ENHANCING INTERNATIONALISATION THROUGH A REMOTELY DELIVERED HANDS-ON STEM CHALLENGE. A CASE STUDY OF COLLABORATIVE ONLINE INTERNATIONAL LEARNING WITH SOCIAL MEDIA AS MEDIUM OF PARTICIPATORY PEDAGOGY

MIGLIORARE L'INTERNAZIONALIZZAZIONE ATTRAVERSO UNA SFIDA PRATICA A DISTANZA. UN CASO DI STUDIO DI APPRENDIMENTO INTERNAZIONALE COLLABORATIVO ONLINE CON I SOCIAL MEDIA COME MEZZO DI PEDAGOGIA PARTECIPATIVA

Gabriella Rodolico[1]
University of Glasgow
Gabriella.Rodolico@glasgow.ac.uk

Neeraja Dashaputre[2]
Indian Institute of Science Education and Research

Rhona Brown[3]
University of Bristol

Abimbola Abodunrin[4]
University of Glasgow

Shanti Pise, Asim M. Auti, Juliana D'souza, Shubhashree Madhavan, Vasundhara Patade, Darshana Kamat, Hermant Ghorpade, Vaishali Kamat, Shubhashree Madhavan, Tanali Bhattacharyay, Shirish Sant and Manisha Nahar
Indian Institute of Science Education and Research

Deborah Simpson, Victoria Doak, V, Jennifer Lammey
University of Glasgow

Abstract

This paper discusses the impact that social media (WhatsApp, Zoom, emails, and Google Classroom) had on a series of Collaborative Online International Learning (COIL) workshops designed for the enhancement of Science, Technology, Engineering, and Mathematics (STEM) education between two

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[1] Author of Introduction, Experimental design, Methodology, Results and Conclusions
[2] Author of...Introduction and Results
[3] Author of... Results, Discussion, Limitations
[4] Author of... Introduction, Results, Discussion
Co-authors and participants to the study

Higher Education Institutions (HEIs) namely, the School of Education, University of Glasgow (UoG), Scotland and the Indian Institute of Science Education and Research (IISER) Pune, both involved in Teacher Education. Four newly qualified teachers from the School of Education, UoG, and ten in-service teachers practicing in different schools across Pune region participated in four sessions spread over an eight-weeklong COIL workshop with four tutors (also researchers in this study - two from each HEI). Findings specifically from participants' feedback (from WhatsApp groups and focus group discussions) and tutors' reflections show that the aforementioned social media play a significant role in enhancing not only communication and active participation but also facilitating knowledge exchange across Scotland-Indian cross-cultural contexts. Additionally, the majority of participants (representing about 79% of the 14 participants) described the participatory pedagogical design of the COIL workshops as effective and enhanced by the ease of communication across the used social media platforms. We believe these findings, are crucial for contributing to the studies of the impact of social media on participatory pedagogy in ways that might help STEM educators to shift from an awareness of students' engagement with and through curriculum content to an orientation of developing related praxis aimed at collaborative engagements and knowledge exchange.

Abstract

Questo studio discute l'impatto che i social media (WhatsApp, Zoom, e-mail e Google Classroom) hanno avuto su una serie di workshops basati sul modello innovative di internazionalizzazione COIL: Collaborative Online International Learning. I workshops sono stati creati con l'obiettivo di consolidare la collaborazione tra due istituti di istruzione superiore (HEIs), vale a dire, il School of Education (SoE), Università di Glasgow (UoG), Scozia e l'Indian Institute of Science Education and Research (IISER) Pune,India, nel contesto dell'ideazione del centro di eccellenza sull'Educazione in STEM. Entrambi gli instituti sono coinvolti nella formazione degli insegnanti. I partecipanti sono 4 insegnanti neo-qualificati della SoE , UoG e 1diesci insegnanti gia' qualificati che insegnano in diverse scuole della regione di Pune. L'intervento si e' basato su quattro sessioni COIL distribuite otto settimane con quattro docenti universitari due da ogni paese (anche ricercatori in questo studio. I feedback dei partecipanti (dai gruppi WhatsApp e dalle discussioni dei focus group) e le riflessioni dei tutor mostrano che i social media svolgono un ruolo significativo nel migliorare non solo la comunicazione e l' attiva partecipazione, ma anche nel facilitare lo scambio di conoscenze in questi contesti interculturali. Inoltre, la maggior parte dei partecipanti (che rappresenta circa il 79% dei 14 partecipanti) ha descritto la progettazione pedagogica partecipativa dei workshop COIL come efficace, derivante in gran parte dalla facilità di comunicazione attraverso le piattaforme di social media utilizzate. Riteniamo che questi risultati siano cruciali per contribuire allo studio sull'impatto dei social media sulla pedagogia partecipativa in modi che potrebbero aiutare gli educatori STEM a passare da una consapevolezza di come gli studenti possono impegnarsi con e attraverso i contenuti del curriculum a un orientamento allo sviluppo di pratiche correlate finalizzate a impegni collaborativi e scambio di conoscenze.

Key-words

Social media, internationalisation, participatory pedagogy, knowledge exchange
Social media, internazionalizzazione, pedagogia partecipata, scambio di conoscenze

Background and rationale

Internationalisation of higher education has exacerbated the demand for educationalists who can function in cross-cultural settings over the last two decades (Esche, 2018). Increasingly, Higher Education Institutions (HEI) are looking to recruit teachers/academics that are interculturally competent and capable of working successfully in a cross-cultural context. While experiential learning (hands-on learning supported by reflection on the learning process) and study abroad programmes (requiring students to travel to different countries) are effective approaches to acquiring these intercultural competencies (De Castro, 2019), they are often

limited by the significant resources required which are scarcely available (Purvis, Rodger & Beckingham, 2020). Consequently, cost-effective approaches such as Collaborative Online International Learning (COIL) are increasingly being utilised.

