characteristics that increase student engagement was posited. Such characteristics include mixed educational methods and formats, immediate feedback on assessments (formative and/or summative), facilitation of reflective thinking, universal accessibility, structural support to the learning process, and variability of learning experiences [27]. Since online learning implies a major reconceptualization and reorganization of the student-instructor dynamic, shifting to effective blended learning has been a complex transition for educational systems [28]. Multiple pedagogical and technological matters were masked by the traditional face-to-face setup. Student engagement, for example, has surfaced as one of the biggest challenges of blended learning. Different sources of information point to the fact that, in online environments, students experience low engagement compared to face-to-face sessions [29].

Despite significant discourse on online learning, there are limited studies in comparison that focus solely on its asynchronous components. Although a number of research papers explored this topic in the early 2000s, the focus was on the efficacy of massive open online courses (MOOCs) [30,31,32]. This is surprising because the asynchronous modality is currently in high demand [33], particularly following the pandemic. Blended learning with asynchronous components is more flexible compared to synchronous approaches as it allows students to study on their own schedule and pace within a certain timeframe and handling different time zones.

To effectively engage students in blended learning, faculty not only must tap into pedagogical and technological approaches that are effective, but also that can be consumed across multiple countries. According to Knight, the internationalization of higher education integrates international, intercultural, and global dimensions with the functions (e. g., teaching and research) and delivery of service at both local and national levels [34]. In the last decades, institutions have included internationalization as a strategic component of their programmatic plans [35] and the student body has become increasingly diverse. Consequently, the incorporation of experiences that embrace diversity, equity, and inclusion is critical. For global connectedness and lifelong learning, students should acquire cross-cultural knowledge and skills that help them understand and respect different cultures, norms, values, and behaviours [36]. In blended learning, students recognize the benefits of being exposed to geographical, disciplinary, cultural, and social diversity [37].

Recommendations to enhance the quality of education for all students include curriculum internationalization and cooperation among institutions across the globe [38]. Creating positive learning experiences to achieve a more international classroom environment requires special considerations. In blended learning environments, faculty acknowledge the need to be trained on the best pedagogical and technology-mediated practices to educate cross-culturally [39] and, therefore, assisting them to effectively internationalize their teaching has become imperative in higher education.

1.1. Objective

In this paper, we describe our international student-faculty partnership as a case study in the co-production of online learning resources, alongside its subsequent evaluation (see Fig. 1). We do this by first presenting the procedural pipeline through which the partnership (2 faculty members; 1 based in a European University, EU, and 1 in an Asian University, AU, and 5 students; 3 based in EU and 2 in AU) developed the resources, and then presenting the evaluation for which a further 3 undergraduate (UG) students from each participating

institution (total $N = 6$) were recruited as student evaluators to provide their subjective perspective on the usefulness and value of the resources. We finally present a reflective overview from the student partners (total $N = 7$) in terms of their perceived value in participating in the co-design process. There are limited examples of student-faculty partnerships with focus on curriculum co-creation for blended learning [40,17,13]. To the best of our knowledge, this is the first paper to report on an international student-faculty partnership, working towards the joint purpose of designing learning resources for use with a global higher education audience.

To promote SoL teaching and learning, this project drew on (1) student-faculty partnerships as a *mechanism* to promote training and development, (2) co-creation as a *model* for curriculum development, (3) blended asynchronous learning as a *modality* for content delivery, and (4) *internationalization* as a strategy to embrace globalization. This partnership, therefore, aimed to co-produce asynchronous learning resources for teaching SoL related topics in higher education by harnessing the value of an international collaboration. In doing so, we implemented numerous pedagogical and technological approaches to improve students' learning outcomes and to mitigate against challenges to effective blended asynchronous teaching.

2. International student-faculty partnership procedural pipeline

2.1. Overview

This partnership was conceptualised as a result of a collaboration between two faculty members, through their joint application to a cross-institutional educational innovation seed funding scheme. The topics of the lessons, i.e., memory and attention, were chosen during the application process. Once the funds were awarded, the international collaboration was leveraged by a 7-person cross-institution team organized by the two faculty members and five student partners with paid positions (see Fig. 1A). The partnership was fixed term and officially ran between January and October 2023 (see Fig. 1C), using guiding principles and

strategies provided by Cook-Sather et al. [41] as a framework. The team organized study related resources in a shared folder in Microsoft One-Drive and participated in weekly 1-hour meetings on Microsoft Teams. The evaluation process for outcomes of this project was approved by Imperial College London Educational Research Ethics Process.

2.2. Curricular co-creation process

The co-creation of curricula of this project included three stages—literature review, design and production, and evaluation (see Fig 2B).

2.2.1. Stage 1: literature review

The objective of the initial literature review stage was to identify and critically evaluate scholarly sources on memory and attention for asynchronous learning in higher education from a variety of information sources, including scientific publications, book chapters, videos, blogs, websites, etc. A Microsoft Word document was set up to outline the stage objective, milestones, and deliverables, and to distribute responsibilities among the team.

To search for scholarly sources, we identified key terms, such as "asynchronous learning" and "blended learning" in relation to the two topics chosen for the lessons. The team cooperated to curate a wide array of scientific publications and other materials (videos, blogs, websites, etc.) related to memory and attention, focusing on teaching content and instructional formats. The sources were condensed and summarized in a Microsoft Excel document, emphasizing its relevance to the main topics and the subsequent ideation of lessons was based on these curated sources.

