1   **Technology-enhanced learning in coaching: A review of literature.**

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21 **Abstract**

22 The purpose of this review was to address the central theme of technology-enhanced learning

23 (TEL) in coaching. Technology-enhanced learning' (TEL), has become a widely-accepted term

24 for describing the interface between digital technology and teaching. The aim was to consider

25 the evidence of TEL in coach education, and where appropriate the wider educational field.

26 The review sought to contribute to an evidence-base of suggestions that can be promoted and

27 developed inside and outside of coach development structures and interventions for TEL. In

28 addition, the review to outline future areas for research, and to stimulate debate about the

29 implementation and effectiveness of technology-enhanced coach learning. The review utilised

30 a critical methodology, using principles of systematic review to gather evidence pertaining to

31 TEL in coaching. From this number and considering the inclusion criteria sixty-four articles

32 were included and reviewed in detail. The review revealed how despite the use of technology

33 in coaching, teaching and learning the evidence of their efficacy is weak, and the use of TEL

34 in coaching requires further longitudinal research that considers learner, pedagogy and

35 pedagogic design in context, in order to understand its potential impact on optimising coach

36 development pedagogies, and therefore, contributing to a discourse of effective coach learning.

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Introduction

Coach learning is fundamental to the development of high quality coaching (Townsend, Cushion & Smith, 2017; Stodter & Cushion, 2017). Consequently, research has attempted to understand the process of coach learning (e.g. Wright, Trudel & Culver, 2007), commonly by attempting to categorise sources of coaches' knowledge (e.g. Erickson *et al.,* 2008; MacDonald *et al.,* 2015) and understand the use of discrete learning practices such as reflection (e.g. Taylor *et al.,* 2015; Gilbert & Trudel, 2001). The emerging consensus is that coach learning remains an idiosyncratic and often informal process reflective of the complex reality in which coaches work. As a result, in recent years alongside the significant increase in the provision of formal coach education (Gilbert & Trudel, 1999), academic interest in coach education continues to grow. The substantial body of literature on coach development however demonstrates a widely-held dissatisfaction with traditional 'face-to-face' coach education opportunities (Stoszkowski & Collins 2016; Cushion *et al.,* 2010), with 'learning' instead controlled and shaped within coaching sub-cultures by a power-dominated process of socialisation (Cushion, Jones & Armour, 2003; Piggott, 2011). Indeed, it is well established that informal learning experiences contribute more to the development of coaching knowledge and practice than formal education (e.g. Cushion *et al.*, 2003; Mallett, Trudel, Lyle & Rynne, 2009; Stoszkowski & Collins 2016; *inter-alia*). This is because coach education programmes tend to be standardised, instrumental and often developed in isolation from the "messy reality" of practice (Cushion *et al.,* 2010; Jones, Morgan & Harris, 2012), with coaches often 'filtering' knowledge from coach education according to "what works" in their own particular contexts (Stodter & Cushion, 2014, p. 75).

There is, therefore, an ongoing concern to outline optimal frameworks for formal coach development (Williams, Alder & Bush, 2016; Stoszkowski & Collins, 2014) that bring coach learning "under greater critical control" (Eraut, 1994, p. 62). An unfortunate consequence of this is a proliferation of 'effective' prescriptions *for* coach education despite little evidence of the impact of such pedagogies on learning. These have included various 'constructivist' approaches that have included attempts to situate learning through communities of practice (e.g. Stoszkowski & Collins, 2014a) narrative approaches (e.g. Douglas & Carless, 2008), ethnodrama (Morgan, Jones, Gilbourne & Llewellyn, 2013) and problem-based learning (e.g. Jones & Turner, 2009; Driska & Gould, 2014). One such perspective that has gained traction within coaching is the increased interest in the use of technologies to facilitate and enhance learning (Stoszkowski, Collins & Olssen, 2015). 'Technology-enhanced learning' (TEL), has

82   become a widely-accepted term for describing the interface between digital technology and

83   teaching – replacing popular terminology such as 'e-learning', 'learning technology' and

84   'computer-based learning' (Bayne, 2015, p. 5). Research has suggested that coaches are

85   increasingly open to the use of technology to support their development, which may be due to

86   their preferences for informal, bespoke learning experiences (Trudel, Culver & Werthner,

87   2013; Stoszkowski & Collins 2016). It has been suggested that technology can be a useful and

88   innovative means to support and structure coaches' learning, through the integration of

89   technology in the design of coach education pedagogy (Stoszkowski *et al.,* 2015).

