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Novel research approaches to gauge teacher familiarity with game-based teaching in physical education: an exploratory #Twitter analysis

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Abstract

This paper examines the use of the microblogging platform Twitter as a tool for research in physical education. The research examined teacher use of game-based approaches (GBA). A rolling Twitter conversation hosted over the course of twelve hours provided the data for the study. Participants were from 18 countries and they contributed on average 11.80 Tweets per person, and the Twitter conversation had a reach of 110,000 people. Two types of data analysis occurred. The first involved quantitative analysis using Twitter metrics. The second involved qualitative analysis using Leximancer software. The analysis showed ‘teacher’ and ‘questions’ as prominent themes. Although GBAs are proposed as student-centred the teacher remains the pedagogical gate-keeper as the choice to use a GBA was largely based on the feeling of the teacher about the use of the approach. The present study showcases a unique contribution to the literature by sharing a process of mixed method research using a contemporary communication platform.

Keywords: Twitter; games teaching, game-based, physical education

Introduction

Sharing and capturing information is part of the knowledge management of the world we live in. A large proportion of our society immerses itself through digital media as a natural part of their learning environment (Laurillard, 2016). The advent of Web 2.0 applications and social media platforms has created the opportunity for greater knowledge sharing and the
opportunity to create connections across and within communities that previously were much more difficult to navigate. Knowledge management in a largely digital world is different from the world where knowledge management was largely book based. There now exists a complex and interconnected picture of knowledge management more independently controlled as content is posted under the masthead of individual bloggers and ‘twitterers’ as well as the traditional media organisations and new media organisations. The advent of third-party platforms for knowledge management, such as Facebook and Twitter, has changed the way information is shared (Bruns, 2012a). The diffusion of new applications and platforms for information management in our view necessitates that academics engage with new forms of knowledge capture for the academic work of knowledge generation and dissemination.

This research engaged with the third-party microblogging platform, Twitter. Microblogging is now a major communication and knowledge management tool (Bruns, 2012b). Twitter functions by users acting as private individuals without the necessity of journalistic or scholarly-academic intentions for the writing; hence, it may be argued the users are intrinsically motivated to connect with the information generation and dissemination (Rudat, Burder & Hesse, 2014). Twitter users can subscribe to feeds of other users, create posts, participate in debates, exchange messages, comment on posts, and send private messages (Bruns, 2012b). Twitter users may be preferentially connected through a shared interest to those they are following and those that are their followers (Rudat et al., 2014). Early research into Twitter use suggested that sharing of information and news by Tweets are among the main intentions of Twitter users (Java, Song, Finin, & Tseng, 2007).

Retweeting is a form of knowledge management. This practice can bring new people into a conversation without directly addressing them or the need for these participants to contribute (Boyd, Golder, & Lotan, 2010). Retweets may, however, be an image of an original message rather than an accurate portrayal of the original tweet where users have
A tool available to Twitter users to support audience knowledge is the use of the # tag to theme an information flow. # tag conversations are thus a means of tailoring information management to an audience as well as communicating ‘ad hoc’ with a community around a topic (Bruns & Jennings, 2012). As with followers, reciprocity with readers of a # tag conversation is not required to engage with the knowledge generation and sharing in the conversation stream. One can follow the conversation without the necessity to follow others engaging with the posting of tweets, retweeting and commenting on tweets using the #tag. In this paper, we have de-identified the conversation from which data was collected by using the pseudonym #Chat or simply referring to this as the ‘Twitter conversation’. Twitter users can also maximise audience reach of a microblog using the #tag conversation link. #tags are thus a user generated means for making microblogging relevant to a specific topic more obvious and easily available (Bruns, 2012b).

An active ability to participate in the digital generation of knowledge and response to this generation is a prominent feature of Web 2.0 applications such as Twitter (Rudat & Buder, 2015). The growth of Twitter usage, the high speed of Twitter information sharing, and its influence raises questions for researchers about how it is used (Bruns, 2012b), but we also suggest questions about how it can be used for research purposes.

While researchers are starting to use knowledge discovery methods and data mining of tweets as a form of qualitative research (Williams, Terras, & Warwick, 2013b), our search of existing literature did not reveal any other examples of the use of microblogging and
Microblogging platforms such as Twitter have become increasingly prominent as both a data collection tool for educational researchers (Gao, Luo, & Zhang, 2012) as well as a site for teachers’ continuous professional learning (CPL) (Carpenter & Krutka, 2014). However, when using Twitter as a research tool a set of Twitter users is defined and selected. We acknowledge that the use of Twitter as a data collection tool samples users from a public stream, therefore the conversation could contain elements of bias by those regularly participating in the medium (Gao et al., 2012). By this we mean that Twitter uses can form communities of practice by connecting with ‘like-minded’ individuals and therefore there is the potential for a professional Twitter conversation to be an example of ‘talking to the converted’.