With guidance from the faculty members, student partners generated preliminary ideas for the learning design, teaching methods, and instructional plans. Insights from the literature review and lessons' ideation were compiled in tabular format in a Microsoft Excel document. This compilation served as the basis to determine the lessons' content, format, and assessments. In terms of content, selected sources were further explored to identify strengths and weaknesses. Regarding
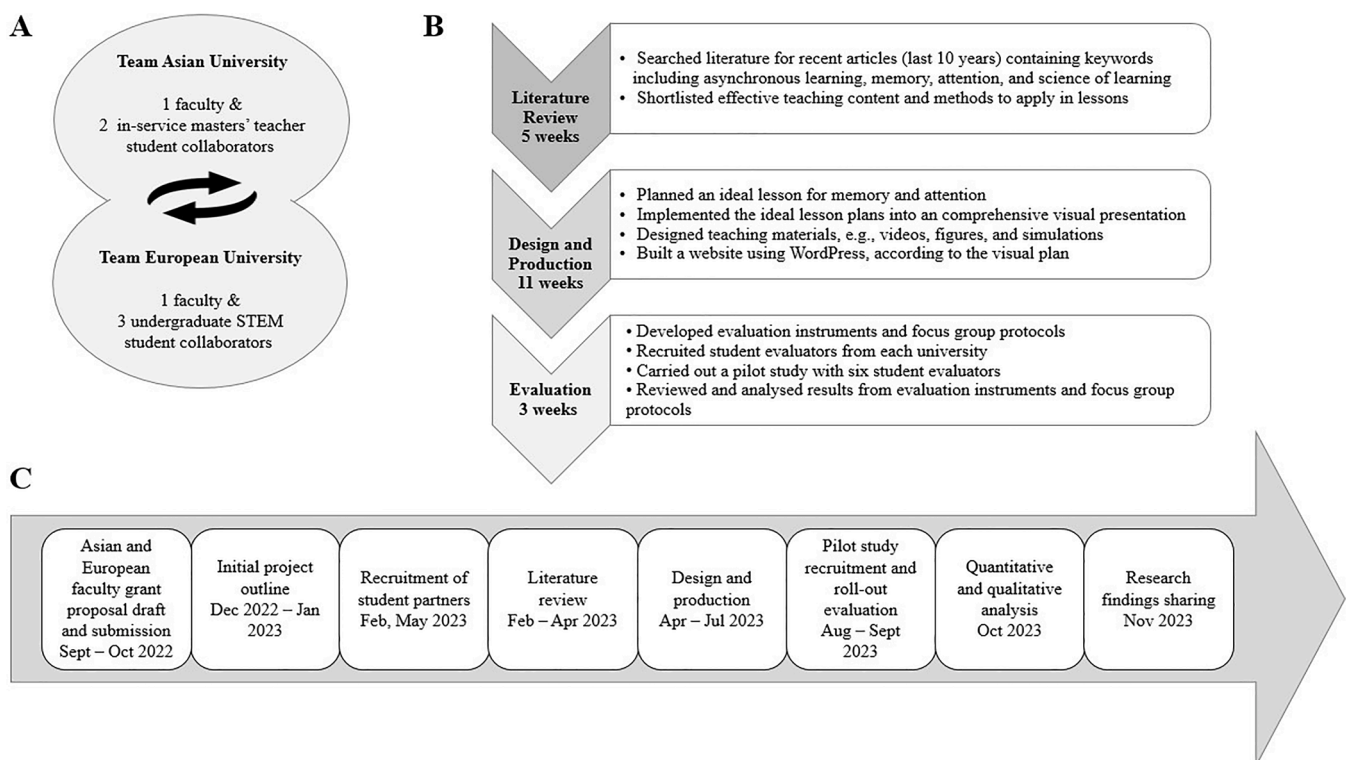

Fig. 1. Project outline (A), student-faculty partnership (B), and 3-stage project process (C).

format, preferences for diagrams, videos, activities, and experiments were highlighted. For the assessments, we decided on using fact-based quiz-style questions in both multiple-choice and open-ended formats to efficiently assess learners' grasp of knowledge and enhance inter-activity with the content.

Approximately 5 weeks were allocated to this stage, where over 120 sources were reviewed. Key takeaways from each source were discussed during the team meetings, along with suggestions as to how these could inspire the design and production of both lessons. The team also iden-tified research gaps to inform which further resources to consider. The literature review stage included the refining of lessons' content, format, and assessments throughout.

2.2.2. Stage 2: design and production

Informed by recommendations on best practices [15,42], the objec-tive of this stage was to design and produce 2 complete and autonomous 3 hr-long lessons on memory and attention intended for asynchronous learning in higher education. An additional goal was to ensure that the two lessons would be similarly effective and useful for international non-disciplinary learners, meaning resources equally accessible and engaging regardless of geolocation and disciplinary background.

The team used a shared online working document to outline the two lesson plans. This process involved deciding upon the intended learning outcomes (ILOs); selecting suitable content and materials; introducing background knowledge; adjusting the content difficulty suitable for undergraduate students; and elaborating assessment components (e.g., quizzes). We also organised the content into sections and rearranged these in a logical manner to improve the lessons' flow. Addressing the lack of interactivity typically reported in asynchronous learning, several activities and lab tasks for application of the taught content were incorporated. To ensure lessons' duration, we designated timeframes for each content section and placed indicative breaktimes.

Subsequently, we translated the lesson plans into a visually acces-sible format using Microsoft PowerPoint, considering the use of diverse presentation formats like text, videos, animations, figures, and flow charts. We also worked on the logistics of incorporating interactive teaching tools, including discussion boards on Padlet (https://padlet.com/), surveys and polls on Mentimeter (https://www.mentimeter.com/), and quizzes on Crowdsignal (https://crowdsignal.com/), as well as on the preparation of scripts for videos, animation, and tasks that required narrative descriptions. For implementation and delivery, different online platforms, including WordPress (https://wordpress.com/) and Google Classroom were explored. We ultimately opted for WordPress, an open-access platform for website creation, due to its ease of use, international accessibility by learners, and maximum flexibility compared to other options. The website integrated the lesson plans, guided by the Microsoft PowerPoint drafts. Based on the prepared scripts, videos and animations were created using Microsoft PowerPoint and Clipchamp (https://clipchamp.com/en/) to edit. BioRender (https://www.biorender.com/) was utilized to create scientific figures, models, and infographics, while interactive elements were embedded directly into webpages. Ensuring consistency, we maintained an uniform design format and layout across both lessons, aligning fonts, indenta-tion, and colours. Keywords were highlighted for emphasis and the lesson's flow was improved with the addition of connecting paragraphs and summary figures.

The team spent roughly 5 weeks in refining the lesson plans, and a further 6 weeks building the website, including an introductory landing page, the 2 complete and autonomous lessons on memory and attention, and a reference page. A total of 4 animations, 5 videos, 15 figures and models, 3 discussion boards, 13 embedded quizzes, 1 poll, and 6 lab activities were designed and produced for both lessons.

In summary, the lesson plans were transformed into a visually appealing website, complete with interactive elements, animations, videos, figures, and quizzes. The 2 3-hour lessons on attention and memory were designed and produced to provide an enriching

asynchronous learning experience for learners.

2.2.3. Stage 3: evaluation

Following production of the learning resources, the team focused on developing an evaluation process by way of exploring the subjective experience of learners engaging with the co-produced content. To this end, we developed a Content Knowledge Assessment (CKA) and a Design Feedback Questionnaire (DFQ) to gauge knowledge and retention for both lessons. In addition, we intended to further unpack the experience of learners through a qualitative approach, by inviting students evalu-ators to take part in a semi-structured focus group protocol (FGP) and subsequently interpreting their perspectives using reflective thematic analysis [43]. In the following sub-sections, we provide design and implementation details of each stage of our evaluation process.

