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Publisher: Routledge

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Asia-Pacific Journal of Health,
Sport and Physical Education

Asia-Pacific Journal of Health, Sport and Physical Education

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/rasp20>

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Published online: 26 Mar 2015.



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To cite this article: Tom Browne (2015) A case study of student teachers' learning and perceptions when using tablet applications teaching physical education, Asia-Pacific Journal of Health, Sport and Physical Education, 6:1, 3-22, DOI: [10.1080/18377122.2014.997858](https://doi.org/10.1080/18377122.2014.997858)

To link to this article: <http://dx.doi.org/10.1080/18377122.2014.997858>

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A case study of student teachers' learning and perceptions when using tablet applications teaching physical education

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Despite developments in information and communications technology (ICT), current research on the use of ICT in physical education (PE) is limited; research has been confined to investigating the use of visual technology, particularly digital cameras. Student teachers (participants) often use each other as learning resources and the purpose of this research was two-fold: first to examine the perceptions of 50 participants when using a range of self-selected 25 tablet applications (tab-apps) when completing micro-teaching (MT) and teaching practice (TP) in the school-based setting: Second to examine what participants learnt from each other during the process and the potential impact of using tab-apps. Third, to determine the potential challenges and future advantages. This qualitative case study considered the participants who were completing their school-based training to be apprentice learners. The author took the lead in guiding participants through the journey of employing *tab-apps* (computer tab-apps) to teach PE. This study reports, with the author having insider status, on data generated to allow for understanding through rational discourse and critique employing semi-structured questionnaires, MT and TP journals as well as interviews on participants' perceptions when learning and using tab-apps. Data were analysed using social learning theory as the study's theoretic framework. The evolving themes from the study include: student teachers' background and personal experience (individual technological biography), perceived preparation for using ITC in teaching PE. Perceptions related to challenges and advantages are discussed with a view to their implications for using tab-apps in teaching PE. Results showed that prior to, during, and after TP participants as a result of using tab-apps developed a community of learners as they became each other's resource for learning and shared uses of tab-apps in their teaching. Participants were confident about the value of, and were likely to use, tab-apps in their future PE teaching. There was recognition and awareness of several 'challenges' which needed addressing if the 'advantages' of using tab-apps were to be realised when teaching. Participants suggested that employing tab-apps resulted in advantageous impact as they interacted with each other and they appeared to be receptive towards adopting tab-apps when teaching PE.

Keywords: tablet applications; information communication technology; advantages; challenges; teaching physical education

Introduction

In the twenty-first century there has been considerable focus on the inclusion of information and communications technology (ICT) in teaching, with a significant

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worldwide drive to raise pupil achievement in schools through the use of ICT across all subject areas. The use of ICT can play an important role in creating an effective and adaptable learning environment, providing numerous opportunities for enhancing teaching, learning and assessment. This has the potential to increase learning opportunities for all learners in varied contexts (see, for example, Chia, Sock Miang, Tan, & Jong, 2000). Goktas, Yidirim, and Yidrum (2009) suggest that the integration of ICT enhances the quality of education by helping participants to do their job and by helping pupils learn more effectively. Thus, recent technological advancement has resulted in almost all of today's western culture classrooms requiring participants to embrace the use of ICT to support their teaching (Tearle & Golder, 2008). Physical education (PE) is no exception, as studies have found that ICT can be beneficial in teaching the subject (McNeill & Fry 2012; Shumack, Simmons, Carpenter, Dyal, & Austin, 2011). Littlejohn, Margaryan, and Vojt (2010) have shown how, at one school, technology, particularly digital cameras, has been integrated effectively into PE. Currently there is an increased opportunity for using ICT in schools as a result of improved mobility of ICT tools (Casey & Jones, 2011). An increasing number of student PE teachers and pupils possess mobile devices that may be readily used in schools giving greater access to technology, as identified by Beale (2012) on the employment of ICT in schools.

Despite developments in technology, current research on the use of ICT in PE is limited. Primarily research has been confined to investigating the use of visual technology, particularly digital cameras (Haydn & Barton, 2007). There appears to be no published research which specifically focuses on the use of a range of technology which could be employed in teaching PE. The process of using ICT does not seem to have become well integrated into teaching PE.

If student PE teachers are to employ relevant technologies in schools, they need to understand how ICT can be used in rich and meaningful ways (Keating & Evans, 2001). Teacher educators play a crucial role in improving participants' proficiency and ability to integrate a range of technologies into the curriculum. However, it has been suggested (e.g. McNeill & Fry, 2012) that teacher education courses do not provide prospective teachers with the necessary skills, competencies and experiences to prepare them to use ICT effectively. Various challenges and advantages to the inclusion of ICT in teacher education courses have been identified. Goktas et al. (2009) found that the main challenges identified for integrating ICT into teacher education courses were lack of in-service training, appropriate software, materials and hardware. They suggested that if ICT is to be adopted successfully in schools there is a need to develop clear policies and guidelines to ensure ethical and safe use of ICT. Seferoglu (2007) examined teachers' perceptions of their self-efficacy in relation to computer use. He concluded that for participants to use ICT effectively certain conditions were required. These included sufficient funding, provision of training opportunity, time for participants to improve their technological skills, funding to secure soft and hardware and institutional support.