This research is of significance as it explores a Web 2.0 application for qualitative data collection. Much of the existing research relating to Twitter examines the messages, messaging sentiment, and details of users (Williams, Terras, & Warwick, 2013a; Zimmer & Proferes, 2014). The ambition of the research was to explore teacher use and familiarity with GBAs from a global scan of PE teachers. A Twitter conversation was hypothesised as a tool to be able to meet the purpose of a global scan of teachers.

**Game Based Approach**

GBA is the term used for a collection of game as opposed to technique centred instructional models. Metzler (2011) used the alternative term Tactical Games Model for this expression of models based practice (MBP) for games and sport teaching in PE. The GBA term captures Teaching Games for Understanding (TGfU) (Bunker & Thorpe, 1982), the Tactical Games Approach (Griffin, Mitchell & Oslin, 1997), the Game Sense Approach (Australian Sports Commission, 1996) – with the Tactical Games and Game Sense approaches representing
developments and refinements of the original TGfU proposition. The term GBA recognises both the centrality of games and sport in PE as well as intentional divergence from the historically common linear technical-to-tactical pedagogically directive sport-as-sport techniques (Kirk, 2010) instructional emphasis within PE. Reviews of GBA research have shown that the pedagogical concepts of teaching for understanding and developing player game sense have been well accepted in teacher education and sport coaching education. Nonetheless, queries remain about the penetration of the pedagogical emphasis on questioning, foregrounding games as a deliberate or intentional learning context through the modification of game constraints to focus and shape player perception-decision making coupling into the ‘everyday practice’ of PE teachers (Harvey & Jarrett, 2014; Oslin & Mitchell, 2006; Stolz & Pill, 2013; Zuccolo, Spittle, & Pill, 2014).

**Method**

**Sample and recruitment**

Following university ethics approval, PE teachers were recruited by microblogs on Twitter of a hosted Twitter conversation (the #Chat). Author 1 and 2 had experience in conducting and moderating Twitter conversations, but author 2 was clearly identified as the lead discussant for the conversation to distance author 1 from the university where institutional research board (IRB) ethics approval for the research was granted as a requirement of the ethics approval. Ethical issues in using Twitter as a forum for research can reveal several sensitive concepts for consideration. To overcome these issues the research team thoroughly considered the suggestions provided by Conway (2014) and discussed these issues with the ethical review board at author 1’s institution. Based on these conversations we took steps to ensure participant privacy. For example, in our cover letter describing the #Chat Twitter conversation, we clearly noted that we were using these data for research purposes (see Table...
1) and emphasised before the Twitter conversation that users had personal responsibility for their posts. We encouraged a diversity of participants through our advertisement of the event and no participants were excluded from the Twitter conversation based on race, gender, disability, etc. Moreover, we protected participant privacy during publication by paraphrasing Tweets and not disclosing metadata such as the name of the Twitter conversation, or participant usernames (Conway, 2014). In addition, we appropriately stored the Twitter conversation data on password protected computers and checked the authenticity of participants through manual checking of Twitter handles during data analysis. Information about the Twitter conversation was posted on Twitter via both author 1 and 2 personal Twitter accounts, and additionally posted on author 1’s personal webpage one month before the conversation was due to commence.

Data Collection.

A rolling Twitter conversation was hosted over the course of twelve hours. Four moderated times suited the global audience being reached. These times were 7am, 11am, 3pm and 7pm Australian Central Daylight Time. Each Twitter conversation was advertised to last for one hour. Eighty teachers responded to the Twitter conversation. The Twitter conversation came from 18 countries and they contributed on average 11.80 Tweets, and the Twitter conversation had a reach of 110,000 people. Table 1 shows examples of the general flow of each of the Twitter Chat conversations. They began with an overview of consent procedures for the study. A series of six substantive tweets were then posted indicating what the background to the conversation was to be about, which also indicted the various nomenclature in the extant literature. From that point the ensuing discussion was moderated by author 2 as per approved ethical guidelines, with support from the author 1 who, where
needed, used various planned prompts to stimulate discussion, particularly pertaining to the third and fourth study research questions (see Table 1).

