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Title

Immersive-Learning Experiences in Real-Life Contexts: Deconstructing and Reconstructing Vietnamese Kindergarten Teachers' Understanding of STEAM Education

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Immersive-Learning Experiences in Real-Life Contexts: Deconstructing and Reconstructing Vietnamese Kindergarten Teachers' Understanding of STEAM Education

Abstract

This paper presents a unique perspective into challenges faced by kindergarten teachers in engaging children in Science, Technology, Engineering, Arts and Mathematics (STEAM) education in Vietnam. It reports on teachers' perspectives of an adaptation of immersive learning experiences (ILE), to develop understanding of pedagogical approaches to STEAM education in real-world contexts. The study adopted a qualitative and interpretivist methodology, engaging 105 teachers in informal and collaborative activities. Their perceptions were gathered via participatory tools; photographic images recorded how they engaged with ILE. Data analysis occurred using de Freitas's four-dimensional framework. The study responds to evidence that STEAM education is not prevalent in Vietnamese schools, and reflects on the top-down siloed approach ubiquitous within its early childhood education (ECE) sector. Findings indicate the necessity for a prolonged period of training using ILE that enables teachers' development of pedagogical approaches to STEAM education. Significantly, it provides new insight for a variety of stakeholders (including teacher trainers and policy makers) into the under-researched field of Vietnamese teachers' pedagogical approaches in ECE, and extends its findings to countries adopting more formalised approaches to education.

Keywords: Early childhood, STEAM education, Immersive learning experiences, Participatory tools

Introduction

In recent years there has been a growing trend towards incorporating Arts into Science Technology, Engineering and Mathematics (STEM) education and creating STEAM (Jones 2011). A key difference between the two approaches lies in the notion that STEAM lends itself to interactive and participatory dialogic art that provides a non-judgmental space to cultivate the question-making aspect of inquiry, the ability to comfortably hold uncertainty, and a sensitivity to the process of discovery (Radziwill, Benton & Moellers 2015). One way of conceptualising STEAM is through a trans-disciplinary approach that enables students to problem-solve using real-life scenarios (Quigley et al. 2017). These scenarios could be defined as immersive learning experiences (ILE).

ILE, or immersive worlds, have long been established as a means for supporting a variety of activities and interactions that enrich the way people learn in virtual environments (Boulos, Hetherington & Wheeler 2007). At the centre of this learning experience, is the learner who operates as an avatar in the virtual space, engaging with experiences as they unfold in real time (Gazzard 2009). This paper discusses an innovative adaptation of ILE in a two-day conference for 105 kindergarten teachers from the Mekong Delta region of Vietnam, by utilising them in the entirely different context of face-to-face learning in the real-world.

Drawing on data, the researchers illustrate how the teachers' understanding and application of new theoretical constructs to child-centred approaches to STEAM education can be enhanced by providing real-world practical activities, which they can subsequently adapt for use with children in ECE contexts. Furthermore, employing ILE enabled the exploration of potential challenges and barriers to the implementation of STEAM education in ECE, which provides new insight for a variety of stakeholders (including teacher trainers and policy makers) into the currently under-researched field of Vietnamese teachers' pedagogical approaches in early childhood education (ECE). It also reflects on how the findings might be extended to other countries that adopt more formalised approaches to education.

Background to the study

The study emerged from an existing collaboration between the School of Education at the University of Hull in the United Kingdom and the Faculty of Education at Can Tho University (CTU) in Vietnam; the latter providing training and qualifications for kindergarten teachers in the Mekong Delta region of Vietnam. CTU raised an issue that was also a key focus of the MoET, namely that Vietnamese students were less competitive in the job market than Western graduates due to their lack of creativity and leadership.

Recognising this challenge, the MoET introduced a New General Education Curriculum in 2017, which indicated the importance and enhancement of STEM activities as a radical innovation that could impact on students' creativity and leadership. More recently, Deputy Minister Duy (Fulbright 2019) recognised that STEAM education could enable students to become individuals who are not afraid to take risks; engage in experiential learning; are creative and collaborative in forming new ideas or solving problems; and embrace interdisciplinarity. Despite identifying STEAM programmes as effective in the development of critical thinking, they have not been received favourably within Vietnam's education system, largely due to a lack of conceptual understanding and knowledge of learning theories and pedagogical approaches (Tinh and Quang 2019). Moreover, Assistant Dean of the University of Science, Dr. Minh-Triet (Fulbright 2019) states that whilst STEAM education has become popular in Vietnam, a clear teaching method has yet to be developed and implemented in the current school system.

Consequently, STEAM education is largely pedagogically unexplored in Vietnamese schools, and even more so within the kindergarten context, with teachers preferring a traditional

top-down siloed curriculum with little opportunity for transdisciplinary, interconnected teaching (Nguyen et al. 2019). Acknowledging that kindergarten teachers arise from many different academic backgrounds (only 53% are graduates from formal ECE teacher training programmes), it is plausible to suggest there exists an unequal understanding of differing pedagogical approaches for engaging children in STEAM education. The disparity appears to have been recognised by the MoET, who have responded by ensuring that kindergarten teachers have access to continual professional development. In 2006, 87% of kindergarten teachers were trained to meet national standards and by 2015 this had risen to 97% (MoET 2015). This increase indicates the importance placed on the training of early childhood teachers, with the latest figures reporting that 98.4% of ECE teachers and management staff had met the required professional standard (MoET 2018).