2.2.3.1. Content Knowledge Assessment (CKA).
Two CKA were drafted (1 per lesson), which constituted a 45-minute online test with a mixture of content-related multiple choice and short open-ended questions, totalling to 25 possible points to score overall. Given the topic-appropriate differences in content across the 2 lessons, the CKA con-tained different distributions of question types. The CKA for the atten-tion lesson included 15 multiple-choice questions (1 point each) and 2 short-answer questions (5 points each). The CKA for the lesson on memory included 10 multiple-choice questions (1 point each) and 5 short-answer questions (3 points each). A brief questionnaire was added at the end to evaluate learners' perceived difficulty level of the lessons (from very easy, 1, to very difficult, 10) and to identify sections that were "most manageable" and "most challenging." This questionnaire did not contribute to the final score. The CKAs were devised to test how well the students had achieved the ILOs of each lesson.

2.2.3.2. Design Feedback Questionnaire (DFQ).
The DFQ consisted of 23 Likert scale questions ranging from "strongly agree" to "strongly disagree" to evaluate the design of the lessons in relation to 4 themes: delivery, structure, interactive elements, and visual interface (see Table 1). An additional question on the likelihood of students recom-mending the lesson to their peers on a scale from 1 (very unlikely) to 10 (very likely) was included, as well as an open-ended question to enter any additional comments. The DFQ was identical for both lessons and aimed to record a snapshot of the learners' subjective opinions on resource design and delivery.

2.2.3.3. Focus Group Protocol (FGP).
The FGP included 22 discussion prompts aiming to unpack reflective insights on the lessons' content, design, and delivery. The prompts were divided into 2 sections: content and visual design of the interface. Discussions of each section were designed to last approximately 30 min leading to a Focus Group (FG) session taking up to 1 hour in total. The FGP was designed to be semi-structured, meaning that the prompts were covered within the natural dialogic flow of the conversation. This semi-structured approach allowed for some flexibility in the sequence of prompts, where the order of questions could be adapted if some topics were covered earlier, as well as the incorporation of occasional follow-up questions to encourage elaboration of thoughts and opinions. The FG sessions were conducted online using Microsoft Teams by 2 student partners (1 from each insti-tution), with recordings capturing video and audio, and automatic captioning enabled for easier transcription.

2.2.3.4. Implementation.
For this student-faculty partnership, we recruited a small sample of student evaluators from each participating institution, who were current undergraduate students and non-experts on the topics covered in the lessons. After a call for participants, a total of 6 undergraduate students were recruited (EU institution, $N = 3$; Asia institution, $N = 3$). While all 3 students from the EU were female and enrolled in a Life Sciences degree, participants from the Asian

institution had backgrounds in Bioengineering ($N = 1$, female), Chemical and Biomolecular Engineering ($N = 1$, male), and Communication Studies ($N = 1$, female). Following obtainment of written consent, student evaluators received instructions of the evaluation process. They were sent a WordPress link to the lessons and instructed to read all sections and fully carry out the activities on the website while noting down completion times. The student evaluators were asked to refrain from taking notes on the lesson content to avoid confounders. Once engagement with each lesson concluded, they were asked to complete the lesson's respective CKA and DFQ, indicate their degree discipline, and disclose any learning difficulty. Then, 2 1-hour semi-structured online FG sessions were scheduled, grouped by institution. All student evaluators completed the lessons, CKAs, DFQ, and FGP, and were compensated with Amazon gift cards valued at 100 GBP/200 SGD.

2.3. Analysis

The evaluation process captured both descriptive quantitative and reflective qualitative data. Quantitative data were exported via Microsoft Forms and organized using Microsoft Excel spreadsheets. Given the small number of student evaluators, we did not intend to inferentially analyse these data; instead, our aim was to examine any initial, illustrative trends in relation to the specific outcomes that the CKAs and DFQ were designed to measure. Descriptive data analyses and visualizations were conducted in Microsoft Excel and R. For the FGP data, raw transcripts were generated via Microsoft Teams and Zoom (European FG) and NetEase Jianwai (Asian FG) automatic captioning functions. Transcripts were then anonymised and edited by the team to reflect an accurate verbatim account of each FG discussion. Qualitative data were interpreted using Braun and Clarke's reflective thematic analysis approach [43], an iterative method where data are read and re-read, with each iteration resulting in further insights before identifying initial codes to be grouped in larger, conceptual themes. The purpose of reflective thematic analysis is to extrapolate participants' subjective perspective of an experience [43]. We were interested in student evaluators' perspective of the value and overall effectiveness of each lesson, for the purpose of utilising their valuable insights in future developments of the co-produced resources. Themes emerging from reflective thematic analysis are influenced primarily by the researcher's interpretation of the language, tone, and topics in the discussion with participants. Identification of codes and grouping into themes was additionally guided by a priori lesson's aspects we were interested in exploring through the FGP, i.e., contend, design, and delivery. Overall, the purpose of analysing outcomes from the evaluation process was to explore students' experience and perceived value of the usefulness and effectiveness of the 2 lessons.

3. Project outcomes

3.1. Descriptive quantitative data

Completion times were relatively similar for both lessons among European and Asian student evaluators (memory lesson, 142.50 ± 44.24 min; attention lesson, 136.00 ± 35.33 min) (see Fig. 2A). Overall, both European and Asian students had higher CKA scores for the lesson on memory (15.83 ± 3.31 points out of 25) compared with the ones on attention (13.83 ± 4.96) (see Fig. 2B). Concerning the self-reported lesson difficulty level, both European and Asian students found the lesson on attention harder (6.50 ± 2.43 points; maximum of 10) compared with the one on memory (5.50 ± 2.51 points) (see Fig. 2C). Table 1 presents a summary of the DFQ completed by all students.