Ongoing discussions in-between each of the four moderated conversations were also captured by author 2 who followed up on developing threads. If threads developed and/or Tweets were made that did not use the #Chat tag then the second author quoted these Tweets, adding #Chat so that they would show up in the later analysis. After all the conversations were completed both author 1 and 2 also followed up with subsequent Tweets to gather additional information or clarification on statements.

The Twitter conversation was captured using a web-based application called Storify the day after the Twitter conversation by author 1. The #Chat was entered into this system and data relative to the hashtag placed in a ‘story’ which was subsequently downloaded to a pdf file and shared with author 2. Author 2 copied each Tweet to a Microsoft Word™ file, allowing the author to become immersed in the data before detailed analysis occurred. Part of this organisational process involved checking Twitter profiles and additional filtering of Tweets/comments related to coaching, which were deleted from the analysis.

Two types of data analysis occurred. The first involved quantitative analysis using Twitter metrics. The second involved qualitative analysis using Leximancer software. Author 3 assisted in the data analysis.

Data Analysis 1: Using metrics

The quantitative data analysis was conducted using metrics generated from the www.followthehashtag.com website. The search was completed five days after the completion of the final #Chat Twitter conversation. Once the search was completed, the
website displayed quantitative information on a dashboard – such as, the total number of
Tweets with this hashtag, the total audience, total contributors, Tweets per contributor, and
total impressions. Moreover, the information relative to a summary content of the Twitter
conversation, such as a word, type of activity (such as Tweets and retweets), best hours when
most tweets occurred and embedded pictures and links shared with the conversation group
can be obtained. This information, as well as a map showing the geographical location where
the most Tweets emanated from, formed the basis of the first analysis.

The main aspects of the Twitter conversation data that will be utilised for the present
study will be data relative to: a) the dashboard, b) content (Tweets and retweets), and c) map
and coverage. These data will be presented in the results.

Data Analysis 2: Leximancer Text Mining

The application of Computer Assisted Qualitative Data Analysis Software (CAQDAS) to
consolidate research and analyses processes continues to develop (Crofts & Bisman, 2010).
By text mining the content of the Tweets we demonstrate the use of a lexicographic tool that
processes text by determining contextual relationships of words and term occurrences via
word positioning and frequencies (Kamimaeda et al., 2007). The Leximancer software
uniquely extracts and illustrates weighted term classifications between key words and
develops concept maps that display the rate at which concepts and significantly related terms
appear close to each other within the text. A diagram illustrating the processing of text and
breaking down the text into words, concepts and themes is demonstrated in Figure 1.
Although Leximancer has been largely used within the fields of business, accounting and education (Fisher & Miller, 2008; Beamish et al., 2006; Rooney et al., 2006; Grimbeek et al., 2004, 2005), the software is only now beginning to be utilised to explore concepts in the discipline of PE (Haynes, Miller, & Varea, 2016; Hyndman & Pill, 2017). In this current study, Leximancer was applied to provide a mechanism to triangulate the data collected by identifying related concepts and themes within the Twitter conversation, which may have been otherwise overlooked through manual data analytical stages. The concepts were then interpreted for additional meaning from the textual analysis.

Themes and concepts were text mined to process the spatial and relational analyses to reveal the relevance of the semantic networks within the Twitter conversation, the relationship between concepts and the occurrences of related terms from that appeared close together within the text. The text mining was followed by determining the significant concepts, themes and contexts by the visual representation of cognitive mapping (Crofts & Bisman, 2010). Instances of similar words revealed from the software were manually merged into singular concepts (often plural and non-plural versions of words) from the Leximancer software e.g. teaches/teach, physed/PE. The findings from the text mining of the Twitter conversation were analysed manually to confirm the words, concepts and themes were linked to the original literature. This process ensured that the research process could be enriched and to enhance the data interpretation.

It was a requirement of ethics consent for the research that the tabling of Tweets in any publication be paraphrased to prevent re-identification of Tweet authors using a web search for the Tweet.

**Results and Discussion**

1. Dashboard
The total number of tweets registered for the Twitter conversation and in the period 5 days after its conclusion was 1,133. The total audience for the conversation was 111,546 and 96 contributors, with 11.80 tweets per contributor. The total impressions for the Twitter conversation reached over 1 million Twitter users (1,970,492), representing 17.67 impressions per audience member. Impressions indicate the number of times a tweet has been delivered to the Twitter stream of a particular account, albeit not everyone will read the tweets delivered to their stream. Impressions therefore indicate the ‘reach’ of a particular tweet, or in this case, of a Twitter conversation using a specific hashtag term.