Theoretical framework

An embodied, socially situated learning perspective was adopted and used to facilitate discussion and interpretation of this study's findings. Learning is social as the individual is always socially positioned in that certain forms are facilitated while

others inhibited (Hodkinson, Biesta, & James, 2008). Learning is embodied as it changes the individual learners' (participants') dispositions towards and their ability to use tab-apps in teaching PE. Lave and Wenger's (1991) concept of situated learning is based on the analysis of apprentice learning. In the current study, the apprentices are considered to be the participants. Various sources provide emergent learning opportunities which Lave and Wagner refer to as communities of practice (CoP). Frequent interaction leads to a group of people sharing a passion for an enterprise to develop their expertise. These CoPs are not necessarily homogenous or symmetrical. Consequently there will be a variation of experiences amongst participants who adopted the role of apprentices learning how they might use tab-apps whilst using tab-apps when completing micro-teaching (MT) and teaching practice (TP). This theoretical framework provides a lens through which this study's finding, recommendations and conclusions might be considered 5218, Page.

Purpose

The purpose of this research was to examine the use of 25 tablet applications (tab-apps) by 50 participants in school when completing MT and TP. The purpose of the research was three-fold to investigate: (1) the influence of participants' background and personal experience in using a range of ITCs considering their competence, confidence and attitudes, (2) their perceptions related to ICT preparation and training teaching with particular reference to what they learn from each other and (3) opportunities to use tab-apps in teaching whilst identified challenges and advantages of using tab-apps and their intention to use tab-apps in future. The author took steps were to encourage participants to consider both the challenges and advantages of the process, whilst illustrating the nuances of meaning and understanding attributed to the process of using tab-apps to teach PE.

Methodology

The research design for this study is an interpretative multiple site – 'insider research' case study (Eide & Kahn 2008). The advantages and caution associated with insider research were prominently considered as reciprocity between the author and participants and the use of tab-apps was developed and meaning made of the situation. As the insider, the author recognises that he possessed a priori intimate knowledge of the community of participants. The case study design is not uncommon in education when investigating a school innovation such as participants' perceptions when using technology in general, and tab-apps specifically, when teaching PE. Yin (1984), in discussing different kinds of case studies, stated that a case study could investigate a contemporary phenomenon. The study of tab-apps is just such a phenomenon: '...the essence of a case study, the central tendency amongst all types of case study, is that it tries to illuminate a decision or set of decisions: Why they were taken, how well they were implemented and with what result' (Yin, 1984, p. 23). The lack of scientific generalisation is a recognised criticism of the case study design. However, it is not the goal of the study to expand on or generalise a theory, but rather to understand more about using tab-apps. There are sensitivities that accompany an ostensibly insider research project and a concerted effort was made by the author for the participants to adopt a critical consumer perspective when using

tab-apps as a pedagogical method as part of their TP. Participants were repeatedly encouraged to engage in honest and open disclosure when responding to the questionnaire, maintaining their journal and being interviewed. This study does not intend to offer generalisable findings; rather it aims to provide an in-depth description from which helpful recommendations and conclusions might be drawn in relation to using tab-apps. This study is explorative in nature, and findings are presented in the light of knowing that further research and investigation will be required.

Participants

The sample comprised 50 student PE teachers (22 men, 28 women) in the final year of a four-year BSc in Physical Education and Sports Science (PESS) programme. They were then taking two modules which included a period of working with pupils in schools on MT (10-week duration) followed immediately by extended time in schools on TP (15-week duration). All participants were invited to be involved in the study and volunteered to take part emphasising that they were free to withdraw for any reason without penalty so avoiding potential unintended coercion.

Background

Two tab-apps ('i-Coach' and 'Arasuma') were identified by the module tutor as being potentially useful to support participants in teaching PE, particularly in relation to the potential to assist with teaching and learning content and lesson organisation. The tab-apps were presented to the participants in class as potential tools to assist in the teaching of PE. After reviewing these, the participants worked in pairs to identify a tab-app they could use to support them in teaching PE. The assumption was that students would learn from one another, so constructing a 'CoP'. After search and review, 25 tab-apps were identified for use in teaching PE. Each pair reviewed their chosen tab-app in relation to how it might be used to support their teaching and presented an instructional PowerPoint to the rest of the group on the potential use of the application. As a result of the PowerPoint presentations, participants classified the 25 tab-apps into one of four categories. The classification into four categories is shown in [Table 1](#).

As a component of the pre-service programme, participants were made aware of recent developments of many tab-apps with potential to support the teaching of PE. The author modelled the use of one tab-app (iCoach) and took care to avoid personal opinion that might influence, hinder or enhance the learning process amongst the community of participants. Participants were introduced to the notion of themselves as apprentice learners when using tab-apps. Possible bias concerning the subject matter and excessive familiarity with case study informants was avoided; for example, they identified categories of analytical, management resource and generic tab-apps. Participants having reviewed and selected many tab-apps only used one during their MT and TP.

Instruments and procedures

Three data sources from questionnaires, journals and interviews were triangulated to constitute a robust collective gathering of data. In recruiting participants to the study

Table 1. Tab-apps selected for use by participants.

