Proceeding

Supplementary Issue: Summer Conferences of Sports Science. 8th International Workshop and Conference of the International Society of Performance Analysis of Sport (ISPAS), 11-13th of September 2019 (Budapest, Hungary) "Technology meets Practice and Science".

Attitudes and behaviours of Canadian National Team coaches regarding the use of technology in their coaching practice

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ABSTRACT

Previous literature has proposed that successful adoption measures involve positive attitudes regarding using technology, high levels of technological self-efficacy beliefs, low levels of perceived complexity, and high levels of perceived relative advantage. The purpose of this study is to investigate these antecedents of technology adoption among national team Canadian coaches. Twenty-five current and retired Summer and Winter Canadian national team coaches participated in this investigation. They completed four questionnaires: a general information form, the Affinity for Technology Interaction Scale (ATI), the Computer Self-Efficacy Measure (CSEM), and the Perceived Relative Advantage and Perceived Complexity Scales (PRA/PCo). Canadian national team coaches who responded were found to have a moderate affinity for technology when engaging with technology in their coaching practice. They also reported to have very high self-efficacy when it comes to using technology. They were shown to have a moderately high conviction in their ability to use technology. Coaches also viewed technology as giving them a high relative advantage over not using technology. Finally, they generally viewed technology as not very complex to operate. Most Canadian national team coaches who responded showed favourable views regarding using technology, had belief in their ability, and seemed capable of overcoming challenges in using technology. Future investigations should also identify elite coaches who do not use innovations and focus on sport specific challenges in adopting or implementing technology, as well as identifying barriers coaches face when acquiring or using new technology. **Keywords**: Technology; Coaching; Adoption; Implementation; High-Performance sport.

Cite this article as:
Jaswal, R., Stergiou, P., & Katz, L. (2019). Attitudes and behaviours of Canadian National Team coaches regarding the use of technology in their coaching practice. *Journal of Human Sport and Exercise, 14*(5proc), S2445-S2454. doi:https://doi.org/10.14198/jhse.2019.14.Proc5.61

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Supplementary Issue: Summer Conferences of Sports Science. 8th International Workshop and Conference of the International Society of Performance Analysis of Sport (ISPAS), 11-13th of September 2019 (Budapest, Hungary).
JOURNAL OF HUMAN SPORT & EXERCISE ISSN 1988-5202

doi:10.14198/jhse.2019.14.Proc5.61

INTRODUCTION

The importance of technology in high-performance sport has been discussed in the literature on several occasions (Ringuet-Riot et al., 2013; Burkett, 2010; Ellapen & Paul, 2016; Guskiewicz, 2008; Liebermann et.al., 2002). State-of-the-art technologies are used in individual and team sports, and winter and summer sports. These include such diverse activities as skiing, speed skating, cycling, swimming, golf, surfing, American football, football (soccer), cricket, tennis, and running (Omoregie, 2016). Technology encompasses several purposes in elite sport including managing, monitoring, and mentoring athletes (Katz, et. al., 2008) pre, during, and post-training (Tanner & Gore, 2012; Ahmadi et al., 2009) and during the rehabilitation process (Saxena & Granot, 2011). Technology is also present in competition to aid referees in their real-time decision making (Duggal, 2014). Although technology is considered integral throughout several processes within a sport, it is difficult to find literature discussing technology adoption behaviours among coaches in sport. Investigation of adoption behaviours in the high-performance space is even more limited, with investigations addressing this topic in the high-performance Canadian sporting space even less so. This study aims to investigate the antecedents of successful technology adoption among high-performance Canadian coaches.

Technology Adoption

The process of adoption has been studied quite extensively and is studied together with several other co-factors which makes up the theory of diffusion (Frambach & Schillewaert, 2002; Greenhalgh et al., 2004; Rogers, 2003). Diffusion refers to a broader phenomenon that proposes to explain how a particular innovation spreads through a group or organization (Rogers, 2003). Katz, et. al., (2009) have proposed a model for implementation of Innovations in coaching (see Figure 1). Ultimately, participation in innovation is a multifaceted problem. As mentioned previously, although the literature on adoption and diffusion is quite large, the research investigating this within the Canadian high-performance sporting space is limited. Further, the literature available is focused on the administrators of National Sporting Organizations (NSOs) and does not necessarily discuss the coach's perspective of technology use (Holt et. al, 2017). Although these investigations give us an idea of the challenge's administrators face when implementing new technology, it gives us little information regarding the challenge's coaches face when it comes to adopting or implementing new technology.