With the use of technology, COIL serves as a pedagogical approach for fostering the development of intercultural competencies in students across classrooms located in various parts of the world (Appiah-Kubi & Annan, 2020) including open-mindedness, international-mindedness, thinking flexibility, second language competence, tolerance and respect for other people and their cultures (Chan & Dimmock, 2008). This implies that for a classroom to benefit fully from COIL, virtual learning spaces must involve students in geographically distinct regions with differences in language and cultural backgrounds but with a common experiential learning tool or technology. While COIL is typically designed to run for a short span (between four to eight weeks or for a semester), it offers a unique opportunity for programme developers (usually faculty members) to co-create a shared syllabus or course material and mentor students on how to collaborate (Appiah-Kubi & Annan 2020). Broadly aimed at getting students to become global thinkers, it enables them to develop the ability to work on projects collaboratively with students from different cultural backgrounds.

Although the COIL experience is widely believed to be highly beneficial to the development of students' intercultural competencies (De Castro et al., 2019; Appiah-Kubi & Annan, 2020), the success or failure of the pedagogical process, to a large extent, is determined by the adopted experiential learning tool (Purvis, Rodger & Beckingham, 2020), which is social media in this case. While a growing body of research is investigating the use of social media in collaborative learning and analysing students' interaction and its impact on the learning process, especially in the wake of pandemics (see for e.g., Ballera et al., 2013; Chan et al., 2020; Khan et al., 2021), there is no known study, to our knowledge, that specifically examines how social media could impact COIL experiences and what pedagogical approaches might facilitate this process.

Aim and research question

Against this background, this study aims to explore the impact of social media on a COIL experience for Newly Qualified Teachers (NQT) and In-Service teachers from India and Scotland who worked together through a series of international workshops on a STEM challenge based on participatory pedagogy. Specifically, we are seeking to address the question of: How does social media impact the learning experience of NQTs and in-service teachers participating in a series of COIL-based STEM workshops through the lens of participatory pedagogy? To answer this question, we begin with the wider context and by defining the term internationalisation of Higher Education (HE) and the process of COIL. Then, we look at the elements required to enhance the experience of Internationalisation at Home and at a Distance, emphasising the importance of participatory pedagogy in this process. We collected data by looking at tutors' and participants' experiences (all co-authors in this article) through tutors' reflective journals, participants' feedback in the form of conference contributions, and a focus group.

Introduction

Internationalisation of HE

Internationalisation of HE can be considered as composed of Internationalisation Abroad (IA), Internationalisation at Home (IaH), and Internationalisation at a Distance (IaD) implemented at home using digital technology. IA focuses on the movement of educators and students across national borders, whereas IaH focuses on merging various international and intercultural aspects into the course curriculum and bringing the outside world into the campus (Wächter, 2000). With the advent of technology, students can also experience international learning environments sitting in their homes, through online courses and workshops, constituting IaD (Mittelmeier et al., 2021).

Although IA has a huge economic impact, recent events have shed light on a shift in priorities, from a largely economic drive to a focus on quality and social goals (Marinoni et al., 2019), and recognising the inequality of opportunity that comes with physical student mobility (Esche, 2018; Rubin, 2017). The internationalisation of HE can be seen as a way that a country can respond to the stimulus of globalisation whilst maintaining the individuality of the nation (Pritam, 2010), and enriching post-secondary education with an international, intercultural, or global dimension (Knight, 2003).

From an Initial Teacher Education (ITE) perspective, this is important, not only to enhance HE students' learning experiences (Qiang, 2003) but also to foster the professional development of already qualified teachers and better equip them to face the challenges of multicultural and multilingual classrooms (Tran & Le, 2017). Chan and Dimmock (2008) illustrate that internationalisation could enhance participants' competencies as it increases their international orientation, promotes cross-cultural sensitivity, and encourages open mindedness and tolerance. In addition to this, the COVID-19 pandemic has forced HEIs to reconsider the roles of technology and online learning (Mok et al., 2021) with a possible reconsideration of IaH and IaD as valid opportunities which could impact Universities' Key Performance Indicators.

Collaborative Online International Learning (COIL)

Although online learning is considered under the umbrella of e-learning with several research-based definitions (Sangrà, Vlachopoulos & Cabrera, 2012), in this study we focus on the concept of COIL which is not simply an extension of online learning but rather a new teaching and learning paradigm. It is linked strongly to internationalisation and cross-cultural and multi-cultural learning, being augmented through online education (Rubin, 2017). As such, COIL is considered a pedagogical approach that allows teachers and students to work together across cultures, contexts, and institutions using digital technology without travelling abroad; this approach aligns closely with IaD (De Castro, 2019).

There are four main components for COIL:

Collaborative: Staff from the participating countries work on an equal footing in a "structured collaboration" (Appiah-Kubi & Annan, 2020, p. 110). Ideally, this involves co-development as well as co-delivery of the module. Similarly, students are given tasks and opportunities to collaborate and indeed the outcome of the module requires effective cooperation. For this reason, Project Based Learning is often used as a medium for collaboration, and "teachers act as facilitators and designers of the collaborative environment" (Appiah-Kubi & Annan, 2020, p. 112).

Online: Most interactions between staff and students occur online and the online component of COIL facilitates the other three aspects (Appiah-Kubi & Annan, 2020). Staff and students use a range of technologies to enable distance learning and communication across distinct geographic locations, and ideally distinct cultural and linguistic contexts (Appiah-Kubi & Annan, 2020). As with other forms of distance learning, it can involve synchronous and asynchronous learning (Esche, 2018).

International: Rather than just experiencing a shared online module, there is meaningful interaction between staff and students from different countries. We define this concept in our next section on **enhancing internationalisation of HE through COIL**. 'Intercultural competences' still lack a specific, agreed definition, and until this complex construct is defined, it will remain difficult to measure (Deardorff, 2006). However, some broad definitions have been more widely accepted, including components such as understanding others' worldviews; cultural self-awareness and capacity for self-assessment; and adaptability and adjustment to a new cultural environment (Deardorff, 2006).

Learning: The module, tasks, and resources should be directly linked to learning outcomes and aligned with wider curriculum objectives and assessments (Appiah-Kubi, & Annan, 2020).