90   However, research to support technology-enhanced leaning in coaching is still a

91   developing area (Stoszkowski *et al.,* 2015). While research (e.g. Stoszkowski & Collins, 2016)

92   suggests technology is used both as a source of knowledge and as a resource for coaches who

93   'self-medicate' their learning needs, the potential for technology to support and enhance coach

94   learning remains critically underexplored. This is particularly important considering the use of

95   technologies in coaching and the wider educational field is outpacing the development of

96   theoretical frameworks and any underlying evidence base supporting their use (Gunawardena

97   *et al.,* 2009; Stoszkowski & Collins, 2014). It is not yet clear however, how best to support the

98   integration of technology into coach development as a means of facilitating coach learning.

99   Therefore, there is a pressing need for an evidence-base concerning how technology is

100 currently used in coach learning and the impact of its use, as well as developing guidelines

101 about how it might be integrated to improve and 'enhance' coach education and learning. The

102 purpose of this paper is to address the central theme of technology-enhanced learning (TEL) in

103 coaching. The aim is to review the literature concerned with TEL in coach education, and where

104 appropriate the wider education and sport pedagogy fields. The review seeks to contribute to

105 an evidence-base of suggestions that can be promoted and developed inside and outside of

106 coach development structures and interventions for TEL. In addition, the review seeks to

107 identify future areas for research, and to stimulate debate about the implementation and

108 effectiveness of technology-enhanced coach learning. Central to the review is the taken for

109 granted assumption that technology can 'enhance learning', hence questions about how

110 technology enhances learning are important and as well as what value is being added.

111 **Methodology**

112 *Procedure overview*

113   The review utilised a critical methodology that drew upon the principles of a systematic review.
114   Because of the extensive body of literature across the fields of education, technology and
115   learning and the growing body of literature in understanding how coaches learn, the review
116   was divided into a number of stages (cf. Cushion *et al.,* 2010). First, a descriptive map of the
117   field of TEL was assembled. This included the synthesis of a wide range of empirical,
118   conceptual and review studies in order to identify evidence as to 'what works' in applying
119   technology to enhance learning across settings such as higher education, teacher-training and
120   pedagogy. Research relating to the use of TEL in the broader education, pedagogy and
121   technology fields, inclusive of critical reviews of the literature, conceptual dilemmas or issues
122   and the underpinning assumptions of TEL as well as examples of best practice, principles and
123   evidence *for* TEL were identified. Next, research was identified that investigated different
124   modalities of TEL and its implementation to coaching, coach education and coach learning.

125   The second phase of the review comprised of analysis and synthesis of the included
126   papers to form a review narrative. The literature was organised according to Kirkwood and
127   Price's (2014) conceptual framework. This framework identifies the following means of
128   categorising research in TEL – operational improvement, quantitative change in learning, and
129   qualitative change in learning (Kirkwood & Price, 2014). This enabled a structure to the
130   discussions surrounding coach learning and TEL and also provided a framework to consider
131   research from other relevant domains. The framework was a pragmatic conceptual tool to help
132   organise a disparate body of literature.

133   *Inclusion Criteria*

134   The review considered the relevant English language research undertaken between 2010 and
135   2016 with a particular focus on technology-enhanced learning applied to coaching, coach
136   learning and coach education, while including literature in relevant related disciplines (e.g.
137   education, professional learning, and educational technology). The review considered research
138   that was published in peer-reviewed scholarly journals as well as books/book chapters relevant
139   to the research questions. TEL features prominently in disciplines such as professional learning
140   and education and constitutes a large body of literature, and TEL itself is a broad term
141   encompassing many modalities. For this reason, generating specific evidence regarding the
142   impact of technology on learning, and also connecting coaching to the wider TEL field proved
143   challenging. Whilst it was clear that many researchers were interested in the use of, and benefits
144   for, implementing TEL, there remained very little evidence as to what 'worked' in specific

145 contexts with varying demographic populations. This process of gathering evidence regarding
146 TEL and its application to coaching was monitored by three measures of quality against which
147 each article was assessed (cf. Cushion *et al.,* 2010). These were:

148 - Trustworthiness of results assessed by the quality of the study (methodological rigour).
149 - Appropriateness of the study for addressing the research question (relevance).
150 - Appropriateness of focus for answering review question (topic relevance).