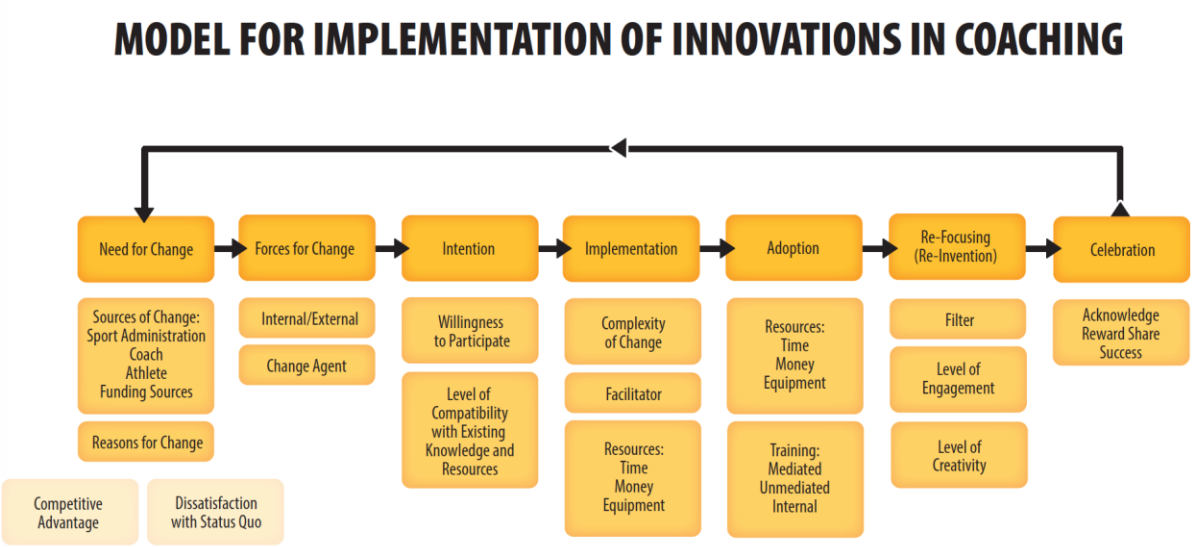

Figure 1. Model for Implementation of Innovations in Coaching.

Antecedents to Technology Adoption

Several different antecedents can predict Technology adoption. Chief among these is the concept of self-efficacy (Ellen et al., 1991). Self-efficacy is the measure of one's confidence in mastering a new challenge (Hartzel, 2003). Studies on technology adoption have shown that a positive relationship exists between self-efficacy beliefs concerning computer use and the motivation to use technologies (Hill et al., 1986; Leslie et al., 1998; Marakas et al., 1998; Webster & Martocchio, 1992). Further, these studies found that a person's level of general technological self-efficacy is instrumental in influencing attitudes towards new technology before or during its use (Hill et al., 1986; Leslie et al., 1998; Marakas et al., 1998; Webster & Martocchio, 1992).

Referring to the Rogers Diffusion of Innovations model, a critical stage of implementation is the 'Persuasion' stage. Persuasion occurs when the individual is forming an attitude (either in favour of or against the innovation). At this stage, the individual is more involved with the technology and seeks information on the advantages and disadvantages of the technology. Although there are five total characteristics, the formation of a favourable or unfavourable attitude regarding adopting technology is primarily based on the perceived complexity, and perceived relative advantage of the new technology (Davis, 1989; Rogers, 1995; Liebermann, 2006; Attig et al., 2017; Franke et al., 2018; Adams, Nelson, & Todd, 1992; Agarwal & Prasad, 1997, Agarwal & Prasad, 1998). Perceived complexity refers to the degree to which an innovation is perceived as relatively difficult to understand and use (Rogers, 1995). The perceived relative advantage of an innovation is defined as the degree to which an innovation is perceived as being better than the idea it supersedes (Rogers, 1995).