While the government has invested in in-service professional development, Anh et al. (2016) report that this has been largely ineffectual due to the theoretical, rather than practical, focus of the training, resulting in teachers finding it difficult to apply a child-centred teaching and learning approach in daily practice. Notwithstanding the MoET's ambition for Vietnamese kindergarten teachers to adopt more westernised pedagogical approaches, the researchers were mindful of Vietnam's long held and firmly established Confucian beliefs regarding hierarchical teacher/pupil relationships and transmission of knowledge from teacher to pupil (Hien 2018, Abbot et al. 2019). Nevertheless, at the request of the MoET and CTU, the researchers sought to explore whether ILE can enable kindergarten teachers to understand and apply child-centred pedagogical approaches to STEAM education.

The aim of the study was twofold:

1. To comprehend Vietnamese kindergarten teachers' conceptions of STEAM education, and provide insight into the potential challenges and barriers they face;

   and

2. To explore whether ILE, in real-world scenarios, can enable kindergarten teachers to understand and apply child-centred pedagogical approaches to STEAM education**.**

Early Childhood Education in Vietnam

ECE in Vietnam has a system of semi-public nursery schools catering for children between one and three years of age and preschools (kindergartens) for children aged three to six years, which receive partial state support. All provisions are centrally controlled and fall under the jurisdiction of the MoET, who provide regulatory guidance for the provision of ECE and

curriculum content. Education Law (first introduced in 2005 and later updated in 2019), stipulates curriculum requirements for ECE together with the required methodologies for preschool education. The regulation on General Preschool Education Curriculum (MoET 2009) additionally stipulates four sets of targets for preschool education, including physical; cognitive; lingual; and emotional and social skills development, and a more detailed curriculum for children aged three to six years.

Focusing specifically on pedagogical approaches, teachers in Vietnam have favoured traditional practices of direct instruction over play-based or constructivist approaches (Piaget 1970; Vygotsky 1978). Hayden and Lan (2013) report that many early childhood centres in Vietnam still adopt teaching strategies that are generally didactic and adult-led. Here, children are encouraged to focus on mastery of theory and the acquisition of memorised knowledge rather than the development of analytical, problem solving and communication skills. Despite the MoET's (2015) drive to reform pedagogical practice in the sector that recognises the importance of providing models, collective instruction, and play activities to support children's development, Hien (2018) highlights the tension this has created between parents and state; this in turn constructs barriers to curriculum reform. She argues that Vietnamese parents generally take an indulgent attitude towards their children, and are often over-protective and reluctant to afford young children opportunities to learn by trial and error. They prioritise educational achievement, believing that a good kindergarten education is one where young children are taught reading, writing and number rather than one that enables them to develop personally, socially and emotionally.

Whilst acknowledging this perspective may support a postcolonial agenda, where progressive educational ideas, practices and policies are borrowed from western education systems as a quick way to improve the quality of Vietnam's education system (Le 2020), the paper presents an argument that child-centred pedagogical approaches support young children's learning and more specifically, their engagement in STEAM education. Banko et al. (2013), for example, perceive that children's learning should be concentrated on exploring and experimenting with their natural environment, and Koester (2013) reminds us that children have an intrinsic desire to learn basic knowledge and gain understanding of how the world works. STEAM education promotes such learning through experiences that allow children to explore, question, research and discover (Colker & Simon 2014) in a natural environment that supports the development of skills through collaboration and communication (DeJarnette

2018); consequently, decisions regarding pedagogical approaches to engaging children in their learning become paramount.

Theoretical context

The study employed ILE as a means to enable the kindergarten teachers to understand and apply child-centred pedagogical approaches to STEAM education. This method draws on constructionist approaches to learning, where the learner constructs a tangible or meaningful product as part of an educational activity (Papert 1980), and where the learning involves mastering authentic tasks in the context of personally relevant, realistic situations (Ertmer and Newby 2013). Papert's constructionism is inspired by Piaget's constructivist perspective, where new ideas are constructed in an active role that are of personal interest to the learner. The principle difference with constructionism is that it not only asserts the need for a meaningful constructing process, but the creation process and the end product must be shared with others to attain the full benefit of learning (Amineh and Asl 2015).

DiSessa and Cobb (2004) set out a taxonomy that clarifies how constructionism connects to the practicalities of learning and teaching. They describe constructionism as a framework for action: a set of prescriptions for pedagogical strategies, often heuristic, providing focus and direction to design the learning environment. An emphasis on design consequently raises awareness of its potential impact on the outcome. For example, when designing ILE for teachers to understand pedagogical approaches that engage children in STEAM education, one needs to consider the affordances and constraints of the activity, and recognise that the available resources shape the activity in ways that might be predictable based on the learners' knowledge and experience. By incorporating the contextual reality with access to hands-on exercises, learners are able to gain meaningful knowledge transfer through the integration of theory, practice, and context giving relevance to their tasks and meaning to their learning.