As well as academic content, developing international or intercultural competences might constitute part of the learning goals. COIL partners may come from the same field to develop COIL modules for students on the same or very similar courses in different countries, for example in Global business programmes, (Nava-Aguirre et al., 2019) or the COIL module can be designed to provide opportunities for interdisciplinary collaboration, for e.g., between project management and environmental engineering students (Appiah-Kubi & Annan, 2020). The content learning on a COIL module or course is augmented by the international component as cultural and educational differences bring "new contextual meaning to the ideas and texts [students] explore" (Rubin, 2017, p. 34).

Enhancing Internationalisation of HE through COIL

According to Rodolico et al. (2022) there are four key elements that should be taken into consideration when planning for COIL:

A topic of common interest: The topic must be chosen based on common ground, and it must be of shared interest to the programmes and assessment agendas of both institutions. This study, for example, is based on the co-creation of a Renewable Energy STEM challenge. It is designed with a Problem Based Learning approach with the "complex task" of designing for sustainability (Yew & Goh, 2016) and a final project to "Build your own model of sustainable house". This created the opportunity for Indian and Scottish educators to use a project to collaborate with both industries and schools, and in alignment with their respective curricula, to create hands-on activities that could enhance fundamental STEM skills from early years, designed to overcome the barriers of Content Knowledge and pedagogical approaches so often identified as challenges to the successful implementation of STEM Education (Ejiwale, 2013).

Mutual enrichment: The concept of mutual enrichment between collaborators can be defined as the process that generates knowledge exchange relevant for the growth of all collaborating institutions (Greenhaus & Powell 2006). According to Hudzik (2020) this can be achieved by developing a curriculum that includes dual-purpose resources. In this study, tutors' and

participants' mutual enrichment was achieved by co-creating resources aimed to provide usable knowledge (Miller & Krajcik 2019) that could contribute to the common goal to build their model of a sustainable house with a functioning source of renewable energy but working in and across two distinct contexts.

Active participation: This is supported by the implementation of a common goal relevant to all participants (Sufi et al., 2018). For example, formative assessment opportunities or summative assessment outcomes (Rodolico et al., 2022), or as in this case, participant teachers were provided with practical tools and opportunities to integrate the outcomes of the workshops into their planning for learning in their own classrooms.

*Remote Cooperative Teaching***:** This is based on active collaboration between tutors who co-create and co-deliver all session contents, aligning it with the curriculum and implementation plans of each country. Co-teaching models based on clear co-planning, co-instructing, and co-assessing are considered effective instructional delivery methods to provide instruction to diverse students (Brendle, Lock & Piazza, 2017). It is possible to speculate that this is transferable also to a Remote Cooperative Teaching model.

Participatory pedagogy and Social Media

Participatory Pedagogy is a pedagogical approach where learners' voices are heard through several processes of active learning and collaborative work, resulting in high participation in the learning process (Simpson, 2018). This innovative approach aims to achieve equity and equality in the classroom, giving higher ownership and autonomy to the learners. In HE courses participatory pedagogy requires tutors to facilitate learning with a student-centred strategy where learners are asked to contribute to course content through, for example, student-led seminars, and activities, and where possible even take the leadership through (co)-authorship of conference contributions and papers (Fennema, 2011). This is in line with a shift from instructivism which is mainly based on teacher-led learning, where information and knowledge are passed to the learners, to Constructivism and Socio-Constructivism which are learner-centered approaches to teaching where learning is an active process impacted by the social contexts, facilitated by a skilled educator and promoted by problem-based activities where learners construct their knowledge through interaction with their peers and teacher (Nikitina, 2010).

In this sense, a COIL approach can facilitate the implementation of participatory pedagogies by enabling more active student participation and interaction; greater choice and control; access to diverse resources; and more opportunities for self and peer-directed learning activities (McLoughlin & Lee, 2007), all enhanced by technology.

Social Media such as WhatsApp and Twitter, are considered valuable tools for participation through their key characteristics of collaboration, sharing and communication which can enable the co-construction of ideas and knowledge, which are also the central pillars of constructivist teaching and learning approaches (Mnkandla & Minnaar, 2017; Manca, 2020). However, although some technologies and social media, such as Twitter, have become firmly embedded in HE courses design and delivery, there are others, popular for personal use, that have yet to be fully explored for their educational potential; WhatsApp is an example (Manca, 2020) and a key social media tool in this project. Studies of WhatsApp use in HE have focused on the

benefits in terms of facilitating discussion and peer learning (Manca, 2020) but its implementation in HE courses and international workshops require further investigation.

Methodology

HE institutions involved

• University of Glasgow (UoG), School of Education (SoE) Scotland.
• Indian Institute of Science Education and Research (IISER) Pune.

Participants

•Four NQT, Alumni Post-graduate Diploma in Education (PGDE) Primary 2020-21 UoG, School of Education.

•Ten in-service teachers practicing in different schools across Pune region. These teachers have been a part of various previous outreach programs delivered by IISER Pune.

International sessions organisation

The teaching team comprised of four tutors: two from Scotland, UoG SoE, and two from India IISER Pune (including two of the authors of this paper: Rodolico and Dashaputre), as well as both countries' experts in Renewable Energy, engineering, and architectural companies. The course content was co-created based on both cultural contexts, curricula, and educational priorities (such as internationalisation, critical thinking, and STEM) with a balance of teaching strategies and pedagogical approaches from both countries. Sessions were discussed and adapted in line with the cultural and academic norms of both countries, with particular attention to time differences that would suit all. Given participants' work commitments the sessions ran mainly on weekends and at 10 am UK time (15.30 pm India time). They were delivered online using the platform ZOOM for synchronous contact. A large volume of resources was uploaded to the open database Figshare within a specific project folder, where all contributors were registered as editors, in respect of each tutor's intellectual property. The sessions were spread over four weeks allowing time for interaction, communication, and reflection within and beyond the synchronous sessions. Participants were given the choice to decide on any other online platforms for their communication outwith the synchronous sessions.

The authors of this study shaped their workshops around the key elements of participatory pedagogy (Simpson, 2018). For example, learning outcomes, objectives, and contents were discussed and finalised with participants as an ongoing collaborative process. Since Scottish and Indian schools follow different academic and cultural calendars, workshop timelines and deadlines for submission were also discussed with the participants. A consensus was obtained from participants in both countries to aid effective participation. Enthusiastic participation was achieved when participants were invited to co-author a paper for the Learning in Higher Education Conference hosted by the Universities of Glasgow and Strathclyde in December 2021.