Further, successful coping with technology is also relevant when investigating positive adoption strategies and is often a predictor of successful adoption or rejection (Franke et al., 2018). As most new technologies require some kind of adaptation and learning by its users (i.e., because of new functions, interfaces, interaction paradigms etc.) (Hawk, 1989; Tyre & Orlikowski, 1996) for there to be a positive adoption of technology, users need to have a strong degree of coping resources (Beaudry & Pinsonneault, 2005; Chen, et al., 2009).

METHODS

Sample Characteristics

Coaches were sampled from Winter and Summer National Sporting Organizations in Canada and were recruited to participate in the quantitative study examining antecedents that may impact technology adoption. Specifically, the High-performance directors of all 52 National Sporting organizations (NSO) were asked to disseminate the forms to all of their high-performance coaches. Further, 61 coaches were emailed directly and asked to participate in this investigation. Coaches were selected based on the criteria that they either are working or have worked with the NSO within the last five years, as well as served as a national team coach in at least one international competition (i.e., a world cup or Olympic games).

Instruments

Coaches were asked to fill in a demographic form and three validated questionnaires that are described below.

General Information Form

This form consists of 11 items that collect nominal and ordinal data about the participant's backgrounds. It was used to collect the demographic profile of the sample population including age, gender, years of coaching, team(s) coached, and level of education.

Affinity for Technology Interaction Scale (ATI)

Franke et al. (2018) developed the ATI Scale. It is a scale that measures the tendency to actively engage in intensive technology interaction. Results of multiple studies with large samples (n>1500) showed that the scale achieves good to excellent reliability and moderate to high correlations with technology enthusiasm, and success with technical problem solving and technical system learning (Franke et al., 2018). The scale has been shown to be unidimensional, has good to excellent internal consistency, and does not have a floor or ceiling effect (Franke et al., 2018).

Computer Self-Efficacy Measure (CSEM)

In order to measure the technological self-efficacy of the users participating in the study, a self-efficacy scale was used. Compeau and Higgins (1995) originally developed the scale. Currently, this is the most cited scale in the literature regarding the measurement of self-efficacy, and one that is still used quite regularly. It has been used 180 times since its inception and has been featured in 93 publications in the last five years, which indicates that it is still a relevant scale (Attig et al., 2017).

Perceived Relative Advantage and Perceived Complexity Scales

In order to measure the perceived relative advantage of technology use, six items from the perceived relative advantage scale were used (Moore & Benbasat, 1991). The six items were made up of the five recommended by Moore and Benbasat (1991) to be used in the short version of the scale. This short version was made up of five items, and the reliability that was reported as 0.90 (Moore & Benbasat, 1991).

In addition, the short version of the perceived ease-of-use scale was used to measure the perception of the coaches about technology use. The version included four items with a reliability of 0.84 (Moore & Benbasat, 1991). The two sections were combined into one questionnaire, all items were tested on a 7-point Likert scale, ranging from “strongly disagree” to “strongly agree”.

Statistical Analysis

Data were analysed using SPSS for Windows Version 23.0 (SPSS Inc., 2015). Descriptive statistics were run on all demographic data, as well as questionnaire data. Likert scale data was organized and had descriptive/parametric statistics run on said data. Frequency tables were compiled to look at the distribution of the questionnaire data. The ATI scale has a corresponding ATI scoring analysis against which the data of the sample was evaluated (Franke et al., 2018).

RESULTS

It was expected that the results from these forms would shed light on three main areas of interest:

1. Attitudes towards technology in coaching,
2. Self-efficacy when it comes to using technology, and
3. How coaches rate technology in user complexity and perceived a relative advantage in enhancing sports results.

Demographic information confirmed most of the coaches interviewed were male (21) with only (4) females. Most coaches worked for winter NSOs (18), with 7 coaches being recruited from summer NSOs. Most coaches had a bachelor's degree or higher (20), while a minority had an associate degree or lower (5). Table 1 provides a summary of the demographic data.

Table 1. Results from Demographics Questionnaire.