Equally important is the motivational and intellectual component of learning. Here, narrative and symbolic immersion operate in a mediated, simulated experience, where learners are required to willingly suspend previously held beliefs or conceptions; this is prompted by an emotional investment in a compelling narrative. Inducing powerful immersion for learning, therefore, depends on exercises that utilise actional, social, and learning experiences (Bonasio 2019). These social learning experiences resonate with dialogic teaching, first appropriated by Alexander (2008). He suggests dialogic teaching should incorporate a collective understanding of a task between the facilitator and learners; reciprocal sharing of ideas

among the learners; a supportive learning environment in which all contributions are valued; a cumulative approach that guides learners towards extending and establishing links within their understanding; and a purposeful intent directed towards specific goals. Boyd and Markarian (2015) concur, maintaining that the key issue of dialogic teaching is how instructional talk functions to 'model and support cognitive activity' (p. 273). Thus, the participants' optimal learning comes from their active and productive engagement (O'Connor 2013), which is built on the creative co-construction of knowledge in interaction between facilitators and learners (Wells 2015).

Both constructionism and dialogic teaching are thus presented as key pedagogical approaches embedded in ILE. Both practical activities discussed herein, illustrate how they facilitated the absorption or engagement of the teachers' mental state within a meaningful activity (constructionism), however, the first activity provides limited evidence of the transfer of knowledge and pedagogical change due to the teachers' emphasis on the end product. Adjustment to the design of the ILE in the second activity, ensured that there was collective understanding of the task between the facilitators and teachers (dialogic). This resulted in some of the teachers being able to articulate their understanding of the suitability of ILE in enabling young children to learn about STEAM education.

Methodology and research design

The study sought to comprehend Vietnamese kindergarten teachers' conceptions of STEAM education; the potential challenges and barriers they face; and consider whether ILE, in real-world scenarios, can enable teachers to understand and apply child-centred pedagogical approaches to STEAM education. This was explored within the context of a conference organised by the Ministry of Education and Training (MoET) in conjunction with CTU, as a constituent element of teachers' yearly professional development programme. Its premise was to provide a theoretical context to STEAM education in ECE, whilst affording opportunities to apply theory in practice. Each day comprised an initial theoretical input session followed by an ILE activity; these each lasted for approximately an hour. The teachers attending, ranged in experience from newly qualified to those who graduated before STEM was first introduced in Vietnam's New General Education Curriculum (MoET 2017).

It adopted a qualitative methodological approach operating within an interpretivist paradigm (Bryman 2012). Central to the design was the use of a participatory approach that offers

epistemological advantages over traditional methods, since participatory techniques can 'access and valorize previously neglected knowledges and provide more nuanced understandings of complex social phenomenon' (Kesby 2000, 423). Initial data collection using a participatory tool (H-form), determined the teachers' perceptions of potential challenges and solutions to implementing STEAM in ECE. An interactive presentation software (Mentimeter) was employed to gain information about the availability of training for STEAM education and understand its current implementation in kindergartens. During the ILE, photographic images were taken that comprised one element for data analysis. Finally, teachers' perceptions were sought to comprehend the impact of these experiences on developing their pedagogical approach to engaging young children in STEAM education. All data written in Vietnamese were translated into English by the research team at CTU. Consent was sought from CTU and the kindergarten teachers prior to the commencement of the research.

Research Tools

H-form

The H-form is an analysis tool designed to structure participants' thinking, facilitate monitoring and evaluation exercises, and generate ideas around a specific question. The tool aims to

> help individuals and/or groups record their own views and ideas in a non-threatening and open yet structured way which fosters individual expression as well as common understanding and consensus (Guy and Inglis 1999, 87).

The tool was used to determine teachers' perceptions of embedding STEAM education in ECE in Vietnam. They were tasked with working in small groups (4-8 people) to list any potential challenges on the left and possible solutions on the right (see figure 1).