2. Content

15.7% of the tweets were original tweets, with these generating 51.3% replies. 25.90% of the tweets were retweets, and 7.1% of tweets that were pictures or links to content such as websites, etc. The word cloud showed the main words utilised during the Twitter conversation. While at the center, the main words were the Twitter conversation hashtag (#Chat) and the names of some of the main contributors to the conversation, the other words generated were such things as: understanding, teacher questions, game, learning, change, play, practice, knowledge, focus, inquiry, tactical, students, time, game sense, resources, principles, drills, models, experience, etc. Finally, the type of activity timeline added information to the breakdown of the individual one-hour sessions. While this shows that the most popular session in terms of tweets was the first session, the type of activity timeline in Figure 2 shows that session three encouraged greater engagement after the hour-long session. In other words, more people continued the discussions on the Twitter conversation after the one-hour time slot without the formal moderation.

Insert Figure 2 here
3. Heatmap and coverage

The Heatmap in Figure 3 shows that the main contributors were from Europe (UK), Australia, South America (Chile) and the North Eastern United States with pockets of interest from Asia (China, Korea, Japan, Singapore) as well as Spain, North Africa, and the Western United States. The most popular contributors (aside from the moderators of the Twitter conversation) were from Australia (15), the United States (10) and the UK (9). Interest from additional areas was sparse, however, some individuals from these areas contributed several tweets to maintain the flow of discussion. For example, one tweeter from Spain recorded 15 tweets and one from Chile recorded 74 tweets.

Insert figure 3 here

4. Leximancer

The Leximancer program developed themes and concepts from the collation of Tweets. Initially, concepts develop according to the relationship between concepts and the rate at which concepts occur. This is shown in Table 2. The concepts of teachers, teaching, coaching, approach and coaches occupied five of the first ten concepts ranked on relevance from the overall text mining analysis of the Twitter conversation. Following this spatial and relational analysis, clustering of the major themes occurs and are visually represented in a thematic map (Figure 4). The thematic map demonstrates that the major themes of ‘learning’ and ‘knowledge’ within the Twitter conversation were closely
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Insert table 2 here

Insert figure 4 about here
<table>
<thead>
<tr>
<th>Major concept identified from the Twitter analysis</th>
<th>Closest related concept</th>
<th>Sample quote/s demonstrating level of concept relationship</th>
</tr>
</thead>
</table>
| TGFU*                                           | Students                 | “I have recently begun...adopting teaching games for understanding with my students...their engagement & progress amazing.”  
“...creating students who are physically literate through teaching games for understanding...looking for more thoughts and ideas.” |
| Knowledge                                       | Knowledge                | “Professional development often includes further insight into approaches such as teaching games for understanding.”  
“Coaches are becoming aware of teaching games for understanding but are reluctant to use it due to lack of knowledge.”  |
| Use                                             | Use                      | “I used to use teaching games for understanding principles in my teaching, though faced difficulties...trying to shift pedagogy.” |
| Develop                                         | Develop                  | “...continue to develop themselves which means the sessions move more towards true teaching games for understanding.”  
“Using teaching games for understanding approach is a process and takes time but the rewards are worth it.” |
| Better                                          | Better                   | “But the more of us that promote teaching games for understanding the better!”  
“...better alignment/sync, can be hard to justify value of game based approaches if coaches just drill n kill, or vice versa.”  
“...better physical education teacher education programs and global awareness to start an education shift for a better society.” |
| Approach                                        | Approach                 | “2012/13 only 40% of our grade 9 students were electing to continue with grade 10. started a game sense approach... now 72%.”  
“A Tactical Games Approach session in Rugby. A models based approach to PE: TGfU. I'll do a Sport Ed unit, then TGfU approach etc.” |
| Skill                                           | Skill                    | “...skill development at a pace and rhythm that they can handle.”  
“...is very much constructivist in that it builds on prior skills and knowledge.”  
“...mainly because teaching games for understanding doesn't marginalise the unskilled it allows all students to achieve.” |
| Practice                                        | Practice                 | “Once there is a culture of practice...it is hard to ignore.”  
“It is about the courage to change, the fortitude to stay the course and support to inquire into your practice?”  
“Asking right questions of ourselves in regards to our own practice.” |
| Coaches                                         | Coaches                  | “Game based approaches need to be embraced by coaches and teachers alike.”  
“Mindset of the teacher/coach is critical.”  
“I'm not a teacher I coach.”  
“Would teachers/coaches like ACTIVE or PASSIVE learners.” |
| Teachers                                        | Knowledge                | “Need a PE Head of Department to disseminate knowledge of best practice to teachers while supporting them.”  
“...you have small games that cater for all levels that challenge and develop knowledge, understanding and skills.”  
“...develops knowledge of skilled and promotes understanding of otherwise frustratingly unskilled.” |
| Drill                                           | Drills                   | “Definitely shouldn’t be an excuse for mindless drills.”  
“Skills and drills is coaching not teaching PE.”  
“Is skills and drills coaching? I use the same approach if I am in a school or in a sports setting.” |
| Skills                                          | Skills                   | “As an inquiry teacher yourself, I believe you address skill set non-stop in your units.” |
Table 3. TGfU, Teachers and Games Concept Relatedness from the #Chat Twitter conversation Leximancer Analysis.