Intervention

The intervention was based on the sustainability project- *STEM challenge* called "Build your own sustainable house" (Rodolico, 2021)

In line with the definition of COIL, the intervention was carried out with the co-creation and cooperative delivery of a series of four workshops between SoE, UoG and IISER Pune institutes between October and November 2021. Through a series of collaborative online tasks and the engineering design process, participant teachers had the final goal to plan and build a sustainable model house complete with renewable energy sources. They also had to detail 'plans for learning' or 'lesson plans' to be implemented in their classrooms supported by a custom-made class practical kit.

Workshops key elements

Workshops were built by following the definition of exploratory, learning, and creative workshops suggested by Sufi et al. (2018) and by creating content in line with the four key aspects identified by Rodolico et al. (2022)**:** A topic of common interest, Mutual Enrichment, Active Participation and Remote Cooperative Teaching as previously described.

More than 12 meetings were attended by tutors of both countries to create and organise material designed to cover 4 two-hour online workshops with additional 36 asynchronous notional hours, delivered in a hybrid format.

Another important element was the time given in between sessions to allow communication and encourage the exchange of ideas in a collaborative setting. Teachers also had the choice of the online communication platform they preferred to use, including social media, in respect of their personal, professional and their institutional perspective on the use of these communication tools in a pedagogical context (Purvis, Rodger & Beckingham, 2020).

Social Media used

Emails and Zoom: Mainly to organise group meetings, synchronous sessions with tutors, and share some initial resources.

WhatsApp: an initial group was developed with all tutors and participants altogether. Participants then decided to create additional small private WhatsApp sub-groups based on their assigned group tasks.

Google Classroom: Teachers' preference to deliver the workshops in their own classrooms

Institutions support and International Vision

The University of Glasgow is implementing the strategy World Changers Together 2025 (University of Glasgow, 2022), with a strong commitment to reaffirm global connectedness and collaboration, based on a culture of open cooperation and a community of discovery. To support this vision the University has established several internal funding sources, such as the International Partnership Development Funding (IPDF), to facilitate programmes that connect faculty members to peers in geographical regions of institutional interest. This is an essential component for a successful COIL activity and was successfully applied to this study (Appiah-Kubi & Annan, 2020).

Similarly, the internationalisation strategy of IISER Pune is based on three major pillars. These include collaborative exercises on research and development, globalisation of curriculum, and cultural exchanges (IISER, 2014). The Institute supports the development of strategic global partnerships in the areas of pedagogy, research, and innovation. Internationalisation is an integral part of the organisation's overall strategy, which was fostered through COIL.

Ethical approval

Ethical approval was sought and granted by the UoG College of Social Sciences ethics committee. Student's written feedback and additional comments in relation to the *Social Media for Learning in Higher Education Conference* (December 2021) have been collected. The researchers accept the limitations of such a small-scale study and do not seek to make generalisations but rather offer points of discussion to inform further research on how social media could impact international projects.

Ethical approval from IISER Pune was sought and granted following the institution's process of application to the IISER's Ethics Committee for Human Reserach.

Data Collection

Tutors/researchers' reflections: Journals written by participants or researchers are an important source of data in narrative research which can offer important perspectives on the research questions (Connelly & Clandinin, 1990) Tutors' reflections are embedded in the discussion.

Participants' feedback: Feedback on the impact of social media was collected through text messages exchanged in the WhatsApp group and the contribution that participants prepared for the social media in HE conference. It was in the format of written or recorded PPT slides on the topic of social media and their impact on the active participation and completion of the series of international workshops.

Data Analysis

Transcripts from the slides and the focus groups were thematically analysed in line with a deductive and inductive coding process (Braun & Clarke, 2021). The deductive analysis undertaken in this study used a pre-existing rubric with themes such as 'enhancing IaD and IaH in Education', 'social media', 'participatory pedagogy" as the three key areas of the research question. The data showed that all the COIL elements were considered relevant for the thematic analysis and have been summarised under the "COIL" theme.

Data was analysed by using Descriptive, In Vivo and Emotion Coding (Saldaña, 2014). Finally, researchers asked participants to read and review initial findings and to actively contribute to the discussion, making them co-authors.

Results

The thematic analysis was based on the key elements of this study shown in Fig 1.

COIL in HE: The key aspects of Collaboration, Online, International Learning were analysed through the opinions of tutors from both countries. Results are reported and analysed in the discussion.

Enhancing Internationalisation IaH and IaD: According to Rodolico et al. (2022), we used 4 main deductive themes and 10 inductive themes (see details in Table 1).

Deductive theme	Inductive Themes
Mutual Enrichment	Knowledge Exchange
Active Participation	Peer Support
Cooperative Teaching	Engagement in Professional Development
Topic of common interest: STEM Education	Informal mentoring: collegiality
	Networking
	Communication Barriers
	Cultural Barriers
	Feelings: belongings, valued friendship, trust, respect
	Leadership of own learning
	Valuing each other's ideas