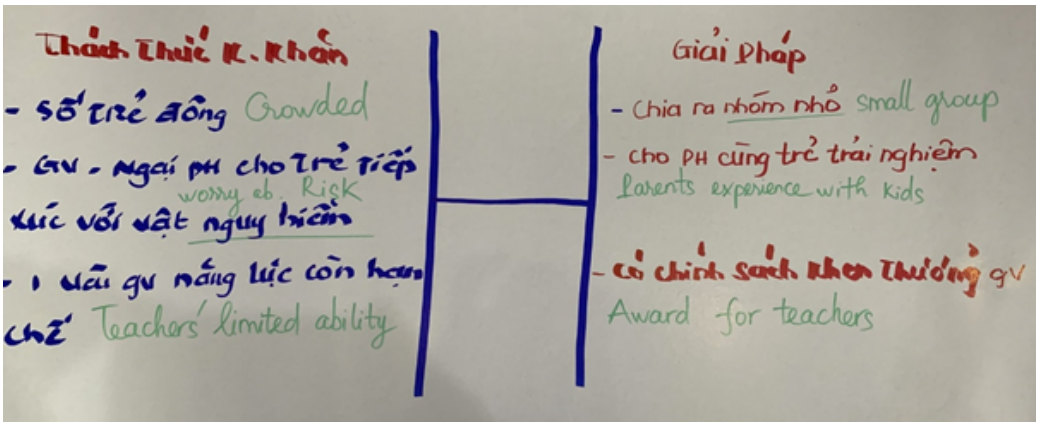

Figure 1. H-form representing challenges and solutions to embedding STEAM education in ECE in Vietnam.

Mentimeter

Mentimeter is a tool that allows participants to answer questions in a variety of ways, using their own internet-enabled devices. The advantage of tools such as this, are that they encourage participant interaction and discussion (Beatty 2004), and peer learning; allow the researcher to gauge levels of understanding (Brewer 2004); and create a fun and energetic learning environment (Caldwell 2007).

The study, herein, utilised Mentimeter as a survey tool at the start of the conference, to gauge the teachers' knowledge, understanding, confidence and experience of embedding STEAM education in ECE (see figures 2 and 3). They were asked four questions:

1. Have you ever attended STEAM workshops?
2. Have you ever applied STEAM in your teaching?
3. How do you teach STEAM?
4. What do you expect to learn from this workshop?

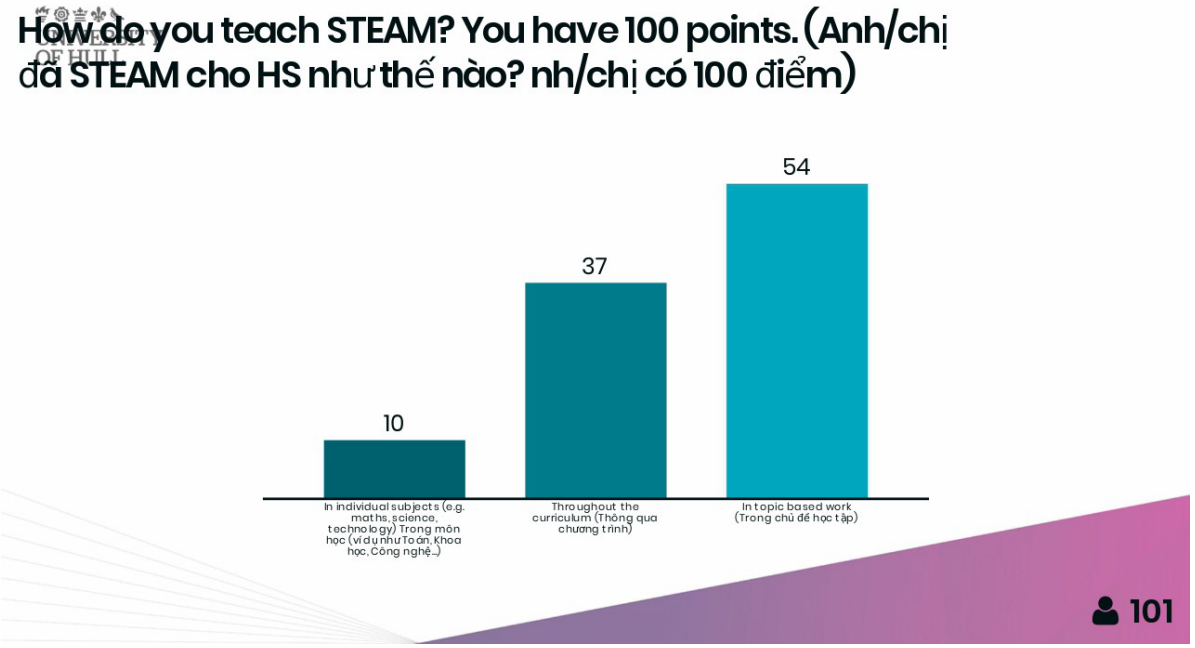

Figure 2. Example of a question and responses from initial survey in Mentimeter.

At the conclusion of the conference, the teachers were asked three more questions:

1. What have you found useful about these sessions?

2. What have you learnt?

3. Do you feel more confident to teach STEAM education?

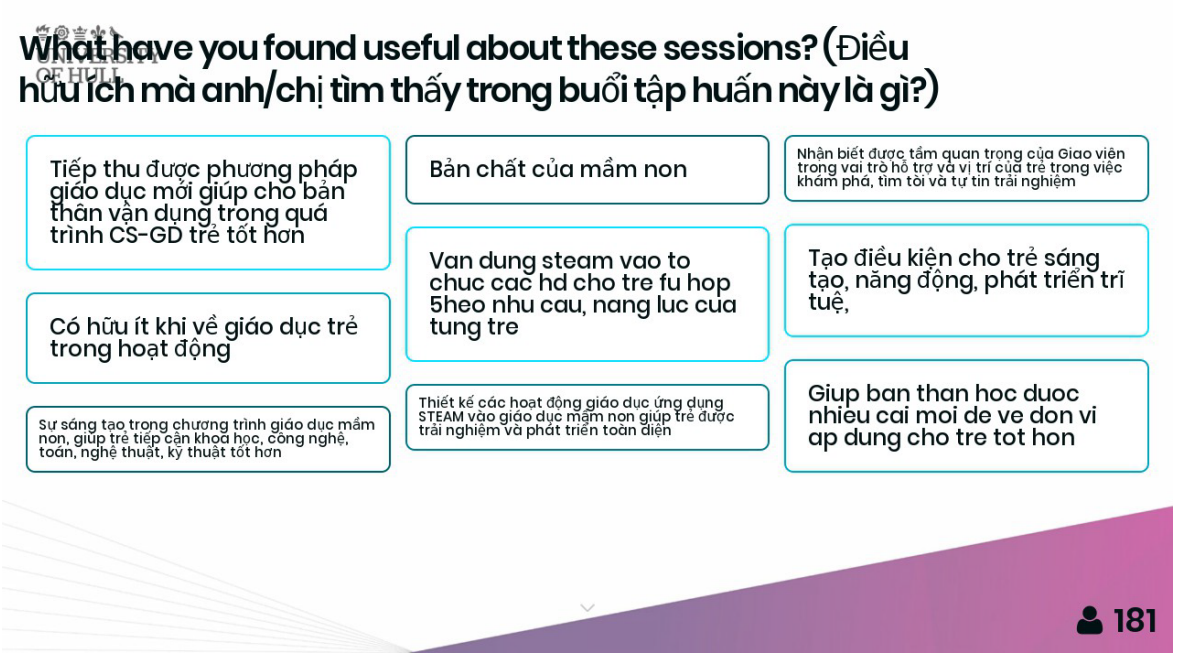

Figure 3. Example of a question and responses from final survey in Mentimeter.

Photographic images from construction activity

Photographic images of teachers engaged in construction activities were viewed through the lens of an interpretivist account. Rose (2007 2) explains that 'images are never transparent windows into the world. They interpret the world they display in very particular ways.' This is a consequence of the way images are perceived to be socially constructed both at the site of production and reception (Banks 2001).

These images recorded teachers engaging in a collaborative exercise to create a device that transported a ball from one place to another, and a further task to deconstruct a gadget, whilst reflecting on the opportunities for children to develop their creativity and critical thinking within STEAM. The photographs were consequently analysed to determine the effectiveness of ILE in developing teachers' knowledge and understanding of pedagogical approaches that engage young children in STEAM education.

Data analysis

The study drew on de Freitas's (2008) four-dimensional framework, which provides a more structured approach to the synthesis and analysis of the research findings. The framework

proposes four dimensions: the learner, the pedagogic approach, the representation and the context in which the learning takes place (see figure 4).

Four Dimensional Framework	
Learner Specifics ● Profile ● Role ● Competencies	**Pedagogy** ● Cognitive ● Associative ● Social/Situative
Representation ● Fidelity ● Interactivity ● Immersion	**Context** ● Environment ● Access to learning ● Supporting resources

Figure 4. The four-dimensional framework (de Freitas 2008).

The first dimension involves a process of profiling the learner and understanding their requirements. This profile ensures a close match between the learning experiences, their environment and the required outcomes. The study utilised the H-form for initial profiling, where teachers were asked to identify the potential challenges and solutions to employing a child-centred pedagogical approach to STEM education. The second element of profiling was revealed through Mentimeter, when teachers disclosed their existing knowledge, opportunities for training, and their confidence to embed STEAM education in their teaching. These profiles provided key information to develop ILE in such a way as to encourage naturalistic interactions that might mitigate the differences in experiences between the participants and lessen the potential gap in learning transfer.

The second dimension analyses the pedagogic perspective of the learning experiences, and considers the methods for supporting the learning processes. This study included the use of associative models based upon task-centred approaches of learning (Merrill 2007) to enable changes in cognitive thinking. Here, the teachers were tasked with exploring how recycled materials might be used to embed child-centred STEAM activities, so that they could apply the theoretical knowledge from the earlier part of the conference. By working in social

groups, the teachers were able to discuss their understanding through the choices and actions they implemented, based on their previous, and potentially newly acquired, knowledge.

The third dimension outlines the representation itself; the extent of interaction required for the learning experience; what levels of fidelity are necessary; and the depth of the immersive experience. Data comprising photographic evidence of teachers engaging in the second task, enabled analysis of the depth of the immersive experiences. The fidelity to the task was adapted from de Freitas's (2008) framework, which considers the extent to which the learner is able to suspend belief of being in a virtual world and connect with the experience as if they are truly present. The study presented here affords a similar approach; it considers whether the teachers were able to apply their theoretical knowledge of child-centred pedagogies to the STEAM task, whilst setting aside their position of adulthood, and in effect become child-like in their learning experiences. Their lack of previous experiential learning may have impacted on the representational dimension, which includes the 'diegesis' or world of the experience that may affect levels of engagement and motivation, or indeed the teachers' ability to transfer knowledge into practice.