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<thead>
<tr>
<th></th>
<th>Practice</th>
<th>Sense</th>
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<tbody>
<tr>
<td></td>
<td>“I think standards for PE are written badly and advocate isolating skills.”</td>
<td>“Inspired to refine and dig deeper into how I teach game sense.”</td>
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<td></td>
<td>“Although if we take an ecological dynamics approach to skill acquisition then a games sense could do both?”</td>
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<td></td>
<td>“I would say teachers on Twitter are interested in professional development but not uniformly Models based practice.”</td>
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<tr>
<td></td>
<td>“Need...knowledge of best practice to teachers while supporting them.”</td>
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<td></td>
<td>“Comes down to depth of analysis of prof practice indeed.”</td>
<td></td>
</tr>
<tr>
<td></td>
<td>“Is it about the courage to change, the fortitude to stay the course and support to inquire into your practice?”</td>
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<thead>
<tr>
<th></th>
<th>Drill</th>
<th>Skill</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>“…drills contain limited decisions games can drill down or open up as the game contains myriad decisions and learning opportunities. Drill: how can you accomplish this?”</td>
<td>“…skill levels improved faster, learning embedded quicker.”</td>
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<td></td>
<td>“Even in later stages, drills far more prevalent than games sense activities, although changing.”</td>
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<td></td>
<td>“The focus is on playing the game...the reason for learning technique and strategies, it definitely shouldn’t be an excuse for mindless drills.”</td>
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<tr>
<th></th>
<th>Need</th>
<th>Focus</th>
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<tbody>
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<td></td>
<td>“…inspired to refine and dig deeper into how I teach game sense. Does it need to be part of every quality PE lesson?”</td>
<td>“Team net games and individual net games. Yes, they were the focus.”</td>
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<td></td>
<td>“In Korea many PE teachers want to get involved in game based approaches...needs to be translated in contexts and environments in here.”</td>
<td>“…that focus on “the one with the ball” is apparent everywhere.”</td>
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<td></td>
<td>“Teachers also need to see the gains for their students.”</td>
<td>“Drills focus on the same aspect for all.”</td>
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<td></td>
<td>“Using “core” games means you only need 2 understand key &quot;principles&quot;.&quot;</td>
<td>“The focus is on playing the game which provides the reason for leaning technique and strategies.”</td>
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<table>
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<tr>
<th></th>
<th>Players</th>
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<tbody>
<tr>
<td></td>
<td>“I have seen players wrestling with a problem posed by the game and devising solutions collectively.”</td>
</tr>
<tr>
<td></td>
<td>“…allowing the kids/players to just play at the beginning and discover is crucial too.”</td>
</tr>
</tbody>
</table>

* Categorised as a ‘name-like’ concept from the Leximancer text mining analysis software. The other concepts in the table are ‘word-like’ concepts.
Table 4. Teaching and Learning Concept Relatedness from the #Chat Twitter conversation Leximancer Analysis