Resource applications (7)	Analysis applications (6)	Tactical applications (6)	Programme Applications (6)
Coach Tools	Ubersense	Coach Note	Split
Assistant Coach	Broad Jump Analyser	Basketball Coach	Run Keeper
Basketball Coach	Coach Eye	Coach Pad	Endomondo
Soccer Drills	Swing Smart	Slow Motion Pro	Mi Coach
Gym Buddy	Dart Fish	Coach Tools	Fitness Buddy
Kids At Play	Shots Zoom	Playbook	SprinTimer
Onefootball			

all were invited under conditions as stated in the signed informed consent form. Clear information was provided about this study and time given to consider respond to invitation to participate. Participants confirmed their understanding of what was required when involved in the study. They were encouraged to ask questions and acknowledged that all questions have been answered satisfactorily. It was emphasised that participation was voluntary and that participants could withdraw from the study at any time without recrimination. Participants agreed to be involved in the study with the knowledge that the data obtained might be published provided that names or other personal identification were not used. Strict confidentiality related to personal information was assured. Finally permission was given to access and use their journals, an assessment item, as data to be analysed.

Questionnaire

All 50 participants completed a questionnaire at the beginning of the module (January 2013), before MT and TP. In June 2013 all participants completed the second part of the questionnaire for a second time, after completing MT and TP. The questionnaire comprised two parts. The first part was designed to examine participants' background and personal experience in using a range of ICTs; their individual technological biography. The second part explored participants' perceived preparation for using ICT to support teaching, competence, confidence and attitudes towards using tab-apps and opportunities to use tab-apps in teaching. On both occasions the questionnaire was completed in a classroom setting as part of the participants' normal sequence of lectures.

Micro-teaching (MT) and teaching practice (TP) files and journals

For the duration of their MT and TP, all 50 participants' maintained comprehensive and extensive MT and TP files, along with journals in which they documented their experiences of using tab-apps in their teaching. The participants were taught how to maintain journals identifying the need to reflect on both the positive/advantages and the challenges/negatives of employing tab-apps as a pedagogical tool. Prompts related to completing the journals included identifying cause for celebration and concern whilst encouraging participants to record 'the good the bad and the ugly'.

Interviews

A sample of 10 participants was selected and invited for a semi-structured interview after completion of the questionnaire after TP (August 2013). The focus of the interviews was to confirm interpretation of data related to participants' perceptions, awareness of how they learnt in their community and to seek further information, conclusions and recommendations related to the potential use and effectiveness of the tab-apps in teaching PE.

Data analysis

According to Lincoln and Guba (1985, p. 333), 'the process of data analysis in the naturalistic paradigm is essentially a synthetic one in which constructions that have emerged (been shaped by inquirer-source reactions) are reconstructed into a meaningful whole'. In this study, the goal was to employ methods of analysis that focused on gaining a better understanding of the participants' background and personal experience in using a range of ICTs; their individual technological biography, perceived preparation for using ICT to support teaching, competence, confidence and attitude as a result of learning from each other how to employ tab-apps, opportunities to use tab-apps in teaching, challenges and advantages of using tab-apps, intention to use tab-apps in future and conditions to support the use of tab-apps when teaching PE.

The questionnaires produced descriptive numerical data. MT and TP files and journals and interview data were subjected to document analysis, combining two analytic approaches. *Analytic induction*, also called conceptual categorisation, involving categories of phenomena and relationships among such categories being identified and discussed. Rather than imposing priori categories, the aim was to induce results. The second analytical approach was that of *constant comparison and contrast* (Locke, 1989). Data analysis was therefore inductive (developed from the general to the specific) and interpretative in that meaning was attributed to the data in an attempt to understand the reasons for change in the study phenomena, i.e. use of tab-apps in teaching PE (Kellehear, 1993). Open coding of the data was employed for the retrieval of text from MT and TP files and journals and interviews. These data were indexed in text units to allow for further exploration. The units were then organised into categories that were systematically related in order to express themes of meaning. It was therefore interpretive in eliciting similarities and differences between the participants' experiences. On the side of caution, the author recognised that he possessed 'an informed perspective' and, during data analysis, he took care to reflect on his own constructivist beliefs and values. Throughout the research process, steps were taken to avoid over familiarity between the author and participants. Triangulation of questionnaire, MT and TP journals and interview data was undertaken to cross check the understanding and interpretation of data and evolving themes. The aim of the study was not only to examine what participants did when using tab-apps but also to discover 'What they wanted to, what they believed they did and what they thought they did' (Portelli, 1998, p. 67). Potential for bias and over-familiarity was minimised by the academic integrity of the author and the team approach to analysis.

Ethical clearance

Ethical clearance was approved by the Internal Review Board (IRB) of the Nanyang Technological University (NTU) Ethics Committee. IRB and students were informed that pseudonyms for both individual participants and schools would be employed when reporting the research findings so assuring anonymity as required.

Results

The results below focus on participants' perceived preparation for using ICT to support teaching, competence, confidence and attitudes towards using tab-apps, opportunities to use tab-apps in teaching, challenges and advantages of using tab-apps and intention to use tab-apps in future. The rich complexity of the findings is presented as a comprehensive description divided into three sections. These are: (1) the influence of participants' background and personal experience in using a range of ICTs (individual technological biography) and included their perceptions related to preparation and training for using ICT to support teaching with particular reference to what they learn from each other, as well as consideration of their competence, confidence and attitudes towards using tab-apps; (2) opportunities to use tab-apps in teaching and intention to use tab-apps in future; and (3) identified challenges and advantages of using tab-apps whilst completing teaching practicum. In presenting the results it is intended that the richness of the participants' descriptions of their experience of using tab-apps will lead and allow the reader to discover their own path in interpreting the data.