Season	**Winter**				**Summer**				**Totals**			
Gender	**Male**		**Female**		**Male**		**Female**		**Male**		**Female**	
Number of Participants	14		1		7		1		21		4	
Age Range	32 - 56		32- 53		33-70		38		32 - 72		32 - 53	
Means and Standard Deviation	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Years Coaching	15.07	8.7	18	12.16	27.71	16.58	6	-	15.58	9.02`	15	11.6
Levels of Education												
Not completed High School									0		0	
High school diploma					1				1		0	
Post-high school education	1								1		0	
Associates Degree	1		1						1		1	
Bachelor's degree	12		2		3				15		2	
Master's degree					2		1		2		1	
Doctorate degree					1				1		0	

CSEM scores and ATI scores were significantly correlated (r=0.433). However, the correlation accounts for only 18.75% of the explained variance. Based on the scoring of the questionnaires coaches who responded showed a moderate affinity for technology when engaging with said technology in their coaching practice. They were also shown to have very high self-efficacy when it comes to using technology and a moderately high conviction in their ability to use technology. A summary of the questionnaire data received is reported in Table 2.

Table 2. Results from ATI & CSEM Questionnaires.

Season	**Winter**				**Summer**				**Totals**			
Gender	**Male**		**Female**		**Male**		**Female**		**Male**		**Female**	
Means and Standard Deviations	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
ATI Scale	3.9	0.87	3.11	0.48	3.6	0.93	2.55	-	3.8	0.88	2.97	0.48
CSEM Scale	9.5	1.09	9.33	0.57	8.14	3.76	10	-	9.04	2.33	9.5	0.58

On the PRA/PCo questionnaire the range of possible scores was between 1 and 7, with a higher score indicating a more favourable response. All item scores were above five, except item #9, " I believe that it is easy to get technology to do what I want it to do" (See Table 3).

Table 3. Results from PRA/PCo Questionnaire.

Questions	**Scores***				
	Mean	**SD**	**Median**	**Mode**	**Range**
1. Using technology enables me to accomplish tasks more quickly.	6.08	1.41	7	7	1 – 7
2. Using technology improves the quality of work I do.	6.16	1.46	7	7	1 – 7
3. Using technology makes it easier to do my job.	5.96	1.54	7	7	1 – 7
4. Using technology enhances my effectiveness on the job.	6.28	1.34	7	7	1 – 7
5. Using technology gives me greater control over my work.	5.92	1.5	6	7	1 – 7
6. Using technology increases my productivity.	5.76	1.69	6	7	1 – 7
7. Learning to operate technology is easy to me.	5.48	1.36	6	6	1 – 7
8. My interaction with technology is usually clear and understandable.	5.44	1.16	5	5	1 – 7
9. I believe that it is easy to get technology to do what I want it to do.	4.92	1.44	5	6	1 – 7
10. Overall, I believe using technology is easy and straightforward.	5.32	1.25	5	5	1 – 7

DISCUSSION

Increasingly we are learning how important technology is to sport-performance (Ringuet-Riot et al., 2013). At the highest levels of sport, if a useful innovation can offer even a fraction of a second advantage over the competition, its importance increases exponentially. The current investigation was undertaken to explore Canadian coaches' beliefs and experiences of integrating technology into their coaching practice. More specifically, this investigation sought to describe how Canadian coaches rank themselves on scales that measure technological affinity and technological self-efficacy, and their views on whether or not they feel technology gives them an advantage over their competition. Generally speaking, those who have a high affinity for technology will be more likely to use new technology in their coaching practice (Attig, 2017). If coaches have high self-belief in their ability to use technology, they are more likely to use technology in their practice (Hill et al., 1986; Leslie et al., 1998; Marakas et al., 1998; Webster & Martocchio, 1992). In addition, those coaches who view technology as giving them an advantage over their peers and believe that using technology is not very difficult or complex are more likely to adopt technology into their practice (Venkatesh, 2003).