Table 1. Thematic analysis of feedback and focus groups. Four deductive themes were identified through the literature review and 10 inductive themes emerged through the initial coding.
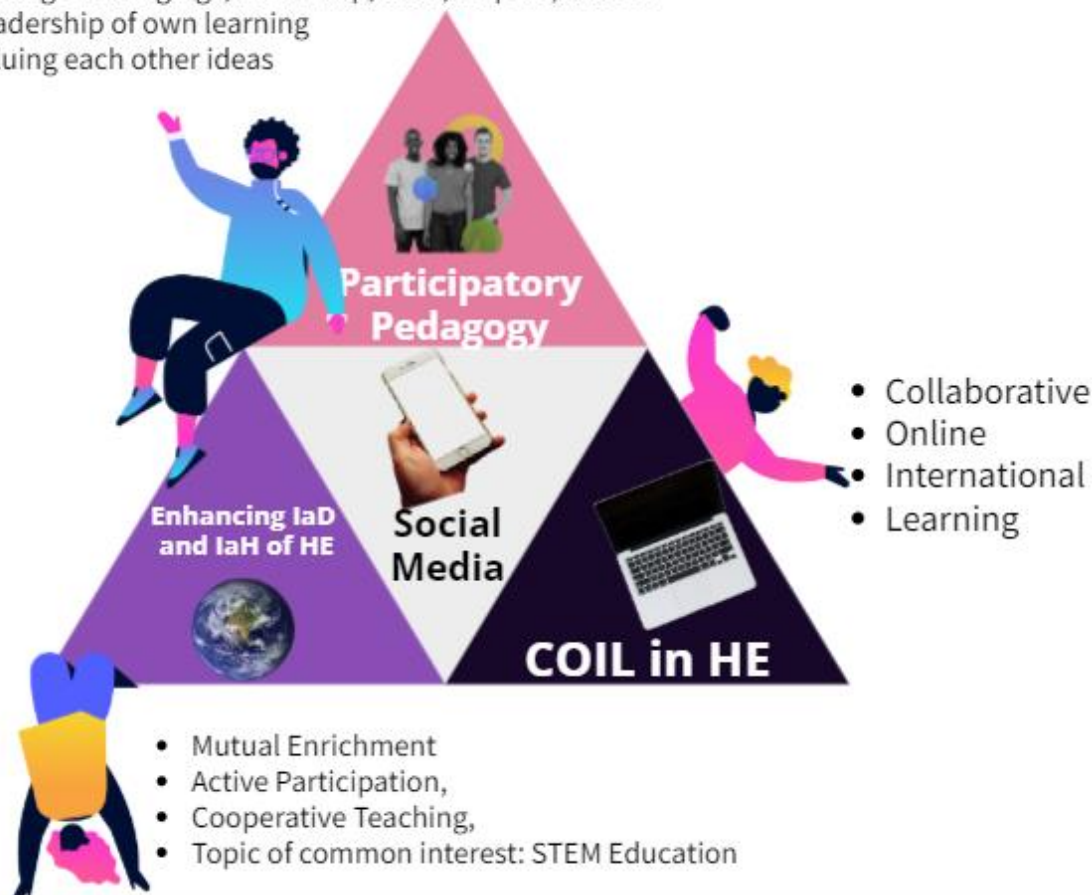
Fig 1. Summary of interrelated deductive themes and inductive subthemes

Discussion

A summary of the discussion key elements is shown in Fig.2

Social Media and COIL in HE. Tutors' reflections

To analyse the impact of social media on the collaborative learning experience of participants, in this section we focus on the tutors' reflections under the headings of COIL and by embedding all the deductive and inductive themes in the discussion.
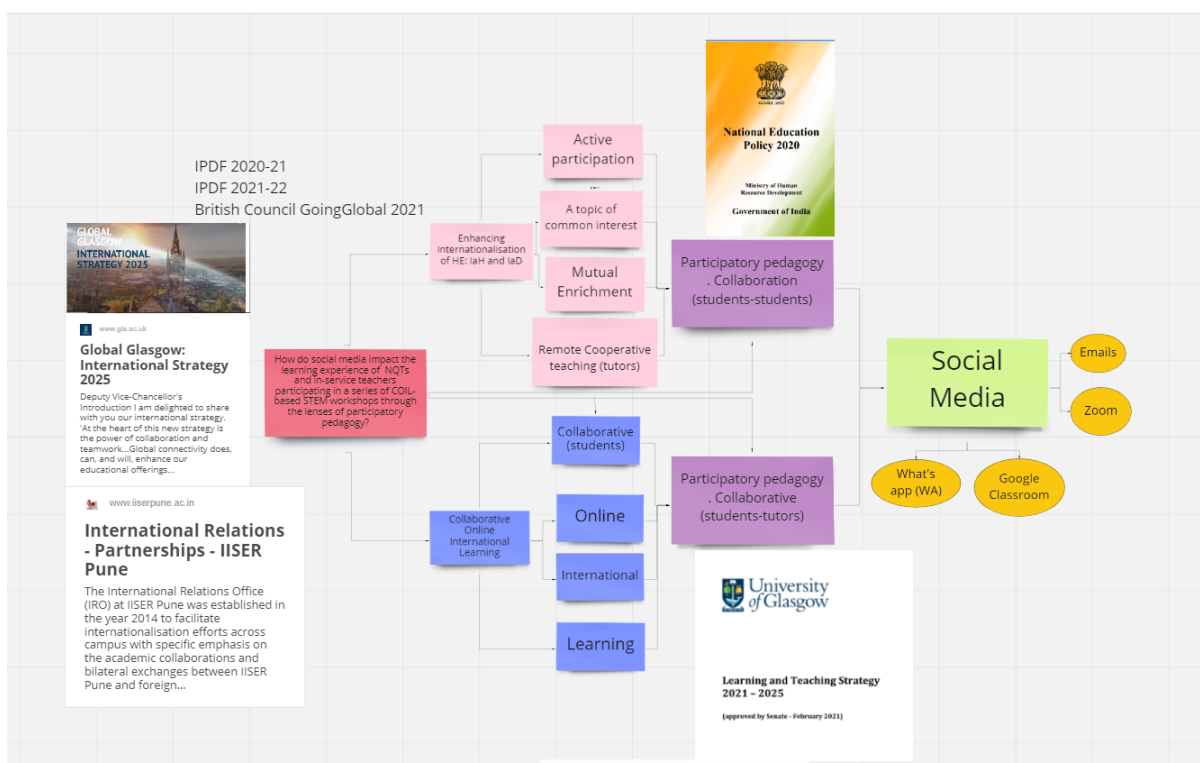
Fig.2 Summary of study.

Preliminary remarks

Although following a COIL approach, there are a few limitations that make this an exploratory COIL project rather than a full COIL model. First, it was a standalone, voluntary, professional development project, not integrated into a wider accredited course at each institution – the Indian participants were in-service teachers, and the Scottish participants were NQTs. Second, the Scottish participants were fewer in number and had taken part in the original 2020 intervention and as such were positioned in support or mentoring roles, for e.g., groups were set up that had 1 Scottish participant working with 3 Indian teachers. However, there is still significant learning that can be taken from this project for future COIL courses.