3.2. Qualitative data

Reflective thematic analysis applying Braun & Clarke's approach [43] was conducted on the FG data. Codes were generated by
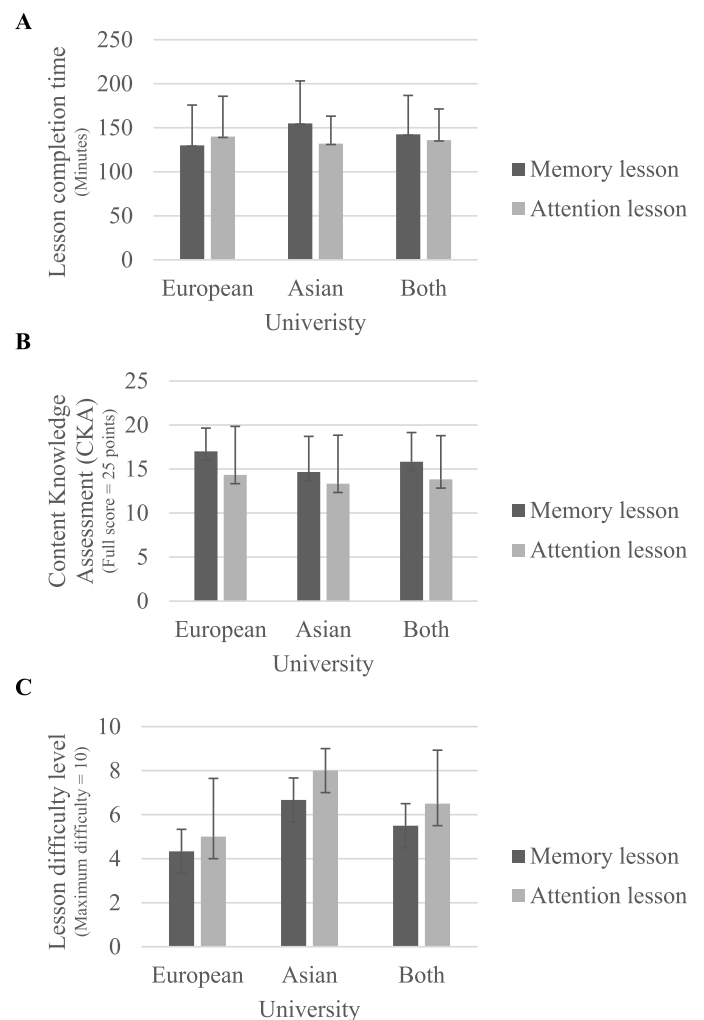

Fig. 2. Student evaluators lesson completion time (A), Content Knowledge Assessment (CKA) scores (B) and self-reported lesson difficulty level (C).

interpreting participants' choice of words and language, broader context of the comment being coded, and the original intention of the evaluation process guided by the FGP. The resulting codes were then grouped into the 3 themes: *relevance to learners' intrinsic motivation, content nature and presentation-dependent engagement,* and *design-related barriers to engagement,* which summarise the main feedback views given by the student evaluators (see Table 2).

3.2.1. Relevance to learners' intrinsic motivation

The student evaluators made explicit reference to how their engagement with the content and retention of information was influenced by the relevance of the lessons' topics to their own learning experience. They also suggested that the lessons aligned well with personal practices when learning in their own degrees, and gave encouraging feedback on finding the content, labs, and activities useful for their studies:

> *"All the sections where it was applied to our daily lives like study habits […] helps me remember it a lot better."(FG/Europe)*

> *"…the massed and spaced learning memorization kind of method…it's something that is quite applicable to our daily life." (FG/Asia)*

> *"I feel like the applications still stick with me." (FG/Asia)*

The way that content was designed allowed students to feel more confident in their understanding of the material; they commented on

Table 1
Design feedback questionnaire (DFQ).

	Memory lesson			Attention lesson			Both lessons		
				University					
	European	Asian	Both	European	Asian Average (SD)	Both	European	Asian	Both
The learning outcomes are clearly defined across the session	4.67 (0.58)	4.67 (0.58)	4.67 (0.52)	4 (0)	4.67 (0.58)	4.33 (0.52)	4.33 (0.52)	4.67 (0.52)	4.5 (0.52)
The session is well-organized	4.17 (0.75)	4 (0)	4.08 (0.51)	4 (0)	4.67 (0.52)	4.33 (0.49)	4.08 (0.51)	4.33 (0.49)	4.21 (0.51)
The language used in conveying the session is rigorous and interesting to read	3.33 (0.58)	3.33 (0.58)	3.33 (0.52)	3 (1)	4.33 (0.58)	3.67 (1.03)	3.17 (0.75)	3.83 (0.75)	3.5 (0.8)
The extended reading material is appropriate and useful	3.67 (0.58)	4 (1)	3.83 (0.75)	4.33 (0.58)	1.33 (2.31)	2.83 (2.23)	4 (0.63)	2.67 (2.16)	3.33 (1.67)
Guidance in extended reading is clear, sufficient and easy to access	3.67 (0.58)	3.33 (0.58)	3.5 (0.55)	4.33 (0.58)	2.67 (2.52)	3.5 (1.87)	4 (0.63)	3 (1.67)	3.5 (1.31)
All learning outcomes are covered by the end of the session	4.33 (0.58)	4.33 (0.58)	4.33 (0.52)	4 (0)	5 (0)	4.5 (0.55)	4.17 (0.41)	4.67 (0.52)	4.42 (0.51)
The flow of the teaching material is intuitive and can be followed easily	3.67 (1.53)	4.67 (0.58)	4.17 (1.17)	3.67 (0.58)	4.67 (0.58)	4.17 (0.75)	3.67 (1.03)	4.67 (0.52)	4.17 (0.94)
It is easy to stay focused throughout the session	3.33 (1.15)	3.33 (0.58)	3.33 (0.82)	3.33 (1.15)	4.33 (0.58)	3.83 (0.98)	3.33 (1.03)	3.83 (0.75)	3.58 (0.9)
The session is taught in a pace that suits my learning habits	4 (1)	4.33 (0.58)	4.17 (0.75)	4 (1)	4 (0)	4 (0.63)	4 (0.89)	4.17 (0.41)	4.08 (0.67)
There is enough connection between different topics	4.33 (0.58)	4.33 (0.58)	4.33 (0.52)	4 (1)	3.67 (0.58)	3.83 (0.75)	4.17 (0.75)	4 (0.63)	4.08 (0.67)
Information is spread equally and reasonably among topics	3.67 (1.53)	3.33 (1.15)	3.5 (1.22)	4 (0)	3.33 (2.08)	3.67 (1.37)	3.83 (0.98)	3.33 (1.51)	3.58 (1.24)
The time designed for each break is reasonable	4.67 (0.58)	4.67 (0.58)	4.67 (0.52)	4.67 (0.58)	4.67 (0.58)	4.67 (0.52)	4.67 (0.52)	4.67 (0.52)	4.67 (0.49)
The course is interactive and engaging	4.33 (0.58)	4.33 (0.58)	4.33 (0.52)	4.67 (0.58)	4.67 (0.58)	4.67 (0.52)	4.5 (0.55)	4.5 (0.55)	4.5 (0.52)
The interactive activities are appropriate to explore the topics	4.67 (0.58)	4.67 (0.58)	4.67 (0.52)	4.67 (0.58)	4.67 (0.58)	4.67 (0.52)	4.67 (0.52)	4.67 (0.52)	4.67 (0.49)
The simulations are easy to navigate through	3.67 (1.53)	4.67 (0.58)	4.17 (1.17)	3.67 (1.53)	3.67 (0.58)	3.67 (1.03)	3.67 (1.37)	4.17 (0.75)	3.92 (1.08)
The difficulty of the quizzes is reasonable	3.67 (0.58)	4 (1)	3.83 (0.75)	4.33 (0.58)	4 (1)	4.17 (0.75)	4 (0.63)	4 (0.89)	4 (0.74)
I understand why I get right/wrong for the questions in the quiz	3.67 (0.58)	3.33 (1.53)	3.5 (1.05)	4.33 (0.58)	3.33 (1.53)	3.83 (1.17)	4 (0.63)	3.33 (1.37)	3.67 (1.07)
The platform functions well and can be navigated through easily	3.67 (0.58)	4.33 (0.58)	4 (0.63)	4 (0)	4.67 (0.58)	4.33 (0.52)	3.83 (0.41)	4.5 (0.55)	4.17 (0.58)
The visual organization of each page is intuitive	3.67 (0.58)	4.67 (0.58)	4.17 (0.75)	4 (0)	5 (0)	4.5 (0.55)	3.83 (0.41)	4.83 (0.41)	4.33 (0.65)
The font, font size, and pictures are easy to read	3.67 (0.58)	4.67 (0.58)	4.17 (0.75)	4 (1)	4.67 (0.58)	4.33 (0.82)	3.83 (0.75)	4.67 (0.52)	4.25 (0.75)
The videos, hyperlinks, and interactive elements can be opened normally	4 (1)	4.67 (0.58)	4.33 (0.82)	5 (0)	4.67 (0.58)	4.83 (0.41)	4.5 (0.84)	4.67 (0.52)	4.58 (0.67)
The user interface makes it easy to navigate between pages	3.67 (0.58)	4.67 (0.58)	4.17 (0.75)	3.33 (1.15)	4.67 (0.58)	4 (1.1)	3.5 (0.84)	4.67 (0.52)	4.08 (0.9)
The user interface is aesthetic and intriguing to read	3.67 (0.58)	4.33 (0.58)	4 (0.63)	4 (1)	4.33 (0.58)	4.17 (0.75)	3.83 (0.75)	4.33 (0.52)	4.08 (0.67)