Participants' perceptions related to preparation and training for using ICT to support teaching

In this section there is particular reference to what they learn from each other; the influence of participants' background and personal experience in using a range of ICTs (individual technological biography); and participants' competence, confidence and attitudes towards using tab-apps. All 50 (100%) participants were familiar with and received training on using a range of ICTs as part their teacher education programme. As a component of two courses, Instructional Methods and Coaching and Learning, participants were introduced to 20 different tab-apps. They reported that they used ICT extensively personally but had not been formally trained to use tab-apps prior to taking the modules and involvement this study. There was considerable willingness among this group of Singaporean students to be involved in the study in that no student withdrew from the study after the ethical permissions briefing described in the Methods section. **Table 2** shows participants' perceived preparation for, competence, confidence and willingness to use tab-apps in teaching.

Prior to TP, 37 (74%) of the participants reported that they had received no or very little specific preparation for using tab-apps in teaching in any other modules on their teacher education course and the ICT training that was provided was general and non-PE specific. These participants perceived it should be a programme requirement to have PE-specific training if tab-apps were to be used effectively in teaching PE. After TP 37 (74%) of the participants perceived the preparation for using tab-apps in teaching was good/very good preparation.

Table 2. Perceived preparation for, competence, confidence and willingness to use tab-apps to support teaching.

	1, almost none	2, very little/low	3, good	4, very good/high
<i>Preparation for using tab-apps to support teaching</i>				
Pre-micro-teaching	19	18	13	0
Post-teaching practice	3	10	27	10
<i>Perceived competence</i>				
Pre-micro-teaching	16	24	7	3
Post-teaching practice	8	10	17	5
<i>Perceived confidence</i>				
Pre-micro-teaching	15	15	10	10
Post-teaching practice	3	5	32	10
<i>Willingness to use tab-apps</i>				
Pre-micro-teaching	6	17	18	9
Post-teaching practice	2	8	30	10

In relation to perceived competence in using tab-apps in teaching PE, there was a change in participants' perceived competence. Prior to MT, 40 (80%) of the participants perceived almost none/low competence. After TP this reduced to 18 (36%), whilst 37 (74%) perceived good/very good competence. In relation to perceived confidence in using tab-apps in teaching PE, there was a change in participants' perceived confidence from prior to MT, when 30 (60%) of participants perceived almost none/low confidence to after TP when this had reduced to 8 (16%), whilst 42 (84%) perceived good/very good confidence. Despite these results, these participants also expressed words of caution related to the use of tab-apps, for example one student teacher reported, 'We learnt a lot from each other and I am more confident now and there are benefits of tab-apps, but some conditions are required' (Simon, journal, p. 6).

After TP, 40 (80%) of participants reported they would be willing to use tab-apps in future teaching. 'I am definitely going to use tab-apps in the future because of what I learnt using them in micro and teaching practice' (Joelle, journal, p. 10) as they were perceived to be 'a valuable teaching asset' (Veronica, interview). However words of caution were again expressed; for example, 'tab-apps are useful if correct, discerned decision making and careful application is undertaken by the teacher' (Judy, journal, p. 9). The data suggest that there was an evolving mutual expectation that student teacher and pupils assisted and advised each other. This way the participants were encouraged to gain from each other's expertise and experience. At the same time they could create improved opportunities to work with tab-apps.

Opportunities for using tab-apps and intention to use in the future

Forty-five (90%) of the participants in this study had good/very good opportunities to use tab-apps to support their teaching on MT and TP and all 50 (100%) had gained hands-on experience of using tab-apps in school. As a result, all 50 (100%) of participants perceived schools to be supportive settings to explore the use of technology in schools. These perceptions are shown in Table 3. Amy exemplified

Table 3. Opportunities to use tab-apps.

	1, almost none	2, very little/low	3, good	4, very good/high
<i>Opportunities for using tab-apps in school</i>				
Pre-micro-teaching	25	20	5	0
Post-teaching practice	0	5	25	20
<i>Hands-on experience specifically using tab-apps in school</i>				
Pre-micro-teaching	27	16	7	0
Post-teaching practice	0	5	30	20
<i>Schools as supportive settings to explore the use of technology in PE</i>				
Pre-micro-teaching	27	9	10	4
Post-teaching practice	0	4	42	8

this view in interview: ‘Before, we were not aware of the possibility of using tab-apps to help us teach. As a direct result of this module, we experimented and learnt a great deal about the potential of them to help us teach’ (Amy, interview).

Participants were positive about the future use of tab-apps and referred to ‘an amazing possibility to use tab-apps in school’ (Seng, journal, p. 12). This positiveness should be tempered, because the participants were highly motivated and compliant to embrace technology-assisted pedagogy. This shared experience of using tab-apps and evolving knowledge appeared to enable participants to discuss strategies and experiences of using tab-apps consequently making themselves understandable to each other and offering suggestions for how to improve the use of tab-apps. It is relevant to note here that typically participants when completing their TP tend to adopt a traditional non-risk-taking perspective as their main focus is to pass the TP rather than experiment with innovative pedagogies.

All 50 participants (100%) reported tab-apps could potentially be employed as an effective tool to improve the teaching, learning and assessment during PE lessons in school:

Although initially troublesome, the use of tab apps improved the pupils’ abilities to record and analyse their performance. I am pretty confident talking to pupils that as a consequence of the process their understanding and performance improved. (Aik Ho, journal, p. 5)

Using tab-apps required careful planning if they were to be deemed a justifiable component of the learning process, not just as a cosmetic addition. ‘The employment of the “tab-app” has to be embedded in the lesson not just as an impressive or false use of technology’ (Vera, interview). A significant perception amongst participants was that all tab-apps, regardless of their category (resource, analysis, management or programme) warranted further use in teaching PE. Forty-three participants identified a future intention to use tab-apps:

Having used tab-app we would be crazy not to continue to see if we can embrace the technology in the future. We have only just begun to learn about how to get pupils to use the applications. (Mary, journal, p. 2).