The final dimension considers whether the participants might be impacted by the place in which the learning is undertaken, or the disciplinary context, such as whether the learning is conceptual or applied. The conference took place on a university campus, which may have given rise to the teachers' expectations of a more theoretical or didactic form of learning experience.

Findings

Learner Specifics

The participants' role was that of kindergarten teachers of children aged three to six years. They were invited to the conference to develop their knowledge and understanding of engaging young children in STEAM education; consequently, a baseline profile of potential challenges and barriers faced by the teachers was sought via the H-form.

Data presents a profile of teachers who are concerned about their competency to engage children in STEAM education. Some teachers indicated their lack of confidence, whilst others referred to their lack of understanding.

Not confident, shy, afraid of learning new things and sharing.

Teachers' limited ability/Training.

Some teachers commented on the space and resources required to deliver the skills.

Crowded classroom/Small learning space.

Insufficient/Limited /Lack of resources

Finally, some alluded to the role the parents had to play in enabling the change in delivery and content.

Parents worried about risk/Do not let children take risks.

Lack of collaboration between parents and teachers.

These representative examples present a profile of teachers who are willing to embrace learning about new ways of teaching STEAM in early childhood, but who are concerned about the competencies they possess and the challenges they face in bringing about change.

Pedagogy

Almost all of the teachers indicated a change in their cognitive development regarding the task-related experiences. Responses in the pre-test H form activity relating to the challenges teachers faced to deliver STEAM education, indicated that they adopted a broadly teacher-led approach.

Experiential learning is limited.

Hard to teach at individual level.

Children's ability is limited.

In the final Mentimeter survey, their comments demonstrated a shift in thinking about a child-centred pedagogical approach and the role of the teacher. However, it is important to note that this was not necessarily reflected by their actions in the tasks; this is examined further in the discussion.

I learnt how to ask to lighten children's imagination and creativity. How to organize children's activities that let them comfortably play but learn.

I learnt the methods to educate children through steam activities in a very natural way, from the simplest things but very effective.

Teacher is the supporter only, make right questions at the right place. Teacher is the one who provides resources for children to experience and create.

Comments about the practical nature of ILE allude to the notion of an associative pedagogy.

I like to practice and experience.

I am very interested when I participate in this workshop. It helps me strengthen my knowledge in my job.

The workshop helped us have knowledge about STEAM education.

Finally, the teachers made reference to learning that occurred through working with fellow teachers. Thus, they demonstrated the importance of the social aspect of ILE.

The workshop is very fun and I had a chance to study, work in a group, and discuss.

I learnt much new knowledge and experience from the trainers and from other classmates and activities.

I gained more knowledge; had a chance to practice, share, collaborate… The practical applicability is very high.

Observing the teachers during the ILE supports the notion that socially constructed experiences are key to their learning. Conversations between the teachers were animated and prolonged, with leaders emerging to guide others through the tasks.

Representation

The first ILE lasted for approximately one hour, during which the teachers were asked to use recycled materials to transport a ball from one place to another. At the end, they presented their device whilst explaining what learning had taken place during the process, and how it might be applied to young children's learning about STEAM education. The photographic images (see figures 5 and 6) are indicative of the fidelity to, and interactivity with, the ILE. Despite some initial reservations, all teachers engaged in the activity. They worked in groups of approximately eight (figure 7) and began discussing the activity's aim, deciding which roles should be undertaken by whom, and which of the resources they would utilise. Some groups moved more quickly onto the practical application, whilst others remained in the discussion phase for longer.

Figure 5. Teachers engaging in a collaborative exercise to create a device to transport a ball from A to B.

Figure 6. Teachers engaging in a collaborative exercise to create a device to transport a ball from A to B.

Figure 7. Teachers engaging in immersive experiences.

Whilst the teachers demonstrated high levels of interactivity and immersion, the experience did not initially provide them with the mechanism by which to reflect on its implication for children's learning or to demonstrate high levels of fidelity; they focused more on the end-product rather than the skills being developed (see figures 8 and 9).

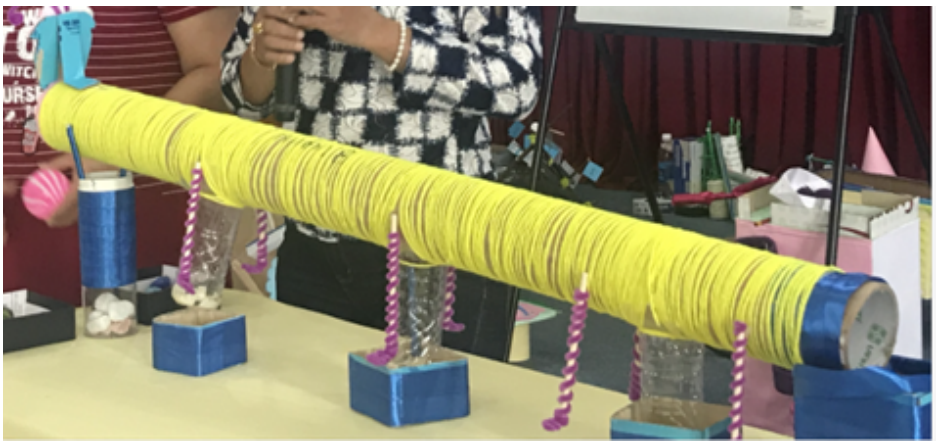

Figure 8. Example of a teacher's device to transport a ball from one place to another.