Collaborative

Collaboration in this project was multi-directional and stretched beyond the institutions themselves, and although it started as mainly tutors' collaboration it soon became a dynamic two-way process which actively involved participants. First, staff at both institutions collaborated closely in the design and delivery of the workshops with the purpose to create content that had to be equally relevant for both groups of participants and so significant revisions were required. Indian tutors reflected that "*we were given enough opportunity to create context that was related to India so that's where I think the true collaboration began*". This involved preliminary mapping of content to curricula from both countries, both school level, and HE level curricula, recognition of the different educational backgrounds and career stages of the participants and understanding of the different Scottish and Indian contexts in terms of sustainability. The distinct geographical locations had a strong influence on the course content, for example, highlighting a need to include solar energy as well as wind power since the former is the main sustainable energy source in India and the latter in Scotland. Tutors

established an initial WhatsApp group: " *it was like we had known each other since for ever, we started our own WhatsApp group with the focus on the workshop designing and we ended up sharing personal experiences and family pictures, it felt just natural as if we were friends since a long time*". Recent studies show that 66% of people believe that WhatsApp has improved their relationship with friends (Kumar & Sharma, 2016) and it is also believed to support the social interactions among peers (Décieux, Heinen, & Willems, 2019), and in this study, this could be the reason for the feelings expressed by the tutors.

The tutors promoted active learning through a problem-based approach and set up a buddy system between participants from both institutions. Smaller groups were set up with one Scottish teacher and a few Indian teachers. They then arranged meetings and carried out ongoing discussions in their own groups. This involved both professional conversations and building friendships through social media and digital learning platforms such as Zoom and Google classroom. Participants opted mainly to use WhatsApp to communicate with their peers and asked tutors to be part of their main group, while they had also private and smaller secondary working WhatsApp groups. Tutors commented, "*It was great to see how teachers in Scotland and India started to comment on and question each other's plans*"

Tutors noted that peer support became a significant part of the project as when one participant had a problem, they could contact their peers for help, so "*all of them were trying to work it out together*". Not only did this support the participants to complete the tasks, but it also highlighted the important role of collaboration in learning so that teachers could then go on to promote and encourage peer support and collaborative learning among their own students.

Online

As outlined above, the online technology enabled the international collaboration, and a range of different platforms was used for different purposes. Zoom, MS Teams and email were primarily used for formal communication and teaching. WhatsApp and GoogleMeet were adopted by participants to meet their own ongoing communication and collaboration needs. The course organisers were aware that they could not dictate what platform or medium that participants should use to communicate out of class time but in this case, there was a consensus that WhatsApp was the most suitable. The participants' WhatsApp group evolved quite organically, and it quickly became a place for informal chats, where participants saw themselves as not only colleagues but also friends. "*The chat became a place where participants and tutors quickly became collaborators and by the end of the workshops and even beyond it, we ended up calling each other "friends"*", a tutor reflected.

As the participants worked through the project tasks, from conducting Biodiversity surveys, to building their model of sustainable houses and installing a sustainable energy circuit with wind or solar power, they shared their ideas and progress through WhatsApp. "*Every time they found something new, they were posting it in the WhatsApp chat [...] It was great to see how teachers in Scotland and India started to comment and question each other's plans and the fact they were so different in some ways, yet so similar in others.*" This helped to keep participants motivated and on track as well as being a valuable source of ideas and knowledge exchange (Gulzar et al., 2021).

Social media also worked as an assessment tool for tutors who were able to monitor participants' progress over time and across geographical spaces. "*Every time a teacher*

completed their circuit, they would post a video of the circuit working. So, in this way, we monitored them throughout the 4 weeks. We didn't leave them totally alone".

In addition, participants were very keen to post every progress of their work demonstrating creativity and engagement through intrinsic motivation (Gulzar et al., 2021).

International

"Working together strengthens not just our academic being but also our human being"(tutors).

The international component can be seen here as contributing both to the academic learning outcomes and the intercultural competences the project strove to enhance, and this was not only for participants but also for tutors (Appiah-Kubi, & Annan, 2020). The easy access to multimedia channels encouraged participants to share information and exchange knowledge (Khan et al., 2021) which extended from wider issues of teaching, curriculum, and assessment to sharing opinions and suggestions on more personal and cultural matters. For instance, participants were curious to find out more about education in their peers' contexts and this led to the realisation that what they had taken for granted as a universal or common educational approach was in fact deeply cultural and contextual. In addition, since the project period spanned important cultural festivals in both countries - Diwali in India and Bonfire Night in Scotland - participants started to exchange cultural information and personal experiences with lots of pictures and stories about fireworks, food, cooking, and family members. In this sense of personal sharing, "*it became more about friendship*".

Learning

The tutors were satisfied that participants achieved not only the intended learning outcomes, but also additional learning related to understanding wider international education and sustainability issues.

Over the duration of the project, the participants presented Biodiversity survey results, how they used the results, the building materials they chose and why, and showed their models of a sustainable house. As well as presenting their completed houses, participants shared their 'plans for learning', outlining what they plan to do with their students in their classrooms, over how long, how and why. This resulted in working not only on critical analysis skills of resources and reflective planning of teaching (de la Torre-Neches et al., 2020) but also on their communication, presentation skills (Heron et al., 2022), and international competencies (Naicker et al., 2021). For example, one Indian teacher had structured his 'plan for learning' based on strong inquiry-based learning principles: "*his lesson plans were all about questioning and getting the students to think*" as described by a tutor. The participants were impressed by the tutors' teaching too: "*I'm so impressed by how much of your teaching and ideas have already filtered into my teaching style*", a participant claimed. Through their comments, it was evident that the participants not only learned about the workshop content but also gained the necessary pedagogical knowledge needed to implement the STEM challenge in their classrooms. They extrapolated this pedagogical knowledge to other subjects as well.

The participants in both countries found it particularly useful that they had gone through the whole process as students, in a version of 'loop input' (Woodward, 1988) which allowed

teachers to make critical reflections on being a learner (Benander, 2009), and realising key aspects of their lessons even before planning it as teachers. From both a technical and emotional point of view, they felt better prepared to support their own students on their own STEM Challenge.