151 *Search Strategy*

152 The initial search strategy involved identifying databases relevant to the research (e.g.
153 psychINFO, SportDiscus; ProQuest), using various combinations of key words (e.g.
154 technology-enhanced learning AND coaching; technology-enhanced AND learning AND
155 coaching OR education OR development). Once identified, an exhaustive search using these
156 databases was conducted. This search was further supplemented by an extensive manual search
157 across relevant journals in the fields of education, learning and technology, as well as that of
158 coaching to identify relevant literature. This was not unproblematic, as despite the substantial
159 body of literature investigating the use of technological resources to enhance learning outcomes
160 across the field of education, coaching research that utilised technology was much more
161 difficult to identify. In order to limit the numbers of relevant articles pertaining to TEL
162 interventions papers that were subject specific were excluded (e.g. language learning; science;
163 computer studies) but articles that were discipline specific were included (e.g. higher
164 education; pedagogy; professional development).

165 As a result, two-layers of research were investigated, first; research relating to the use
166 of TEL in the broader education, pedagogy and technology fields, inclusive of critical reviews
167 of the literature. Second, research was identified that investigated different modalities of TEL
168 and its implementation to coaching, coach education and coach learning. The initial search
169 strategy involved reading the abstracts of selected papers against the inclusion and exclusion
170 criteria, removing duplicate papers and compiling a database of research notes as to the key
171 points of each paper. All articles without a clear focus on TEL related to the aims of the review
172 were excluded. From the initial searches over 5000 abstracts were reviewed and yielded 262
173 papers to be read more closely. From this number and considering the inclusion criteria 64
174 articles were included and reviewed in detail. Ensuring the review was systematic and
175 transparent presented challenges, particularly in identifying robust and defensible

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176 inclusion/exclusion criteria, resulting in a tension between inclusion and research that was
177 useful, relevant, and having an impact on the field. For this reason, judgement of value was
178 based on an aggregation of methodological quality, methodological relevance, and topic
179 relevance (cf. Cushion *et al.,* 2010).

180   *Analysis*

181 The papers were analysed deductively against Kirkwood and Price's (2014) organising
182 framework. Each article was read several times in order to become familiar with findings about
183 enhancements and the evidence presented to support these claims. Each author read the articles
184 independently and noted salient points relating to (1) the driver for the intervention/study, (2)
185 the enhancement sought, (3) the research/evaluation approach and methods, and (4) the type(s)
186 of evidence acquired. As part of the analysis the role of technology were considered in terms
187 of three outcomes; first, replicating existing 'teaching' practices, second, supplementing
188 existing teaching practices, and lastly transforming teaching or learning processes (cf.
189 Kirkwood & Price, 2014). Replicating existing practices involved an element of 'conventional'
190 delivery that was copied and delivered using a form of technology. Supplementing practices
191 involved resources or tools being made available to increase flexibility for learners, with the
192 research examining the response to the increased flexibility. Transforming practices involved
193 a structural change in the teaching and learning process using technology (see table one below).

194 ***Insert Table 1 here***

195 Furthermore, the literature often identified more than one 'enhancement' for example,
196 increases in peer-to-peer learning and critical thinking – and therefore the research was
197 organised into; operational improvement, quantitative change in learning, and qualitative
198 change in learning (cf. Kirkwood & Price, 2014). Table 2 below lists and maps the studies
199 conducted in coaching relating to the enhancement identified – the gaps denote no studies
200 conducted in coaching reporting the particular conception of enhancement.

201 ***Insert Table 2 here***

202 Table 1 served as a map of the intervention studies according to their use of technology, while
203 table 2 enabled us to map an understanding of how enhancement was conceived. Overall, as
204 can be seen, most papers were concerned with enhancement as qualitative changes in learning,
205 or operational improvement. Only one study sought to demonstrate a quantitative change in

206 learning, and while two studies reported qualitative changes in learning while using
207 quantitative data collection methods.

208 **Overview**

209 The following overview is organised into three parts. First, the TEL interventions in coaching
210 are mapped and reviewed against an organising framework utilised in the wider educational
211 literature (Kirkwood & Price, 2014). Next, the wider educational field (including physical
212 education and sport pedagogy) is reviewed to attempt to synthesise and draw out some
213 recommendations for best practices in the use of technology to support and enhance learning.
214 Finally, we discuss methodological, theoretical and practical issues related to research on
215 technology-enhanced learning applied to coaching, offering some recommendations for
216 developing a research agenda.