how the topic/segment areas made good sense and tied logically into the overall lessons. The connections between some of the topics taught and participants' own strategies and intrinsic motivations for learning were highlighted in both the EU and Asia FGs. While the students reported that lessons were challenging in different ways, they agreed that both the content on memory and attention were good representations of learning:

"Memory helped me see hands on how different techniques could benefit howI study in the future." (FG/Asia)

"...[both] made me reflect on how I think."(FG/EU)

3.2.2. Content nature and presentation-dependent engagement

Findings from both FGs indicated that the format, style, and overall display of the materials in both lessons directly impacted the active and effective engagement of student evaluators with the content itself. They made frequent comments on the 'clean' and straightforward presentation:

"...diagrams and exercises […] can reinforce consolidation." (FG/EU)

"I learn how to be more attentive, how to improve my memory capacity, and stuff like that, like how to study better" (FG/Asia)

The students also agreed on the impact of clearly stated and sign-posted ILOs at the beginning of each lesson to have an idea of what they would be covering. The ILOs also seemed to help students manage their own expectations as to what the course designers realistically expected them to achieve. They frequently checked back to the ILOs while progressing through the lessons to be on track:

"I think all the content ticked all the learning outcomes, I think […] highlighted pretty well on the website, it was there waiting for us as soon as we open the page […] learning outcomes. And I think the content pretty much followed that." (FG/EU)

One difference between the EU and Asia FGs comprised the difficulty of the materials which, according to student evaluators, was perceived by the amount of content in each lesson. While the FG/EU commented on the amount of content being *"slightly under"* what they were typically expected to engage with in their degrees, the FG/Asia reported finding the content *"just right."* It is possible that these face value judgments on the content's complexity were due to different expectations on what the

Table 2
Indicative quotes per emerging theme.

Relevance to learners' intrinsic motivation	Content nature and presentation-dependent engagement	Design-related barriers to engagement
Related to how I could study better	*The diagrams and exercises were really useful*	*More instructions for some of the activities would be great*
Kept the flow going	*Order was good*	*Writing wasn't very colloquial*
Interest in knowing more	*A lot of content included*	*No instructions on level of detail needed*
Wouldn't feel too inclined to do outside reading	*Had a visual cue that this [a] section is relevant or more important*	*Technical difficulties with the activities*
Quite fun to do	*Neurobiology part was very content heavy, and I couldn't remember all the details*	*[Some] instructions felt a bit fake*
Didn't feel like homework	*Having an integrated game is rather nice*	*Needed review before being tested on content*
Quite intuitive	*Research papers can be a bit overwhelming*	*[Attention] no bullet-point summaries*
Reflect on how I approach my memory and attention span	*Interactivity, the level was just about right*	*Some quizzes were too long*
Engaging content on attention	*Well thought-out flow*	*Open-ended questions were vague*
Interested on how memory works	*Interactive games were interesting*	*More types of questions would be better*
How we can improve learning and how to improve attention	*More spacing up needed between sections*	*Page would randomly refresh*
Memory helped me see hands on how different techniques could benefit how I study in the future	*Lengthy content can feel dragging*	*No score given for some of the activities*
[Both] made me reflect on how I think	*I would find it more useful and intuitive if I could flick through the pages easier*	*Too much detail at points*

appropriate amount of material should be.

Students in both FGs commented positively on finding appropriate transitions, regardless of the lack of background disciplinary knowledge; the flow from one content section to the next *"made sense" (FG/Asia).* For both lessons, student evaluators found the neurobiology components to be the most challenging in relation to the rest of the content, even when these were presented as supplementary to aid their understanding of the topics covered. Despite of that, they commented on how these components particularly drew their attention and *"made them want to learn more" (FG/EU).* The difficulty aspect of the neurobiology was reported as being down to the unfamiliar terminology, as well as the amount of content that was included:

"…the neurobiology section and the memory lesson could be more friendly." (FG/EU)

"…at times it was hard to keep up, too many terms coming out." (FG/Asia)

Interestingly, the sections covering learning differences through the use of vignettes and hypothetical scenarios was particularly well-received across students.

Regarding the choice of online platform (WordPress), students commented on how the presentation was somewhat "*crowded.*" Due to the open access nature of the platform itself, the existence of advertisements was noticeable and reported as being distracting.