One final area where the learning benefits of international collaboration could be seen, was in the participant-directed discussions and comparisons of their education systems. The tutors left space in the online sessions for participants to explore emerging areas of interest and this led to new learning and insight. The tutor reflected "*For example, a Scottish teacher says, 'this is done to increase parental engagement', and then an Indian teacher would ask, 'why are you doing this? Is it in your policy? How do you encourage parents to take part in this?' so there was a lot of exchange going on that we felt very happy about*".

Where the Indian teachers wanted to know more about parental involvement in learning, the Scottish teachers were curious about the Indian 'tinkering labs'(Atal Innovation Mission 2020) attached to some schools and were keen to explore if they could apply similar ideas in their after-school clubs. These examples of cross-cultural learning clearly show one of the greatest advantages of social media which is the possibility to blend the COIL components in a more integrated approach as opposed to making them separate elements (Roberts et al. 2022).

Social Media and enhancing internationalisation experience through the lenses of

participatory pedagogy. Participants' feedback and focus groups

To further analyse the impact of social media on the collaborative learning experience of participants, we now turn to examine participants' feedback in focus group discussions held after the COIL workshops. We will focus on three specific themes which emerged from the analysis and which we consider interrelated.

- Engagement in Professional Learning
- Leadership of own learning
- Feelings: belongings, valued friendship, trust, respect

Engagement in Professional Learning

Feedback from participants described the COIL experience as "*really engaging and hands-on*" and that it provided them with the opportunity to improve their practice as newly qualified and in-service teachers through the Engineering Designing process and the modelling of sustainable housing. For example, a Scottish participant describing her experience stated: "*I found the STEM challenge project really engaging…mainly due to my lack of experience in the area of developing sustainable housing models… I was really interested in learning more about it, and the opportunity to work with colleagues in India and Scotland and have that dialogue with them. I think that added to the engagement and it was such a lovely experience to be able to share our ideas using social media to do that.*"

The participants admitted that they used to teach sustainability as a concept, quite passively, but through this STEM project they had found ways to embed it into a real context of learning which is proven to be essential for teaching sustainability in HE as well as in school education (Gamage et al., 2022). The participants saw the sustainable house as a great example but said it had fostered many more ideas and increased their own awareness of the issues.

The project was variously described as "interesting", "engaging", and "unique" with one participant reflecting and elaborating that, "*I have handled many students in the past in doing different kinds of science projects, but the COIL STEM is different because it allows me to build a model and also think of ways of making my lessons learner-centered, that is, letting my students build models of sustainable houses, then having classroom discussions on how to improve the models.*" This excerpt not only demonstrates how the participants found the collaborative learning experience engaging but also shows that participants were active contributors to the project and responded positively to the professional development opportunity to experience first-hand new approaches to teaching and learning. The practical task of 'planning for learning' helped facilitate knowledge exchange and served as a motivator for designing learner-centred lessons and improving teaching practices.

Leadership of own learning

Participants agreed that the collaborative learning experience offered them the unique opportunity of learning through interaction with colleagues within virtual platforms without instructors' pressure and the rigid demands typical of more 'traditional' classroom settings. This is in line with literature where classroom rigidity for active participation is recommended for practical timetable scheduling but also needs to be balanced with more freedom of learning (Grigorkevich et al., 2022) as also confirmed in this study. In fact, in this study, a participant revealed that "*…sometimes, I get so excited in the project, and I would forget that there is a time difference between India and the UK and would send messages on WhatsApp to my Indian colleagues when they were probably in the middle of the night, sleeping. There are really no limitations to our discussions… we initiated several discussions and shared ideas on innovative ways to build our sustainable housing models.*" While this account reflects enthusiasm for learning as well as a cultural barrier to communication in terms of time zone differences, it also exemplifies the flexibility of asynchronous knowledge production and exchanges which are not restrained by rigid timing. Similarly, it demonstrates that the participants took initiative and leadership in their own learning, further developing their self-directed study skills linked to life-long learning and professional development (Bidokht & Assareh, 2011). In particular, participants were not heavily reliant on tutors for delivering course content, but they actively constructed learning in a social manner at a distance and through social media (Schrader, 2015).

Feelings: belongings, valued friendship, trust, respect

A major feature of the adoption of social media in collaborative learning is that it facilitates connections and socialisation – an affective learning perspective that is equally as important as cognitive abilities, especially in the area of collaboration (de la Torre-Neches et al., 2020). Analysis of the FGDs reveals that socialisation (borne out of the need for peer support) occurred between and across participants and tutors. As noted earlier, participants especially took the initiative with tasks and to support themselves in terms of their language ability needs. This experience made both Indian and Scottish participants comfortable with communicating with each other over time so much that a participant (pseudonymised as Sunita) observed, "*…we became such good friends. Afterward, we started understanding ourselves, there was no need for text messages…we simply use voice notes… we learned a lot from our groups. [name withheld] was in our group, so we learned a lot from her. There was mutual sharing. We shared about our family, so many things – dogs and cats and so on.*" This account demonstrates a shift in participants' perception of themselves as colleagues to being friends so much that they were comfortable with sharing aspects of their personal lives with one another. This indicates that despite the existing cultural difference among participants, there was the

attainment of trust and a high level of mutual respect – intercultural competencies regarded to be highly beneficial in the praxis of experiential and collaborative learning (Benander, 2009).

Participants' thoughts were consistent, and they mentioned that they had a great learning experience and were generally pleased with the outcome of the STEM challenge workshops and collegial interactions over social media. Words such as 'confidence', 'engaging', 'enjoyable', 'knowledge exchange', 'sense of belonging' and 'friendship' were among the keywords that were repeatedly mentioned to reflect the participants' satisfaction with the constructive conversations and informal exchanges they had and the extent to which they have forged personal relations with their international colleagues. In fact, when asked about how the STEM challenge project has enriched their knowledge and empowered them to teach STEM better, many of the participants noted their keen interest in future networking opportunities with both peers as well as tutors. Among such thoughts is that of a participant who disclosed, "…*we would like to interact more and have more of the informal talks beyond the course work and the primary objective of the workshop*". Like the others, her thoughts emphasise the salience of informal conversation in forging personal relations, which was an important aspect of knowledge exchange within this cross-cultural group (Appiah-Kubi, & Annan, 2020). In fact, tutors' observations have shown that participants continue to have these informal exchanges even after the end of the STEM challenge project.