217 *Qualitative Change in Learning*

218 Kirkwood and Price (2014) suggest that a qualitative change in learning with the use of
219 technology promotes reflection on learning and practice, deeper engagement, and richer
220 understanding. For example, Stoszkowski and Collins (2015) and (2014) analysed the content
221 of twenty-four and twenty-six undergraduate students' online blogs to examine the quality of
222 reflections and the extent that blogging promoted higher-order thinking. In the 2014 study
223 descriptive reflection exceeded higher-order thinking and reflection, though the blogs showed
224 a trajectory toward higher-order thinking. While the blogs provided an effective platform for
225 supporting tutor-student interaction an online community did not emerge. The authors suggest
226 that sporadic use of the blog and a lack of a reflective structure inhibited the process of
227 reflection. Moreover, simply providing access to peers was insufficient to promote peer-to-
228 peer engagement and develop a learning 'community'. In the 2015 study the authors used a
229 framework of knowledge typologies to analyse and classify blog entries and found an
230 improvement in higher-order thinking processes and reflection but that these were variable and
231 progressed in a non-linear fashion. The authors did report an increase in peer collaboration and
232 posited the creation of a 'community of practice' as the tutor and supporting structures provided
233 a clear guide. However, in line with research in the wider educational literature (e.g. Hew &
234 Cheung, 2013), because of the research design the authors were unable to clarify if the
235 improvements were due to the blogs themselves or the way that the collaborative tool was used.

In a further study, Stoszkowski *et al.* (2015) sampled twenty-three undergraduate student coaches to take part in four semi-structured focus group interviews gauging their perceptions about the use of group blogging for reflection and learning. Participants reported positively about their experiences and indicated improvements in reflection, knowledge acquisition and their coaching practice. The authors suggested that the formal structure provided by the course and tutor and peer support were key mechanisms in facilitating reflection. Moreover, the format and accessibility of the platform on mobile devices and ability to engage in the work asynchronously was outlined as helping student uptake. These findings were balanced with participants having time and the 'attitude' to engage with the group blog as well as issues with group dynamics and group sizes. The authors pointed out that the technology was enabling of learning rather than being the mechanism for learning itself, a finding echoed in the wider educational field (e.g. Hannafin & Land, 1997).

Jones and colleagues (2015) examined the use of video diaries to support coach learning and reflection using evidence from a long-term (three year) case study tracking twenty-seven coaching students through their undergraduate coaching course. The authors challenge some of the positive claims surrounding the use of video diaries showing their use produced less engagement with reflection than written logs and group discussion. The perceived burden of completing entries was highlighted as outweighing the perceived benefits of using the approach. As a result, the production of video entries then became mediated by tutor involvement. The authors pointing out that it is important to consider "with whom and in what context will they be used, factoring in issues of time, inclination and general enthusiasm from potential respondents" (p. 407) as well as optional versus compulsory use. Furthermore, Mead, Spencer and Kidman, (2016) interviewed six performance-level coaches in four invasion sports about their perceptions of the use of video self-reflection as a tool for learning within their ongoing development. Contrary to Jones *et al*. (2015) the authors highlight the positive reception use of video technology to support reflection, but also indicate time and a lack of training/experience as barriers to its use.

Partington *et al.* (2015) tracked the coaching behaviour of five elite football coaches over three seasons (approximately 30 months) using a computerised observation system (Coach Analysis Intervention System, CAIS) (Cushion, *et al.,* 2012) and video feedback. The study reported significant differences in four behaviours, instruction, feedback, silence and questioning. The authors reported that the use of objective data and video feedback provided a

268 structure for reflective conversations, improved self-awareness and provided a trigger for
269 behaviour change evidenced over the duration of the research. In a similar vein, Kuklick,
270 Gearity and Thompson (2015) monitored the reflective activity of twenty-one coaching
271 students over a 12-week practicum. The students used an online journal and responded to
272 weekly reflective prompts that were posted by course tutors. Students completed the self-
273 reflection and insight scale (SRIS; Grant, Franklin & Langford, 2002) and the quality of
274 reflection was measured using an adopted reflection rubric. Pre- and post-test scores from the
275 SRIS showed a significant improvement in measures considering intrapersonal knowledge and
276 an increase in the levels of reflection from the rubric. The authors also highlighted the use of
277 technology as a means to facilitate better connections between students and tutors.