<table>
<thead>
<tr>
<th>Major concept identified from the Twitter analysis</th>
<th>Closest related concept</th>
<th>Sample quote/s demonstrating level of concept relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching</td>
<td>Coaching</td>
<td>“...shouldn’t coaching be a form of teaching?”</td>
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<tr>
<td></td>
<td></td>
<td>“Continued self-reflection of teaching/coaching...”</td>
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<td></td>
<td></td>
<td>“Continued use of questioning in teaching/coaching.”</td>
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<tr>
<td></td>
<td></td>
<td>“...teachers/coaches spending too much time talking instead of players learning in action.”</td>
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<tr>
<td></td>
<td>Questions</td>
<td>“when you have standards u teach to standards so sometimes eliminates the freedom for questions and exploration of concepts and movement.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“Students sitting/standing in lines waiting their turn is much more appealing for many teachers. Plus no questions!”</td>
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<td></td>
<td></td>
<td>“Asking right questions of ourselves in regards to our own practice.”</td>
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<tr>
<td></td>
<td>Teachers</td>
<td>“In education in general, good teaching, is good teaching, but too many teachers still rolling the ball out/grading.”</td>
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<td></td>
<td></td>
<td>“...is it a case of teachers not taking a risk in their teaching?”</td>
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<td></td>
<td>Skill</td>
<td>“...if a standard says teach how to hit with a long handled bat you have to teach that skill right?”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“Professional Development for experienced teachers on moving towards game sense and away from drill/skill repetition.”</td>
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<tr>
<td></td>
<td></td>
<td>“Skills and drills is coaching, not teaching PE.”</td>
</tr>
<tr>
<td></td>
<td>Players</td>
<td>“...became more concerned about what students/players were actually learning and assessment of. Continued use of questioning in teaching/coaching.”</td>
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<tr>
<td></td>
<td></td>
<td>“...too much time talking instead of players learning in action.”</td>
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<tr>
<td>Learning</td>
<td>Students</td>
<td>“...mainly because teaching games for understanding ...allows all students to achieve.”</td>
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<tr>
<td></td>
<td></td>
<td>“Just as we try to identify barriers to learning within our students, what comes first?”</td>
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<td></td>
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<td>“...game coherence modifications propose by the students and student design games will be so important too.”</td>
</tr>
<tr>
<td></td>
<td>Skill</td>
<td>“...can have diff tasks they need to accomplish within a game...skill levels improved faster, learning embedded quicker.”</td>
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<tr>
<td></td>
<td></td>
<td>“Like children learning a new skill changing teaching habits takes time and involves struggle.”</td>
</tr>
<tr>
<td></td>
<td>Coaching</td>
<td>“When your coaching yourself through drill, you are so busy, you don’t realise the children aren’t till you step back.”</td>
</tr>
<tr>
<td></td>
<td>Practice</td>
<td>“Online learning through Twitter, experimenting with my practice in school....”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“teaching games for understanding - if people confuse it for other models/ideas then easy to label poor practice.”</td>
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<td></td>
<td></td>
<td>“...strongly guided like MosstonStyle-F provides a platform for good practice to be highlighted and shared.”</td>
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<td></td>
<td>Questions</td>
<td>“What key questions have been asked/discussed so far...?”</td>
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<td></td>
<td></td>
<td>“...ask questions instead of directions. Its about raising awareness and showing the benefits to learning by changing the paradigm.”</td>
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<td></td>
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<td>“tactical questions others use, I know its organic based on the moment but some questions may help.”</td>
</tr>
<tr>
<td></td>
<td>Focus</td>
<td>“...as result focus purely on enjoyment as opposed to learning.”</td>
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<td></td>
<td></td>
<td>“I use a mixed models-approach, but always focus on outcomes-based instruction.”</td>
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<td></td>
<td></td>
<td>“...all games have more than one learning objective in them. Drills focus on the same aspect for all.”</td>
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</tbody>
</table>
clustered with the themes of ‘coaching’ and ‘teaching’. The theme of ‘skill’ was closely clustered to the themes of ‘teachers’, ‘develop’ and ‘understanding’. Other closely clustered major themes from the Twitter conversation included ‘understanding’ and ‘time’, the themes of ‘approach’ and ‘teaching’ and the major themes of ‘approach’ and ‘questions’.

It was discovered that the concept of ‘TGFU’ was as equally relevant (100%) and counted (n=37) within the chat as the most relevant overall word-like concepts of teachers and games. The name-like concept of ‘TGFU’ was examined in closer detail and it was revealed to be most closely related to the concepts of ‘students’ (54% relatedness), ‘knowledge’ (50%), ‘use’ (41% relevance), ‘better’ (38% relatedness), ‘approach’ (38% relatedness), ‘skill’ (38% relatedness) and ‘practice’ (38% relatedness).