Figure 9. Example of a teacher's device to transport a ball from one place to another.

Responses in the final Mentimeter survey allude to the teachers' enjoyment of ILE, time and space for reflection on their pedagogical practice, and contemplation of how they might alter it accordingly.

I liked the experiment/experiential learning activity.

I had chances to practice and experience many useful activities; understand more about STEAM and how to apply it in pre-schools.

Can let children deconstruct things or construct things, find out what they do not know yet.

A second immersive exercise enabled the teachers to deconstruct a gadget (see figure 10), whilst reflecting on the opportunities for children to develop their creativity and critical thinking within a STEAM context. Here some of the teachers demonstrated higher levels of

fidelity by articulating what the children might learn about STEAM education in immersive experiences such as this.

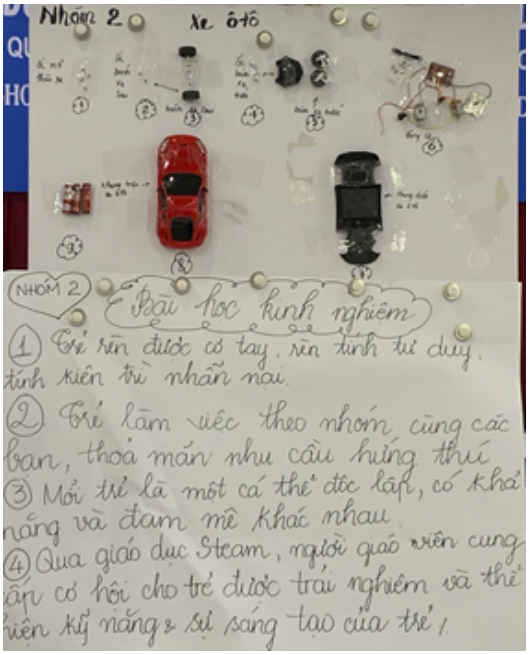

Figure 10. Example of a teacher's deconstruction of a gadget and accompanying STEAM explanation.

Context

Situating the conference on a university campus may have affected the teachers' initial expectations of the training, however, they may not have been fully aware of the interactive and immersive nature of the training itself. Comments in the initial Mentimeter survey exemplify their expectations of the workshops:

I want to learn the methods of how to apply STEAM in schools the most effective way.

I want to apply STEAM to teach children in a gentle and friendly way, but I have to meet the goals of the curriculum.

I want to apply STEAM in teaching children, organise activities to let children learn by playing.

I expect that I can design and apply STEAM activities for children.

I want to learn some practical methods to apply STEAM.

Focusing on the teachers' access to learning, comments in the H-form disclose that experiential learning is limited; teachers have little understanding of STEAM; STEAM is a new concept; and there is a lack of training. Data from the Mentimeter survey supports this explication, revealing that only n=11 (10.89%) had previously attended a STEAM workshop,

and n=90 (89.11%) had not. A further question about whether those who had attended a workshop had ever applied STEAM in their teaching, revealed that n=21 (23.60%) had done so, and n=68 (76.40%) had not. This indicates that although some teachers have access to training they do not appear confident to translate it into practical application.

Finally, the use of everyday and recycled materials in the workshop appears to have changed the teachers' thinking about resources. In the H-form activity, some teachers cited a lack of resources as a challenge to the embedding of STEAM education in ECE. Following their engagement with ILE, some had changed their perceptions.

I learnt many new things, how to make use of available resources and environment.

I can make use of available resources to lessen the budget of the school.

Let children use abundant resources.

Discussion

Drawing on the findings, this paper argues that ILE can be extended from their current use in virtual contexts to learning in real-life situations. Studies relating to their use in entirely online learning environments (see Beckem 2012; Borup, West, Graham and Davies 2014), propose that participants who have encountered a positive experience in virtual contexts that rely heavily on social constructivism, will be more willing to transfer their learning to real-life situations. Using illustrative excerpts from the study designed to facilitate changes in pedagogical practice, this paper submits that ILE can be employed to similar effect in real-life scenarios from the outset; however, this is not without difficulty.