Participants were enthusiastic to explore ways to create more opportunities to use tab-apps but recognised the need for further training as well as further research on available tab-apps:

Using tab-apps will not be easy and there are a few solutions to be found but we as a group think with careful intervention there is certainly some merit in using them in future. We must be sure they will improve us as teacher and impact on pupil performance positively otherwise we could be accused of adopting a fad. (Siti, journal, p. 11)

Challenges, advantages and potential of using tab-apps in teaching PE in future

As a result of inductive qualitative analysis, three significant categories emerged related to the use of tab-apps: challenges, advantages and the potential of using tab-apps in teaching PE in future. An immediate advantage of using tab-apps on i-pads is that, unlike traditional computers, i-pads are easily transportable; require no energy supplementation during teaching in the uniquely practical and diverse learning contexts and settings of the gymnasium, swimming pool and on the playing fields. However, participants identified several challenges to be addressed if tab-apps are to be used effectively in teaching PE.

Perceived challenges for using tab-apps in PE

The challenges identified were: training requirement; time considerations, with the potential loss of activity time; potentially distractive learning environment; and financial concerns.

Training requirements

Current ICT training provided by the university as a component of teacher education is generic. Participants identified that the modules they were studying, which underpinned this study, were the first in which they had seen and were introduced to using ICT specifically for PE. Thirty-four (68%) of participants suggested a need for greater, more PE focused (with more PE specific applications), formal training as a component of their teacher education. 'We do get encouraged to use ITC in general subjects, but not in PE. This exposure to tab-apps and other possible technology should become a stronger focus for all PE modules' (Paul, journal, p. 14). Having used the tab-apps, there was a perception that 'it is not too difficult to use tab-apps if you get well prepared' (Siti, journal, p. 10).

Time considerations

A significant challenge identified was the time constraint for both teacher and pupils when preparing to use tab-apps in lessons. For example, one student teacher reported 'Pupils take too much time learning how to use the tab-app during the lesson. We need to organise preparation between lessons' (Ronnie, interview). Participants also expressed worries about the required training time necessary for pupils to use them effectively with the minimum of fuss:

Time constraint is a real concern. We need to teach pupils to use tablets outside lesson time if we want to achieve lesson outcomes. We cannot spend the entire lesson with pupils learning how to work on i-pads, as this could be detrimental to their playing ability. This could be a real negative of trying to use the tablets in lessons. (Jiachun, journal, p. 7)

As a result of their limited experience of using a tab-app as a teaching tool, 42 (84%) of participants highlighted the need to review and improve time management. There was concern that introducing tab-apps was time-consuming and potentially might lead to pupils losing opportunities to be actively engaged in terms of maintaining high games play and/or activity time. For example, 'pupils take too much time using the tab-apps during the lesson' (Jenny, journal, p. 17). The challenge of creating time to be well organised was identified if tab-apps were to be successfully implemented.

Potentially distractive learning environment

Twenty-eight (56%) of participants expressed the opinion that, if not correctly managed, the i-pad became a distraction for the pupils. Several participants reported that pupils could become disruptive, argumentative and off-task:

Pupils fight over the tab-apps. Constant bickering and scolding was evident between the pupils as they argued over who was to use the tablet. Teacher intervention is required here to prevent the situation from getting out of hand. (Joelle, journal, p. 5)

Participants identified the need for highly structured lesson planning both as prevention of and a solution to this undesirable behaviour.

Financial concerns

Limited PE department budgets were a concern, especially in considering the potentially high cost of purchasing, introducing and maintaining devices to support the use of tab-apps. Thirty-seven (74%) of participants identified a challenge in generating the required funds to support the initial purchase of devices to support tab-apps, as well as ongoing maintenance required:

The financial commitment required I see as potentially a threat to using tab-apps. We might need to justify and generate money to purchase the devices to run tab-apps. (Sylvia, interview)

Participants identified some possible solutions to this challenge included; pupils could be encouraged to bring their i-phones and i-pads for use in PE. This would result in diminishing the financial responsibility for the school and PE department. Words of warning/caution were expressed by the participants concerning to the unintended 'privileging' of pupils who brought their own device and a need for careful usage and adequate provision for potential damage (e.g. insurance). This requires further investigation. Participants also highlighted a requirement for schools to construct a policy with guidelines for the use of mobile devices in school to which they could adhere. It is clear that the use of use tab-apps in teaching PE is not without its challenges. However, 38 (76%) of participants perceived that, with careful

management accompanied by sensitive teacher intervention and attention to detail, these challenges could be overcome, allowing tab-apps to be used to support PE teaching. It was evident amongst the participants who demonstrated awareness of challenges of using tab-apps that there were potential significant advantages in using them in teaching PE.

Perceived advantages of using tab-apps in teaching PE

Several advantages of using, and learning from each other how to employ, tab-apps were identified by the participants, these included: pupil leadership; establishment of a community of practice; change in pupil engagement and performance; pupil and teacher empowerment through developing communities of practice; and generation of lesson content and support material.