From the initial analyses that revealed the ranked concepts in relevance from the Twitter conversation (Table 2), the highest ranked concepts of teachers, game, teaching and learning were also examined in further detail. The most related concepts to the concept of ‘teachers’ from the Twitter conversation text mining were ‘coaches’ (82% relatedness), ‘knowledge’ (67% relatedness), ‘drills’ (44% relatedness), ‘skill’ (44% relatedness) and ‘practice’ (44 relatedness) (Table 3). The most related concepts to the concept of ‘games’ were ‘sense’ (100% relatedness), ‘drills’ (78% relatedness), ‘skill’ (50% relatedness), ‘need’ (50% relatedness), ‘focus’ (50% relatedness) and ‘players’ (38% relatedness). The concept of ‘practice’ being strongly related to TGfU would suggest that practice is a key component for students to continue to develop game play, think tactically and be directed to elements of game play to ensure improvement by and ‘better’ themselves within PE class (Stolz & Pill, 2013).

Concepts from the overall text mining demonstrated a teacher-focused theme.

Previous studies suggest uncertainty from many teachers around the use of GBA to shape students’ perception-decision making within PE classes (Harvey & Jarrett, 2014; Stolz & Pill,
The data reflects that those involved in the Twitter conversation appeared to be more concerned with the delivery of PE content in comparison to student experiences or outcomes. The concept of ‘teaching’ was revealed to be most related to ‘coaching’ (50% relatedness), ‘questions’ (42% relatedness), ‘teachers’ (38% relatedness), ‘skill’ (38% relatedness) and ‘players’ (38% relatedness) from the TGFU chat.

Examining the concept of ‘teacher’ in more detail revealed a strong association with the concept of ‘knowledge’. Such a finding conforms to Tinning’s (2007) suggestion that PE teachers must have the knowledge of a variety of teaching methods to produce engaging experiences for students in PE. Ward (2013) also reports that a strong content knowledge is vital to generate effective learning outcomes in PE. Content knowledge has been previously linked to teaching ability and the potential to illicit more complex questioning techniques and inclusion of students within PE lessons (Stronge, 2007; Horsley, 2012). Although when applying a GBA teachers are often less reliant on sport-specific domain knowledge (Pill & Stolz, 2013) and require deeper tactical knowledge to guide understanding of complex tactical game situations (Diaz-Cueto, Hernandez-Alvarez, & Castejon, 2010; Gurvitch, Blankenship, Metzler, & Lund, 2008; Harvey & Pill, 2016; Metzler, 2011; Wright, McNeill, & Fry, 2009).

Related to the concept of practice was teachers developing a culture of GBA practice and reflecting on GBA delivery (Table 3). The high relevance of the ‘practice’ concept with TGfU was associated with teachers requiring further practice in the facilitation of GBA. Similarly, the strong relatedness between the concepts of ‘use’ and ‘better’ with TGfU were related to teachers’ uptake/adoptio of GBA, the processes and rewards of GBA application and the promotion of a better GBA culture in schools driven to be driven by teachers, rather than students’ use of such game knowledge.
When examining the concept relatedness between ‘game’ and ‘need’ there was again a teacher-focused association. Rather than the concept of need being associated with students’ development, the results revealed that the concept of need was strongly associated with teachers’ need to translate GBA to certain contexts, a need to see gains from the GBA approach and a need to understand key GBA principles during game facilitation. Within PE and sport, facilitating students’ understanding of the skills to negotiate complex tactical and technical game situations by using GBA (e.g. striking, net/wall, target, invasion games) has been promoted as a distinct need in PE for decades (Pill, 2011; Light, 2013). The limited understanding of the nature of learner-centred pedagogy may be the reason this aspect of a GBA remained underdeveloped in the Twitter conversation, a problem discussed by Goodyear and Dudley (2015).

The strong occurrence of a teacher-focused theme from the overall text mining is surprising given that the GBA is considered a game-based model that contrasts directive, traditional teacher-centred PE methods (Metzler, 2011). Nonetheless, the overall results reflect the Twitter conversation and the concepts closely related to the core conversation concepts of ‘game’ and ‘TGfU’ concepts.

Further analysis of the concept of ‘teaching’ revealed the distinctive pedagogical focus of game-centred models like the TGfU as questioning. Questioning students has previously been identified as a cornerstone of a GBA as a means to bring students towards ascertaining the value and significance of key tactical aspects within games (Harvey and Light, 2015; Stolz & Pill, 2013).