3.2.3. Design-related barriers to engagement

A point raised in both FGs was on how the design of the lab activities in both lessons could at times be a barrier to engagement. Students identified several design-based elements that impacted their progress along the content and understanding of the key concepts. Such elements

included the language used, the clarity of instructions, and the presence/absence of feedback after completing some of the activities:

"…sometimes I wasn't quite sure whether the questions where assessment or evaluation questions like…'why might you think that happened or something?' Wasn't quite sure […] how to answer." (FG/EU)

"I think it'll be better if you specify to how deep, how much detail you wanted me to go into [for short answer questions within the website]." (FG/EU)

The clarity of language and instructions for formative assessment and sense-checking during the lessons is a key factor to consider in asynchronous learning. The learner, despite background knowledge and level of ability, should be able to engage in an independent self-paced way with the materials without the need for additional clarifications. Assessment types and the feedback given (if appropriate) should be specific and developmental so that they facilitate further engagement and curiosity to learn. For example, students noted that for some of the assessments, the page would *"randomly refresh" (FG/EU)* in the middle of a quiz, which not only interrupted the pace, but also seemed to cancel out some of the already submitted answers. The lack of clarity in terms of what level, amount, or depth of information was expected of them, in terms of the responses to the questions, was also consistently reported across student evaluators.

4. Reflective insights from student partners

The student partners were equal participants during the 3-stage curricula co-creation process. The final source of input when exploring the project's success comes from them. The 2 faculty members asked each of the student partners involved (3 from EU institution, 2 from Asia institution) to reflect on their experience and feedback on aspects that were particularly meaningful.

The student partners shared on the collaborative skills gained through the co-creation process:

"I think my biggest takeaways from this project is improving my critical thinking and collaboration skills. Throughout the project, we consistently divided our tasks into multiple parts, with each team member taking responsibility for specific portions. We then can reflect on each other's work and provide feedback, which was very helpful for developing the lesson." (EU partner 1)

"Academic collaboration and online communication (with peers, research leaders and participants)." (EU partner 2)

"In the collaborative process, as a student from an Asian country, I typically follow the assigned tasks and plans. In contrast, European participants tend to take the initiative to kickstart a task and take the first step. I also noticed that there are significant differences in the courses we design." (Asia partner 1)

Additional insight on how student partners were able to get a 'behind-the-scenes' appreciation of the process involved in curating content for learning were exposed; they explicitly discussed how their design skills improved:

"Throughout the research, design, and evaluation stage, I need to constantly evaluate whether the materials I found or have created are relevant and suitable for our purpose. I need to stand on the user's point of view to decide what is the best option I can offer to improve the lesson quality." (EU partner 1)

"[Development of skills on] design and evaluation of webpages." (EU partner 3)

"When it comes to content, I firmly believe that, in addition to covering the subject matter comprehensively and professionally, it's paramount to approach course design from a student's perspective. This entails considering what students will gain from the course, which content will

engage them the most, and how the material should be presented." (Asia partner 1)

Further comments on the critical thinking skills student partners developed were offered:

"Through the literature review stage, I gained a better understanding [of] topics……and how to find articles on relevant topics by using keywords and other search criteria." (EU partner 2)

Of particular interest are student partners' views on the research skills gained through this experience:

"In the realm of research, I not only systematically gathered relevant literature but also took charge of the focus group component. Conducting a focus group was an entirely new and challenging endeavor for me. Afterwards, we had to process the collected data, involving qualitative analysis, and I acquired valuable knowledge about coding. Another major challenge is to constantly uphold impartiality." (Asia partner 1)

Based on the above reflections, participating in the co-creation process allowed the faculty and students partners involved to develop a sense of ownership and confidence in their pedagogical decision-making, through ongoing dialogue and an iterative process. Student partners can be knowledgeable sources of insight into what type and level of content might appeal to their peer cohorts and, therefore, make an invaluable contribution when calibrating learning materials [7,10]. The student partners involved in this project needed to transcend perceived and real cultural borders, being tasked with contributing to designing content that would be internationally appealing.

The second FG emerging theme on content nature and presentation-dependent engagement offers further support for the impact of this partnership. Student evaluators identified elements that allowed them to engage effectively with the material. This type of engagement requires recruitment of both cognitive and emotional resources and we can, consequently, assume that the elements highlighted by the evaluators were the ones that were most effective in achieving this goal.

The decision to curate content drawn from the broader SoL curriculum [1] also adds weight to the discipline's currency and relevance for a global higher education audience. As a discipline, SoL should be of interest not only to faculty, but also to students who see it as an opportunity to debunk perceived demands made of them within learning environments. Emerging themes from this project suggest that the self-paced learning design and sequencing between lesson sections allowed student evaluators time to process information effectively by being in control of how they progressed through the content. Additionally, the positive response to the labs and interactive activities signifies that hands-on engagement with the content and feedback on progress can be useful for building learners' confidence with regards to the material taught.

5. Discussion

This project aimed to explore the effectiveness of co-created learning resources targeting SoL related content designed with cross-cultural learners in mind. Considering the ever-increasing mainstreaming of blended learning teaching approaches in higher education [43], we sought to identify which aspects of this co-created content would resonate well with students, and which aspects might prove to hinder engagement. Aware of the challenges in transitioning to blended or fully online learning environments [28,29,44], we applied useful insight from cross-cultural student-faculty partnership to co-create online lessons that would appeal to a wide and international range of higher education students. Earlier work on the importance of co-produced content, particularly in terms of curriculum development, points to educational benefit for the institutions, faculty, and students. There is the potential for a transformative educational experience for the students involved in co-creation [15,45] and for achieving complex educational outcomes

[46].

We implemented a layered procedural pipeline to co-produce, implement, and evaluate two lessons, positing that the learning resources would provide accessible opportunities to engage with the content, regardless of students' prior knowledge and disciplinary background. Findings from our evaluation process show encouraging signs that this project was effective in several ways, although there are still steps to be taken to further develop the co-produced resources.

The descriptive quantitative data demonstrate some informative trends. For example, we may have potentially overestimated the time needed to successfully complete each lesson, as the student evaluators from both institutions reported relatively short completion times. Based on the CKAs scores, we further note that the amount and level of content retained by students was regular, although this may have been an artifact due to working under artificial time constraints to complete the evaluation process.

In addition, the qualitative data from FGs provide insights as to the possible barriers for content retention and overall engagement in terms of design and delivery. The transition to blended or online learning is a challenging task [28]. However, the student evaluators reported confidence in having met the ILOs for each lesson despite their asynchronous and self-paced format [29]. These findings are in line with literature reporting the effectiveness of faculty-student partnerships [10,39]. For both the selection and curation of content, as well as the pedagogical decisions for the calibration of each lesson, the learning resources were understood equally well across the EU and Asia student evaluators. This is especially promising when devising co-created content intended for a global audience. When considering the increasing momentum that internationalisation of higher education has gained in recent years [35, 37,38], the onus is on academic faculty to design and deliver content that is fit for purpose, constructively aligned across activities, assessment, and ILOs [47] and that ideally taps into students' motivation to learn [48]. The literature suggests that when students are intrinsically motivated, they are more likely to engage with a task due to their own personal interests, rather than the presence of any external pressures or demands [48].