Pupil leadership

Forty-three (86%) of the participants reported that pupils with greater experience of and access to technology adopted leadership roles (especially when teaching sport education) and assisted other pupils in using the tab-apps. This is a contradiction to above where such pupils were seen to dominate the use of the i-pads. Participants saw this as a considerable advantage and of great assistance as the majority were being innovative and creative in encouraging and/organising the use of i-pad in PE for the first time. One expressed the opinion that:

If tab-apps are to be used in the school setting it is essential and a requirement that we build on the natural ability of pupils who are technologically savvy. Without them, the task would be really onerous. (Paul, journal, p. 3)

Establishment of communities of practice

Thirty-two (64%) of participants perceived that both pupils and participants were willing to share and to act sensitively in the sharing of technological hardware. Participants also reported that through a developing community of practice an encouraging trend for collegial learning, with all involved in using tab-apps (pupils and participants) taking responsibility for allowing equal time for others to explore the applications:

I am sure that having pupils and teachers alike share the i-pad created opportunities for them to work together in terms of sharing responsibility and allowing them to interact with each other in a way not normally evident in traditional PE. (Jiachun, journal, p. 9)

Change in pupil engagement and performance

Forty-six (92%) of the participants reported that pupil engagement and performance was changed when using tab-apps. They identified that pupils applied the information learnt from the tab-apps, resulting in perceived improvement in game play during the lesson:

The pupils seemed to play better having watched the video on i-pad related to how to play with width and need to accurately pass the ball over distance. They also liked the fact that they could capture their performance like real/professional sport. An unexpected outcome of using tab-apps was noticing how students became self managers especially when using the i-pad. They were responsive to the instructions when given time to refer to the tab-app (iCoach). They frequently interacted with each other and solved issues of how best to use the app. (Aik Ho, journal, p. 5)

Thirty-three (66%) of participants perceived there was knowledge transfer, especially in tactical games, in which pupils were required to play games with reference to tactical concepts promoted by teachers:

Teaching concepts are difficult but because we capture pupils on the i-pad we can encourage them to analyse their games using principles of play. For example in all invasion games space, time, support cover is always relevant. (Adilah, journal, p. 2)

Changes pupil engagement was perceived by participants as a result of the innovative use of tab-apps. An additional advantage identified by participants was that of having pupils developing accurate feedback, with subsequent improvement in performance. Added pupil accountability was also identified as an unintended engagement of tab-app usage: 'Pupils were acutely aware that their performance was being captured and subject to analysis post lesson' (Joelle, journal, p. 2).

Pupil and participant empowerment through the construction and development of communities of practice

Another perceived advantage of using tab-apps related to self and peer teaching. Pupils adopted the roles of 'captain, coach or i-pad manager' in taking responsibility for managing and consequently leading either a game, activity or analysis of performance. Indeed, 'It was interesting to see pupils being empowered by taking on self and peer-teaching when using tab-apps. This was a result of being put in a leadership role of i-pad operator as well as cameraperson' (Luke, journal, p. 6). In addition, participants identified the construction of individual support packages by way of PowerPoint presentation as a 'real bonus' in allowing pupils to take on self and peer-teaching roles. Several participants reported that pupils, with teacher assistance, constructed task cards and a checklist, which impacted on improved performance. 'We should further develop these resources and distribute to other participants and should use task cards to assist pupils using the app for the first time' (Adilah, interview). It appeared that both pupil and participants benefitted from using tab-apps.

Generation of lesson content

Thirty-seven of the participants reported that they were 'always under constant pressure to plan comprehensively' (Jenny, journal, p. 8) and as a result of using tab-apps (particularly those classified in the resource applications; see [Table 1](#)), they found new lesson content and 'ideas, especially from the resource tab-apps, we could use conveniently to supplement our lesson preparation' (Amy, interview). Indeed, tab-apps classified in the resources applications category were particularly well

received by participants because of improved access to lesson plans, task cards, assessment criteria and checklists. They perceived, as a result of working as a community of practice, that they could alter the material and lesson content to suit the character of pupils and the performance level of individual classes.

Discussion

In this section we discuss how the description of the participants' practice of employing tab-apps employing the lens of a framework of social learning. This provides opportunity to explore how the participants became resources for each other's learning during the course of TP. It is proposed that the groups of participants be described as CoPs (Lave & Wenger 1991). This embodied and socially situated perspective of learning has proven useful in understanding the process of employing of tab-apps in teaching PE.

A CoP exists when members engage with each other and negotiate how to make sense of their actions. Similarly the participants not only used tab-apps independently but also actively engaged with each other on a regular basis on shared problems when using tab-apps. In overcoming the instructional time constraints when teaching pupils to use table devices. Using participants' practices as a point of departure the opportunities for learning are discussed and described.

A key outcome of this study was the positive perception, interest and enthusiasm by 37 (74%) of the participants to using tab-apps to support their teaching in future. Their willingness and intention to use tab-apps is in stark contrast to recent research which found there was little interest in using ICT in teaching PE (McNeill & Fry, 2012). It is clear that the participants were compliant to both course and research conditions and highly motivated to be involved in the research and this might also influence that writing in terms of open and honest disclosure of experiences when using tab-apps. Although these student teachers, who adopted the role of critical consumers, were convinced of the value of tab-apps, they also recognised that there were several challenges that need to be addressed if the advantages of using tab-apps. This is an interesting finding, highlighting the awareness of participants to potential issues associated with using tab-apps.