The impression is that GBAs are used by teachers because of how the model makes them feel about their teaching. These feelings may be generated by the results they perceived as achieved by using a GBA compared to other pedagogical models they have used; but
The Map presents an interesting picture of where the interest in the GBA exists. That a GBA would resonate in Australia is unsurprising. The Game Sense approach (Australian Sports Commission, 1996), has been a cornerstone of Australian sport coach education since the mid-1990’s, and then the foundation of the Playing for Life Philosophy (Australian Government, 2015a) and associated programs such as the Active After Schools Program (Schembri, 2005) and Sporting Schools Program (Australian Government, 2015b). What is interesting is the Map does not extend to the major population centres in north-east Australia (Brisbane) and Western Australia (Perth). This is a potential thread for further research analysis concerning the penetration of the idea and practice of the Game Sense approach in Australia. In North America, the Map covers the major west and east coast population centres. The Map shows most engagement from the east coast. We could speculate that the GBA has achieved better penetration in this part of the country given the authors of the Tactical Games Model teach at ‘eastern’ universities. Data generated from the Map of the Twitter conversation highlights pockets of influence, most of which are English speaking. The exception being one South American country.

Conclusion

We concur with Bruns (2012b) that Twitter provides substantial opportunities for research. Ethical matters for researchers, such as the need to gain IRB approval ahead of time, to clearly outline the research intention of the chat to participants so that participation implies informed consent, and to communicate which aspects of chats are being used for analysis are important in the process. However, we suggest that in addition to micro-blogging as a form of public communication that contributes to an academic’s scientific impact via amplification of
research dissemination and communication, Twitter holds tremendous potential for qualitative research, especially where the research seeks to gain a global perspective.

Understanding how to selectively and effectively use Twitter as a research tool, whereby the platform is used as a professional outlet and kept by the researcher separate from social communication, is a boundary on behaviour we recommend to researchers.

The overall findings from the Leximancer text mining analysis of the Twitter chat reflected the PE teachers’ collective focus on the facilitation of the GBA as a ‘pedagogical gate-keeper’ with the prominent concepts being teacher-related. Strong relatedness was revealed between the concepts of ‘teaching’ and ‘learning’ with ‘questioning’, which is a central component of GBA. When specifically examining the core concepts of the Twitter conversation of ‘TGfU’ and ‘game’, strong relatedness was identified to ‘students’ and ‘players’, reinforcing the GBA as a model to suit the experience of students, emphasise the development of student thinking and game intelligence. It might take a while for the learner-centred nature of TGfU to permeate in practice as increased understandings of this concept is understood by teachers (Goodyear & Dudley, 2015). Certainly, the social conditions of schools do not help this matter, as shown in Harvey and Pill (2016). Diffusions of innovations in research would suggest an optimal number of early adopters are needed to reach a tipping point before TGfU is centred as normative practice in schools. Focusing a research agenda on a positive agenda with narrative tales of successful TGfU practice may assist this process rather than relying on crisis theory (Pill, 2014).

The Map reveals pockets of global interest in the GBA. This might be because of limitations in the design of the study, yet based on our current analysis which supports other metrics such as the TGfU website statistics, there is an increased interest in GBA as a global movement. This global movement is illustrated by the proliferation of research and the distribution of interest is severely limited to English speaking countries.
This is a pre-publication version. The full version is found here http://dx.doi.org/10.1080/18377122.2017.1315953
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Table 1. Twitter Conversation Prompts.

<table>
<thead>
<tr>
<th>Stage of chat</th>
<th>Script/Prompts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consent Procedures Tweets</td>
<td>• Send a tweet notifying the conversation participants that the data is to be used for a research study. Note individuals will not be identifiable from chat. Tweet if they have any questions or email Author 1</td>
</tr>
</tbody>
</table>
| Substantive tweets examples | • Tweet Use #Chat conversation stream  
• Tweet 1 This #Chat is to investigate teachers use & non-use, & questions about, the 'tactical games model' (GBA) (Metzler, 2011) in physed  
• Tweet 2 GBAs include TeachingGamesforUnderstanding (TGfU)(UK), GameSense app(Aust), TacticalGames app(US), GamesConcept app(Sing) #Chat  
• Tweet 6 2 get the #Chat started - Who uses a tactical games model in physed-why do u use it? & If u don't use it-why not? |
| Tweet Prompt examples | • Are there any benefits using GBAs in physed? #Chat  
• What are the limitations or barriers in using GBAs in physed? #Chat  
• What features of GBAs enhance student learning in ways not possible if games&sport in physed taught differently? #Chat |
Figure 1. A model of how Leximancer processes text into words, concepts and themes.

Figure 2. Type of activity occurring during the #Chat Twitter Conversation.
Figure 3. Heat Map depicting the global contributions from #Chat Twitter Conversation.
Table 2. The highest ranked overall concepts from the text mining analysis of the #Chat Twitter conversation.