As coping with technology is a function of personal & system resources (Czaja & Sharit, 1993; Kortum & Oswald, 2018), the results in table two suggest that the coaches who responded to the surveys are comfortable with technology. Personal resources on successful coping are two-fold: First, the higher the skills and knowledge regarding interaction with specific systems, the easier it is to cope with similar new systems. Second, users' personality characteristics also play an essential role to the extent that they manifest in general interaction styles. A key dimension of user personality is the way people approach new technical systems. That is, users' affinity for technology interaction means that they tend to actively approach interaction with technical systems or, alternatively tend to avoid intensive interaction with new systems (Franke, Attig & Wessel, 2019). The Canadian coaches in this study had favourable views regarding the use of technology, based on the ATI Scale. This indicates a moderate affinity for the use of technology (Franke, Attig & Wessel, 2019) and tells us that those Canadian coaches are reasonably inclined to approach new technical systems as opposed to avoiding them altogether (Franke, Attig & Wessel, 2019). Further, they are also more inclined to engage in cognitively intensive technology interaction, rather than be discouraged by future challenges that may come up when learning how to use new technology (Attig, 2017).

As mentioned previously, behavioural factors have become increasingly important in being determinants of whether or not users are inclined to adopt new technology (Compeau & Higgins, 1995). There are several determinants that may indicate positive technology adoption, chief among these is technological self-efficacy (Bandura, 1986). Self-efficacy, the belief that one has the capability to perform a particular behaviour, is an important construct in social psychology. Self-efficacy perceptions have been found to influence decisions about what behaviours to undertake (Bandura et al., 1977; Betz and Hackett, 1987), the effort exerted, and persistence in attempting those behaviours (Barling and Beattie, 1983; Brown and Inouye, 1978), the emotional responses (including stress and anxiety) of the individual performing the behaviours (Bandura et al., 1977; Stumpf et al.,1987), and the actual performance attainments of the individual with respect to the behaviour (Barling and Beattie, 1987; Collins, 1982; Locke et al., 1984; Schunk, 1981; Wood and Bandura, 1989). The CSEM, the validated instrument which is the current standard in self-reporting measures when it comes to measuring technological self-efficacy, was administered (see Table 2) and a mean score of 9.12, and a strength of 62.14 was found. This indicates that the Canadian coaches who participated in this investigation see themselves as very confident when it comes to using technology, and moderately confident in the answers they provided on the scale. As self-efficacy has been found to play an important role in shaping individuals' feelings and behaviours (Compeau & Higgins, 1995; Stephanidis, 2019), these scores may

indicate that the respondents to this investigation have very positive views when it comes to using technology, and would be more open to using a new piece of technology to complement their coaching practice. Individuals with high technological self-efficacy are noted to use technology more (Zheng et al., 2018), find enjoyment in using technology (Mckinney & Yoos, 2019) and feel less anxious in doing so (Rahman et al., 2018).

Finally, those Canadian national team coaches who responded generally viewed technology as giving them a high relative advantage over not using technology and also see technology as not very complex to operate. The coaches overall had very favourable views regarding both the advantage which technology provides, as well as viewed technology as not very complex to operate and use. All but one respondent had favourable views regarding technology and only 34 out of a total 250 answers were a score of 4 or lower. As previously mentioned, respondents indicating using technology as being relatively free from complexity and giving themselves an added advantage over their peers if the technology is put into use generally favour the implementation of said technology (Agarwal & Prasad, 1997; Premkumar et al., 1999; Parthasarathy et al., 2019). PRA and PCo are central to several models which are predictive of user uptake of a new technology (i.e., TAM, UTAUT, and Rogers Diffusion of Innovations model). A high score on these scale attributes should indicate a trend towards acceptance of new technology by coaches in their professional duties (Davis, 1989; Rogers, 2003; Venkatesh, 2003).

Limitations

Limitations of this investigation include self-selection bias, as those who are more inclined to use technology may also be motivated to volunteer for this investigation.

Future Considerations

Future investigations should:

1. Engage coaches who do not use technology in their professional practice and study the factors that influence that decision.
2. Encourage national team programs to examine sport specific challenges in adopting and/or implementing technology as some sports are more technologically inclined than others (e.g. the emphasis of technology use in Paralympic sport vs. others).
3. Examine more specific behaviours and barriers that coaches face when using technology in their coaching practice. More specifically:
    a. Study how coaches encounter technology,
    b. Examine those features coaches find useful,
    c. Identify the barriers and support mechanisms that are available,
    d. Obtain a perspective on how new technology should be introduced for maximum buy-in/use.

Technological innovations are seriously impacting athletic performance and coaching practice. Future research into best practices is still badly needed.

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