These participants suggested it would be 'foolhardy to ignore the challenges we experienced', and 'challenges are to be considered and pitfalls avoided if we are to use tab-apps successfully' (Vera, interview). The challenges encountered by these participants were similar to those identified by Goktas et al. (2009), including the importance of training (of participants, teacher educators, teachers and pupils); time considerations; potentially distractive learning environment, and financial concerns. These challenges need to be addressed in order to fully realise the advantages of using tab-apps in teaching PE.

The apparent enthusiasm for the adoption of tab-apps by the participants in this study might be due to the use of tab-apps to support their teaching being a key component of the two university modules on which the participants in this study were introduced to the use of tab-apps to support PE teaching. This might also explain the overwhelming expression of the intentions of all participants to use tab-apps in teaching PE in future. The current study considered only the participants perceptions of the use of tab-apps in the future, and not examine the use of tab-apps

impact on adopted pedagogy or the enhancement or otherwise on pupils performance and learning.

In line with the findings of this study, previous research (Anderson, Varnhagen, & Campbell 1998; Schoep, 2004) has suggested that providing access to ICT alone is not enough and that there is a need for ongoing provision of training if ICT is to be used successfully in the school situation. Participants also recognised that they need 'assistance in learning how to use ICT/tab-apps in teaching PE' (Fabrini, journal, p. 5). They needed training in methods for integrating tab-apps in their PE teaching. This result parallels literature which suggests training in ICT needs to be provided continuously for teachers using ICT as a teaching tool (Shumack et al., 2011). Many participants commented on the current lack of training in the use of ICT for teaching PE in their teacher education course. Thus, consideration needs to be given to the quantity and quality of ICT training in the PESS programme. These participants suggested that training needs to be PE specific, it should include tab-apps and emphasise the practical use of ICT.

The findings in the literature (Bullock, 2004; Littlejohn et al., 2010) parallel this study's results in terms of the need for good role models. It is important that teacher educators demonstrate awareness of innovative and appropriate use of ICT and act as exemplars for participants by modelling the practical use of ICT generally and tab-apps in their teaching. Technical support for teacher educators and participants was identified as critical if the use of tab-apps in teaching PE is to be significantly improved.

Furthermore, pupils need training in the use of tab-apps in PE. In this study, there was a clear perception amongst participants that pupils required simple instruction to access the tab-apps so that the opportunity for pupils to be engaged in physical activity and play was not reduced. Participants recommended the development of task cards for pupils as a potentially appropriate form of guidance.

Participants reported that a significant amount of time was required if tab-apps were to be used successfully, including time to explore internet sites to investigate possible tab-apps to use and learning from each other how to use a tab-app in lessons. However, participants acknowledged that teachers have limited time. Allowing adequate time for learning how to use tab-apps may require training outside the normal lesson time for both teachers and interested and motivated pupils.

Time constraints within the lesson were identified and typically the participants expressed the belief that PE is essentially a practical subject, consequently the potential loss of activity time and less pupil participation was at the forefront of expressed concerns. Many reported that, when using tab-apps to teach, there was potential to lose 'precious class time when setting up, turning on or downloading programs which might result in pupils getting less time to move' (Judy, journal, p. 6). Participants were insistent that effort should be made to avoid a loss of activity or movement opportunities. David summarises 'a central goal of PE is to improve pupil physical activity Using tab-apps should not inadvertently decrease the play-time' (journal, p. 5). Thus, the use of tab-apps (or other ICTs) should not be at the expense of activity time. Chia et al. (2000) warn that too much technology within PE may be contrary to the aims of the subject and can actually lead to decreased levels of activity. They point out that reflective users of ICT (and of tab-apps) must be aware that their use should not be without compromise. A potential solution to this was perceived by these participants was careful management and pre-lesson preparation

and the encouragement of pupils to fulfil technology-related tasks prior, between and post lessons.

Lack of finance was also a challenge expressed by these participants, resulting in i-pads not always being accessible. Participants perceived that Singapore is fortunate in that most schools have broadband access and technology is a central focus. However, if there is to be an increase in the use of technology in PE teaching, schools may need to purchase new hardware and software and allocate a budget for updating and upgrading them. This may require innovative ways to increase equipment within a limited budget, such as the sharing of resources between departments.

If these challenges can be addressed, tab-apps were perceived by the participants in this study to be a useful tool for teaching PE. There is evidence from these participants' experiences that tab-apps have potential to bring benefits to PE in terms of improving teaching, learning and assessment in terms of content, innovation and creativity (McNeill, Mukherjee, & Singh, 2010). Recent research suggests that the use of technology can provide numerous opportunities for enhancing teaching and learning. Sang, Valcke, Van Braak, and Tondeur (2010) have previously shown how ICT developments have been integrated effectively into PE. However, the participants in this study recommended that only with the careful employment of technology would there be a significant impact on PE teaching. 'Nothing is perfect but there is something we can learn from use tab-apps when teaching' (Adilah, journal, p. 10).

Among the perceived advantages highlighted by participants were changes in pupil engagement and performance as a consequence of using tab-apps. According to Mary, '...witnessing of different pupil engagement as they managed the i-pads and performance. Pupils were actively engaged in leading each other when using the tab-apps' (Mary, Journal, p. 13). Game performance was perceived to improve in terms of access to feedback. Concrete examples of abstract game concepts were made available through video analysis and performance capture.