Overall, we have presented evidence towards the successful co-creation of resources that meet these criteria, by unpacking the benefits this partnership can bring, particularly from students partners' reflective statements.

The drastic shift to fully remote higher education resulting from the COVID-19 pandemic has since provided institutions with sufficient information on the relevance of pedagogically-sound blending of online and face-to-face teaching modalities. Despite blended learning existing long before its urgent necessitation due to the pandemic [43], current curricula are now putting renewed emphasis on the design and development of such offerings. We have shown encouraging insight on how student partners are ideally placed not only to identify and curate relevant content, but also to calibrate the pitch at which to deliver it to meet educational goals.

6. Conclusion

The Science of Learning is fast becoming a field of interest for higher education worldwide. Building on this momentum, this project examined the effectiveness of learning materials targeting attention and memory. Harnessing the benefits of working within a multidisciplinary and international student-faculty partnership, we posited that the modality in which this content is presented, i.e., asynchronous learning, may very well enhance the relative benefits of students' learning. By placing student partners at the forefront of the co-creation process, we allowed them to contribute with their unique ideas and ability to identify the best ways to design and deliver lesson content. We have highlighted the importance of this kind of partnerships in successful curriculum design, as a crucial component in ensuring engagement and a meaningful learning experience for higher education students. Finally,

we have presented a case study exemplar of an effective international student-faculty partnership in helping to reach a global learner audience.

6.1. Limitations and future directions

We recognise that the data highlight preliminary trends and do not constitute a research-based exploration of effectiveness. However, we have provided useful information from this partnership, which benefited from the student-faculty collaboration each step of the way and the international makeup. The benefits we observed can be rolled out to different disciplines to further explore how students as co-creators of learning resources can influence the higher education experience. Similarly, unpacking the impact of international collaborations to the co-creation process is of key interest and should be investigated. Insights from this and other, similar academic partnerships can be particularly useful in informing faculty training and development to foster collective understanding of best pedagogical practices and the overall teaching and learning scholarship. This project lead to future, testable research questions for collaborations of a similar nature, to further our understanding of both perceived and real benefits of co-creating with students in higher education.

CRediT authorship contribution statement

Astrid Schmied: Writing – review & editing, Writing – original draft, Methodology, Funding acquisition, Formal analysis, Conceptualization, Supervision. **Iro Ntonia:** Writing – review & editing, Writing – original draft, Supervision, Funding acquisition, Formal analysis, Conceptualization. **Man Kiu Jenny Ng:** Writing – original draft, Methodology, Investigation, Formal analysis, Data curation. **Yijie Zhu:** Writing – original draft, Methodology, Investigation, Formal analysis, Data curation. **Fontaine Gibbs:** Writing – original draft, Methodology, Investigation, Formal analysis, Data curation. **Hanqiao George Zou:** Writing – original draft, Methodology, Investigation, Formal analysis, Data curation.

Declaration of competing interest

The authors declare that there is no conflict of interest.

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References

[1] A. Privitera, S.H. Ng, S.H Chen, Defining the Science of Learning: A Scoping Review Protocol, 2023, https://doi.org/10.17605/OSF.IO/J5XBS.

[2] A. Schmied, A. Jamaludin, Neuroscience literacy in educators' training programs in asia: a call to action, IBRo Neurosci. Rep. (2023), https://doi.org/10.1016/j.ibneur.2023.10.006.

[3] J.C. Horvath, J.M. Lodge, A framework for organizing and translating science of learning research. From the Laboratory to the Classroom: Translating Science of Learning For Teachers, 2016, pp. 7–20.

[4] Y. Weinstein, C.R. Madan, M.A Sumeracki, Teaching the science of learning, Cogn. Res. 3 (2018) 2, https://doi.org/10.1186/s41235-017-0087-y.

[5] J.A. Newson, Disrupting the 'Student as Consumer' model: the new emancipatory project, Int. Rel. 18 (2) (2004) 227–239, https://doi.org/10.1177/0047117804042674.

[6] R. Cuthbert, Students as customers? High. Educ. Rev. 42 (3) (2010) 3–25.

[7] N. Maloshonok, I. Shcheglova, From "Customer" to "Partner": Approaches to Conceptualization of Student-University Relationships, 2021, https://doi.org/10.1007/978-981-13-3364-4_4-2.

[8] A. Cook-Sather, et al., What are student-faculty partnerships?: our guiding principles and definition. Engaging Students As Partners in Learning and Teaching: A Guide For Faculty, John Wiley & Sons, Incorporated, 2014, pp. 1–14.

[9] K. Matthews, Students as partners as the future of student engagement, Student Engag. High. Educ. J. 1 (1) (2016) 1–5.

[10] Kathrine Jensen, Liz. Bennett, Enhancing teaching and learning through dialogue: a student and staff partnership model, Int. J. Acad. Dev. 21 (1) (2016) 41–53, https://doi.org/10.1080/1360144X.2015.1113537.

[11] A. Cook-Sather, et al., Outcomes of student-faculty partnerships support from research literature and outcomes for faculty and students. Engaging Students As Partners in Learning and Teaching: A Guide For Faculty, John Wiley & Sons, Incorporated, 2014, pp. 97–132.

[12] Mercer-Mapstone, L., Dvorakova, S.L., Matthews, K.E., Abbot, S., Cheng, B., Felten, P., Knorr, K., Marquis, E., Shammas, R., & Swaim, K. A systematic literature review of students as partners in higher education (2017).

[13] I.I. Amdal, K. Endresen-Maharaj, How do pre-service teachers understand and experience. Participation in teacher education? Nordisk Tidsskrift for Utdanning og Praksis, Special Issue 17 (2) (2023) 34–52, https://doi.org/10.23865/up.v17.5191.

[14] C.K. Prahalad, V. Ramaswamy, Co-creation experiences: the next practice in value creation, J. Interact. Market. 18 (3) (2004) 5–14.

[15] M. Dollinger, J.M. Lodge, H. Coates, Co-creation in higher education: towards a conceptual model, J. Market. High. Educ. 28 (2018) 210–231.

[16] Chandarana, Priyanka & Rickaby, Rebecca & Sonnex, Kimberley & Allegrucci, Cinzia & Garcia-Ara, Amelia. Student Co-creation of Digital Learning Resources: an evaluation and reflection of veterinary pharmacy and care home pharmacy interprofessional education packages. 5, (2024).

[17] Eric Tsui, Nikolina Dragicevic, Irene Fan, Meina Cheng, Cocreating curriculum with students, teachers, and practitioners in a technologyenhanced environment, Educ. Technol. Res. Dev. (2023), https://doi.org/10.1007/s11423-023-10301-5.