Although participants and tutors expressed initial feelings of fear of understanding accents, however, the informal exchanges helped them to develop very cordial collegial relationships wherein they were free and comfortable to ask for mutual assistance with understanding the task, instructions, and contributions made by colleagues. Using an Indian participant's words they said, "*...talking about accent, when we were told we had to work with teachers from the UK, we were wondering whether we will be able to communicate well, whether we will be able to understand. When we had the first workshop, we literally struggled to understand and grasp what [name withheld] was trying to explain to us, but once we started interacting, we became comfortable with each other and made attempts to slow down, listen and concentrate more.*" Similarly, a Scottish participant was critical of her inability to exactly meet the language needs of her Indian colleagues, they claimed (in teary composure): "*It feels like I failed because I can't speak your language while you can speak mine.*" Speaking further, they said, "*I'm from the west coast of Scotland, and we speak very quickly, but I have learned to slow myself down so that I can be understood.*" These excerpts are indicative that participants were mutually self-aware of their learning inabilities in terms of language and/or communication barriers but they were willing to adapt their language abilities to facilitate effective knowledge exchange (Keogh, 2017).

Again, the social media platform (WhatsApp) provided that "safe" learning space for participants to express themselves freely while attempting to improve themselves towards facilitating the learning needs of their colleagues. Further chats on the WhatApp group even after the project was completed showed a willingness to engage in further networking with both peers as well as tutors and more importantly, this is now showing to be more of a friendship space where there can be opportunities to share and exchange knowledge not only directly related to the workshops' tasks.

Overall, there are several positive implications of this study on teachers' professional development and STEM learning. Social media like WhatsApp, blogs, Twitter, YouTube are now part of the day-to-day life of learners, and this makes their use for active learning, knowledge exchange and collaborations quick and effective, allowing learners to express

themselves in multiple, flexible ways and enhancing their learning experience (Natarajan, 2017). Their use can be intended as an aspect of participatory pedagogy where knowledge is co-constructed by participating in the learning processes and, as a result, learners begin to see themselves as authentic producers of knowledge, sharing their professional voice and representing their worldviews through these diverse media (de Sousa, Loizou & Fochi, 2019).

Working with social media such as WhatsApp helped break down some political and geographical barriers and brought teachers and instructors together, all sharing their research and finding in an ethos of equity and collaboration. Participants were able to quickly and easily share pictures, videos, voice recordings. Some of them also shared that they could mute the group chat when they did not want to be disturbed, making this a desired feature of WhatsApp, and again demonstrating a flexible and individualised approach. Emails, although accessible for all participants, did not gather a very positive response for communication. Some participants did not find the email platform suitable for continuous communication, as it required desktop access whereas WhatsApp could be accessed on mobile devices and generated handy notifications.

The best feature was the voice recording function which facilitated instant and fluent oral communication whilst still allowing each member to have the chance to work in their own time zone and regions (India and UK). This meant the participants could access the files at their own convenient time, but it still preserved the ethos of professional discussion.

Conclusions

Engaging in professional dialogue and practice via social media with international partners, as well as with colleagues from other local authorities' schools has been considered hugely beneficial to the professional development of all teachers involved, with a focus on expanding knowledge and practice from other schools, institutions, curricula, and countries. This has, in turn, raised awareness of positive learning experiences as well as barriers and challenges faced by teachers and pupils in diverse classrooms in Scotland and India. Furthermore, as most of the contact was done via social media, it allowed all participants the time to read, comprehend and respond to questions, queries, and suggestions at times that were convenient to them. Indian tutors commented that WhatsApp helped in maintaining day-to-day interaction with the participants towards building a relationship with them during and beyond the Covid-19 pandemic. Teachers in remote villages who might not have access to high bandwidth/internet data found it easier to communicate using WhatsApp.

Drawing on different approaches and knowledge sources across countries also made a small contribution towards a shared understanding of what is meant by decolonising the curriculum, and tutors from India commented "*After this experience, I certainly don't feel like stopping! It was really wonderful.*"

Overall, the tutors and participants responded very positively to the STEM Challenge project. The learning from it has informed the development of *Enhancing Teacher Education in STEM through a linguistic lens: a cross-curricula and transnational effort challenging gender stereotypes,* a new project funded by the British Council's Going Global Exploratory Grant. To build programme sustainability and scale up impact, the key principles and tasks of the

STEM Challenge are in ongoing discussion to be integrated into Teacher Education programmes at the University of Glasgow and at a partner institution of IISER Pune.

Limitations

There are, however, a few limitations to be considered. First, WhatsApp might have data protection issues which are handled in a different way by different governments. A clear example has been the different approach to the recent change in WhatsApp and Facebook data handling which affected EU/UK and non-European users in different ways (Lorico, 2021).

Zoom meetings generated different opinions for different participants. For Indian partners, for example, Zoom meetings had a time limit of 45 minutes. This was not the case for Scottish participants. On the other hand, Indian teachers had a more direct positive experience with Google Meet while Scottish teachers can use TEAMS through their institution's account. These examples highlight the importance of contextually specific options being considered in COIL planning stages and the readiness to change and adapt in response to participants' needs.

Technology in international collaboration offers many benefits but practical, ethical and legal issues must be tackled too. The teams explored the development of possible third spaces to allow access to learning material to both institutes in a regulated and protected environment where intellectual property rights are assigned to each author. This tackles the problem of participants in one country being 'guests' rather than users with equal access when accessing resources hosted at one institution, e.g., on Moodle or MS Teams. Material has been deposited in the *Figshare* database with equal access rights from both countries' participants but at the same time, with intellectual property assigned in a rightful and ethical working environment. Files deposited on *Figshare* also provide users with a DOI so they can be easily shared with other participants and more widely.

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