Another identified advantage was empowerment of both pupils and participants. Empowerment for both pupils and participants was perceived to be a direct result of using tab-apps requiring teachers to facilitate pupils to take responsibility for managing the i-pad, analysing of pupil performance and leading a game. Participants also perceived that the use of tab-apps resulted in cooperative learning amongst themselves and pupils due to the central focus on working together to solve problems to enhance their learning. Pitler, Hubbell, Khun, and Malinowski (2007) found that ICT played a vital role in cooperative learning by facilitating group collaboration, providing structure for group tasks and encouraging members of groups to communicate.

The participants in this study generally perceived that ICT encouraged them to work with each other and develop CoPs and consequently provided the potential to enhance and develop the role of the PE teacher. 'Using tab-apps allowed us to work with each and change and improve how we taught PE; it was not easy but worth doing!!!' (Ronnie, interview). As a result of access to tab-apps these participants perceived the opportunity to work regularly with each other and make a pedagogical shift from being 'deliverers of content' to what many referred to as 'facilitators of learning'. However, participants were of the opinion that the highly complex and nuanced demands of teaching cannot be met solely by computers. Pupils and

participants learn in different ways, at different rates, and numerous factors affect their progression on any given day. Thus, they did not foresee that technology could replace the PE teacher.

In order to achieve the potential advantages associated with using tab-apps in their teaching, participants perceived certain conditions, actions and recommendations were needed. The first action to be undertaken was a school audit of available ICT and tab-apps. Beale (2012) recommended that any adopted ICT infrastructure needs to be guided by the schools' administrative, financial and teaching needs. However, in order to effectively integrate tab-apps (as well as ICT more generally) into the teaching of PE and to realise the advantages of using tab-apps to support their teaching, the participants identified the need to be strategic and for there to be 'technology plans' in schools. Such plans should integrate the vision and strategic direction of the school and/or PE department. Existing plans, policies and strategies may require updating and developing. This should include a policy guide encouraging all potential users to work with each other and providing with a set of rules and etiquettes, including respecting equipment and their peers when using ICT in PE lessons. This supports recommendations of previous research that policy guides need to be developed to support teachers in using ICT in schools (Zeichner, 2010). Only with careful management and the construction of clear policies would it be appropriate for pupils to bring their own devices into schools for use during PE lessons.

Conclusions

In conclusion, while the findings of this study are promising they indicate that despite the relatively brief exposure to tab-apps participants developed a belief that they might be a viable alternative approach to teaching of PE. This study provides initial data pertaining to the challenges, advantages and potential use of tab-apps in teaching PE. Results suggest that there are potential advantages of using tab-apps, and they can be a viable tool in teaching PE, including impacting positively on the attainment of a core outcome of PE to promote intelligent performance through purposeful movement. Participants suggest that the challenges of employing ICT generally, and tab-apps specifically, need to be recognised and steps taken to minimise them if the potential advantages are to be realised. The identified challenges were not perceived as insurmountable but they require addressing with considerable thought, care and continued collaboration between educators. Participants perceived that, with careful management, improved support and guidance amongst their community of practice, tab-apps might provide potential alternative-learning opportunities. Participants said 'It is not difficult to see how, with careful employment, tab-apps can improve the opportunity to learn in PE by putting the best tab-apps in the hands of both teachers and pupils' (John, journal, p. 8). Participants identified the need for all involved in teaching and learning in PE (student teachers, teachers, teacher educators and pupils) to continue developing 'new skills to best use tab-apps we are similar to apprentices in learning a new trade' (Sylvia, interview). Many expressed confidence, enthusiasm and advantages of using tab-apps in their teaching not least being the sharing of experiences during the time spent in school completing MT and TP. They also identified that it was important to maintain and express their experiences of using tab-apps and 'the traditional and

timeless attributes of good PE teachers to care for pupils whilst promoting innovative technological outcomes by using tab-apps' (Joelle, interview). This is an encouraging comment for teacher education programmes encouraging innovative use of ICT and support the need for further research.

The results of the study appear to highlight, in particular, the need for continued professional development taking advantage of CoPs, professional development requirements and awareness of school resourcing needs. Professional judgement must be used to make decisions about the use of ICT generally and tab-apps specifically to enhance pupils' achievement of learning outcomes, providing opportunities to explore and enhance understanding.

It seems inevitable that the use of ICT in teaching PE will continue to be an integral part of many future developments and initiatives. There appears to be a requirement for teacher educators, participants and teachers to develop general ICT and tab-apps specific skills. A pertinent question is: Will the acquisition of ICT skills improve the delivery of PE in school? Reflective practitioners are professionals who keep up with the times and predict the changes to come and demonstrate a willingness to 'keep ahead of the game', in this case in terms of innovative and creative use of tab-apps in enhancing PE teaching. From the insights gleaned through this study it is evident that integration of tab-apps is not simple and requires diverse knowledge and sensitive pedagogy – remembering the core goal of PE is to get all pupils moving and physically active. A clear advantage of adopting an insider researcher approach was that prior to introducing the innovative pedagogy of using tab-apps in teaching PE that the teacher educator possessed a good understanding of who the participants were, their prior experiences and perspectives about teaching, schooling sport and PE. This study was based on an exploration of one particular PE setting, it would be an exaggeration to claim the study represents a picture of how participants can use tab-apps and each other as learning resources. This study focused on the use of tab-apps to teach PE, research in this area is still in its infancy. Future research might focus on the use of other ICT's in PE lessons, including: animated task cards and digital assessment disks.

Notes on contributor

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