[18] Sandra Nunes, Luisa Carvalho, Sandrina Moreira, Raquel Pereira, Pedro Mares, Pedro Santos, An Outlook on the Facilitators' Perspectives of a Cocreation Project at a Higher Education Institution, 2023, https://doi.org/10.4018/978-1-6684-6701-5.ch004.

[19] Catherine & Bovill, Cherie. Woolmer, How conceptualisations of curriculum in higher education influence student-staff co-creation in and of the curriculum, High. Educ. (2019) 78, https://doi.org/10.1007/s10734-018-0349-8.

[20] Bokolo Anthony Jnr, Adzhar Kamaludin, Awanis Romli, Mat Raffei, Anis Farihan, Danakorn Phon, Aziman Abdullah, Gan Ming, Blended learning adoption and implementation in higher education: a theoretical and systematic review, Technol. Knowl. Learn. (2022), https://doi.org/10.1007/s10758-020-09477-z.

[21] R. Castro, Blended learning in higher education: trends and capabilities, Educ. Inf. Technol. 24 (4) (2019) 2523–2546, https://doi.org/10.1007/s10639-019-09886-3.

[22] Dr Lalima, Kiran Dangwal, Blended learning: an innovative approach, Univ. J. Educ. Res. (5) (2017) 129–136, https://doi.org/10.13189/ujer.2017.050116.

[23] B.B. Lockee, Online education in the post-COVID era, Nat. Electron. 4 (2021) 5–6, https://doi.org/10.1038/s41928-020-00534-0.

[24] J. Lee, T. Sanders, D. Antczak, et al., Influences on user engagement in online professional learning: a narrative synthesis and meta-analysis, Rev. Educ. Res. 91 (4) (2021) 518–576, https://doi.org/10.3102/0034654321997918.

[25] Florence & Martin, Doris. Bolliger, Engagement matters: student perceptions on the importance of engagement strategies in the online learning environment, Online Learn. J. 22 (2018) 205–222, https://doi.org/10.24059/olj.v22i1.1092.

[26] Emma Vermeulen, Monique. Volman, Promoting student engagement in online education: online learning experiences of Dutch University Students, Technol. Knowl. Learn. (2024) 1–21, https://doi.org/10.1007/s10758-023-09704-3.

[27] R. Meylani, What Really Determines the Success of an Online Learning Environment, 2023, https://doi.org/10.21125/iceri.2023.1907.

[28] R. Imran, A. Fatima, Salem I Elbayoumi, K Allil, Teaching and learning delivery modes in higher education: looking back to move forward post-COVID-19 era, Int. J. Manag.Educ. 21 (2) (2023) 100805, https://doi.org/10.1016/j.ijme.2023.100805. Epub 2023 Apr 3. PMCID: PMC10067450.

[29] Amber & Dumford, Angie. Miller, Online learning in higher education: exploring advantages and disadvantages for engagement, J. Comput. High. Educ. 30 (2018), https://doi.org/10.1007/s12528-018-9179-z.

[30] M. Zhu, M.Y. Doo, The relationship among motivation, self-monitoring, self-management, and learning strategies of MOOC learners, J. Comput. High. Educ. 34 (2) (2022) 321–342.

[31] A. Saleem, F. Ali, I. Ashraf, An innovative approach in the field of higher education: blended learning and massive open online courses, Int. J. Linguist. Cult. 4 (1) (2023) 201–220.

[32] V.N. Kukharenko, MOOCs: an insider's perspective on a novel educational method with historical, organizational, participatory, and evaluative aspects, Educ. Dimens. 9 (2023) 59–119.

[33] P. Hill, Online educational delivery models: a descriptive view, Educ. Revi. 47 (6) (2014) 84–86.

[34] J. Knight, Higher Education in Turmoil: The Changing World of Internationalization, Sense Publishers, Rotterdam, 2008.

[35] Hans de Wit, Philip G Altbach, Internationalization in higher education: global trends and recommendations for its future. Higher Education in the Next Decade: Global Challenges, Future Prospects, BRILL, 2021, pp. 303–326.

[36] S. Aririguzoh, Communication competencies, culture and SDGs: effective processes to cross-cultural communication, Humanit. Soc. Sci. Commun. 9 (2022) 96, https://doi.org/10.1057/s41599-022-01109-4.

[37] E. Lehtomäki, J. Moate, H. Posti-Ahokas, Global connectedness in higher education: student voices on the value of cross-cultural learning dialogue, Stud. High. Educ. 41 (11) (2016) 2011–2027, https://doi.org/10.1080/03075079.2015.1007943.

[38] Hans de Wit, Internationalization in higher education, a critical review, SFU Educ. Rev. 12 (2019) 9–17, https://doi.org/10.21810/sfuer.v12i3.1036.

[39] Alex Kumi-Yebaoh, Designing cross-cultural collaborative online learning framework for online instructors, Online Learn. 22 (2018), https://doi.org/10.24059/olj.v22i4.1520.

[40] J. Money, T. Dinning, S. Nixon, B. Walsh, C. Magill, Co-creating a blended learning curriculum in transition to higher education: a student viewpoint, Creat. Educ. 7 (2016) 1205–1213, https://doi.org/10.4236/ce.2016.79126.

[41] A. Cook-Sather, et al., Practical strategies for developing student-faculty partnerships in engaging students as partners. Learning and Teaching: A Guide For Faculty, John Wiley & Sons, Incorporated, 2014, pp. 143–170.

[42] Varkey, T., Varkey, J.A., Ding, J.B., Varkey, P.K., Zeitler, C.M., Nguyen, A.M., Merhavy, Z.I., & Thomas, C.R. Asynchronous learning: a general review of best practices for the 21st century (2023).

[43] V. Braun, V. Clarke, Thematic analysis, J. Posit. Psychol. 12 (3) (2017) 297–298.

[44] C. Dziuban, C.R. Graham, P.D. Moskal, et al., Blended learning: the new normal and emerging technologies, Int. J. Educ. Technol. High. Educ. 15 (2018) 3, https://doi.org/10.1186/s41239-017-0087-5.

[45] T. Lubicz-Nowrocka, C. Bovill, Do Students experience transformation through co-creating curriculum in higher education? Teach. High. Educ. 28 (7) (2021) 1744–1760.

[46] S. Tun, C. Wellbery, A. Teherani, Faculty development and partnership with students to integrate sustainable healthcare into health professions education, Medical Teacher 42 (10) (2020) 1112–1118.

[47] J. Biggs, Enhancing teaching through constructive alignment, High. Educ. (32) (1996) 347–364.

[48] D. Rose, Universal design for learning, J. Special Educ. Technol. 16 (2) (2001) 66–67.