ILE were deemed successful in increasing kindergarten teachers' theoretical knowledge and understanding of pedagogical approaches to engaging young children in STEAM education, however, they did not initially facilitate a shift in pedagogic practice. Of interest here was that while the teachers demonstrated a degree of fidelity to the task through their willingness, enthusiasm and engagement, this did not translate into a cognitive shift in thinking whereby they were able to consider how children might engage in this pedagogical approach to STEAM education. Their apparent inability to distance themselves from an end-product scenario, rather than concentrating on STEAM processes within, may have been due in part to their previous learning experiences. Teachers' comments alluding to the predominantly theoretical nature of prior training sessions, combined with Vietnam's tendency towards a more formal and result-driven curriculum, may have affected their ability to transfer their

knowledge of STEAM into the practical task. Thus, it appears that a more prolonged period of training is required in which pedagogical considerations, such as child development theories, are discussed, and more time afforded to a symbiotic approach to learning, in which opportunities for discussion between the facilitators and the teachers are created. Initial teacher training could offer a suitable environment to embed ILE, where trainee teachers might engage with this method, whilst concurrently exploring new pedagogical approaches to learning and teaching within ECE, over a more sustained period of time.

Another potential challenge is that the framing of ILE may actually anticipate the resulting learning outcomes, rather than present an open-ended consequence to the task. For example, observations of ILE based upon learning task construction and task-centred analysis, often result in task-centred outputs; these may be more suited to training-based contexts for learning (de Freitas et al. 2008) rather than shifts in cognitive pedagogical thinking. Careful consideration must be afforded to the extent and type of interaction required for the learning experience to meet its intended objectives. In-depth discussions to determine the extent to which participants have internalised the purpose of the tasks in the early stages of training, will enable facilitators to refine their teaching and revisit relevant theoretical constructs and pedagogical approaches to learning in ECE.

Context is also central to the ways in which participants engage in ILE. Given that the teachers' previous experience of training was more theoretical and outcome-driven, it is plausible that conducting the conference on a university campus, which constitutes a more formal context for learning, may have impinged on their perceptions of the tasks they undertook. Consequently, they may have felt pressured to produce an identifiable object, rather than investigate the learning that children would encounter if conducting a similar activity. The context also includes any supporting resources, which in this study were recycled materials that may have been unfamiliar for the teachers to use in this regard.

Notwithstanding these challenges, the second activity where the teachers were tasked with deconstructing a gadget, revealed a small shift in thinking and application. By revisiting the theoretical pedagogical approaches to young children's learning, which enable inquiry-based, problem solving, and discovery zones where children engage with content to find solutions to problems (Ostroff 2012), the teachers were able to reflect on how they responded to the initial ILE. Through discussion with their peers in active learning groups, some teachers demonstrated and articulated their understanding of an inquiry-based pedagogical approach to

engaging children in STEAM education. This was evident in comments relating to letting children deconstruct or construct things to find out what they do not yet know; learning in a natural way; and the teacher acting only as the supporter, making the right questions at the right place and providing resources for children to experience and create.

Central to the success of ILE, was the use of actional immersion; this had novel and intriguing consequences resulting from the teachers' drawing on their own prior experience of moving a ball from one place to another. This pedagogical approach reflects Papert's (2008) view of learning as a reconstruction, rather than as a transmission, of knowledge, and is most effective when employed as part of an activity using manipulative materials. It merits the consideration of learning experiences as involving social interactions between members of the learning group. To this end, facilitators may consider the pedagogic approaches required for the taught subject field, the learner group, and the context for learning. Use of the four-dimensional framework can support this process, by identifying the previous knowledge and experience of the group; providing opportunities for discussion between the facilitators and participants and the participants themselves; and considering the most appropriate ways of integrating ILE.

Conclusion

This study provides evidence of an original approach to utilising ILE in real-world scenarios, which previously focused on virtual learning environments. Although more recently ILE have been introduced in a wider range of settings including a classroom context, it is recognised that they need to be deployed in a pedagogically consistent manner to support and expand learning opportunities (Bonasio 2019). The findings herein, illustrate the importance of employing a constructionist pedagogical approach to learning that incorporates dialogic teaching; this facilitates the construction of activities that enable participants to make significant changes in their cognitive thinking, resulting in observable shifts in pedagogical understanding over a period of time.

By utlising participatory methods in ILE, the study reveals hitherto potentially unknown barriers and challenges to applying a child-centred pedagogical approach to STEAM education within the context of ECE in Vietnam. Given the afforded prominence of STEAM education in Vietnam's new Education Law (MoET 2015), a significant aspect of this research is the disclosure of the kindergarten teachers' initial lack of confidence, and

exemplification of how ILE can create opportunities for increased knowledge and understanding for engaging young children in STEAM education. The study offers potential to extend its findings to other Southeast Asian countries that adopt more formalised approaches to education. Providing mechanisms by which participants can discuss their thinking with facilitators and peers in a supportive, and at times anonymised, manner, exemplifies the importance of constructionism within this learning approach.

More widely, the findings indicate that ILE can provide opportunities for participants to reflect on their current understanding or perspective; extend and establish links with their understanding by applying theoretical constructs in novel and innovative activities; engage in dialogue with participants and facilitators; affect learning outcomes or behavioural changes relating to an array of specified goals or fields; and inform a range of stakeholders including policy makers and teacher trainers.

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