278 *Quantitative Change in Learning*

279 Kirkwood and Price (2014) suggest that quantitative changes in learning tend to be interpreted
280 as an improvement in the acquisition or retention of knowledge, increased engagement or time-
281 on-task and students achieving improved test scores or assessment grades. In the only study to
282 take this approach, Glang *et al.* (2010) designed an online education course for youth sport
283 coaches. The course was designed to develop sport concussion prevention and management
284 practices. The authors developed a short three module online resource that included scenarios.
285 Seventy-five coaches took part in a randomised control trial with pre-and post-test measures.
286 Significant differences were reported between treatment and control participants on measures
287 of: (a) knowledge about sports concussion, management, and prevention; (b) attitudes about
288 the importance of preventing sports concussion; and (c) intention and self-efficacy in sports
289 concussion management and prevention. The authors argued that the results illustrated the
290 course had an impact on understanding – though acknowledge that the study cannot suggest
291 the extent that the coaches would use the skills or knowledge in practice.

292 *Operational Improvement*

293 Operation improvement refers to the potential efficacy of TEL in coach learning and
294 development. For example, Hay *et al.* (2012) proposed using Web 2.0 technology to develop
295 assessment of coaching practice as learning experiences. Drawing on protocols for online
296 clinical assessment of practical skills in sports medicine, the authors suggested a three-stage
297 model that included tutor exemplars as a reference point for learners, learner-generated video

298   of practical skills with tutor feedback, and real-time video conferencing summative assessment
299   of practical skills. Despite no evaluative research design, Hay *et al.* (2012) argued that the
300   technology has the potential to facilitate a shifting of responsibility to the coach in the context
301   of their development. Kuklick *et al.* (2016), based on feedback from a case study with a single
302   coach, highlighted the potential for technology-based learning community meetings to connect
303   coaches with trustworthy and knowledgeable facilitators and peers in a manner that fits with
304   the coaches' busy schedules – and hence the potential for such technology to promote coach
305   learning effectiveness.

306   *Use of Technologies*

307   Analysis of the limited literature and evidence available on technology in coaching and coach
308   development suggests that technology offers a means of increasing the efficiency of existing
309   coach development processes, enhancing reflective practices or offering a means to transform
310   coach education pedagogy. However, the limited evidence on coaching means that it is difficult
311   to synthesise and draw out best practices or evidence pertaining to different modes of
312   technology to enhance learning. There is a wide range of Web 2.0 technologies available for
313   use in learning, however in coaching, technology is commonly used to replicate or supplement
314   traditional activities through online reflection, social spaces, online collaboration or online
315   delivery (Hew & Cheung, 2013). In the next section, we consider the literature from education
316   and sport pedagogy in an attempt to synthesise recommendations for the integration of
317   technologies into coaching and coach development. Hew and Cheung (2013) reviewed twenty-
318   seven articles considering the use of Web 2.0 technology in higher and secondary education –
319   they identified podcasts as the most commonly investigated, with investigations also
320   considering, blogs, wikis, social media and virtual (learning) environments (VLE). In the next
321   section, each use is now considered.

322   *Podcast*

323   Evidence from educational research suggests that podcasts with supporting materials have
324   reported generally positive results compared to just 'lectures' or 'traditional delivery (Hew &
325   Cheung, 2013). The positive results stem from learners receiving additional relevant
326   information or content. However, in their review, Hew and Cheung (2013) reported that
327   positive effects are not attributable to the podcast *per se* but how podcasts are used. For
328   example, when podcasts provided additional support to 'classroom' only instruction

329 improvements were noted – when groups received the same information none or trivial

330 improvements were reported. All of the research reports on tutor created material – no research

331 has considered the impact of learners developing their own original material, but this is posited

332 as having potential for developing learner ownership and deeper engagement (Hew & Cheung,

333 2013). No empirical findings support this and it is therefore an area for further exploration.

334 *Wiki*

335 Research examining the use of wikis is underdeveloped with relatively few studies being

336 undertaken. Those conducted in education have reported mixed results – with improvements

337 assigned to pedagogical design rather than the use of technology in itself (Hew & Cheung,

338 2013). Poor research design (e.g. lack of pre-tests, single groups) and confounding variables

339 such as different tutors involved with courses and increased staff-student ratios compared with

340 courses not using wikis have also been identified as issues in terms of the impact on learning.

341 In a sport related study, Hastie *et al.* (2010) implemented wiki technology with two classes of

342 secondary school physical education pupils to design a new invasion game. Data were collected

343 using a reflective log and interviews. The authors reported use of the technology

344 asynchronously (24/7 classroom) and an extended learning community beyond the classroom.

345 The authors make the case for a 'higher quality learning experience' suggested by increased

346 engagement provided by the technology and student ownership of the task.

347 *Blogs*

348 In a similar vein to the coaching literature, gains in learning have been reported through using

349 blogs in the wider educational context, particularly linked to learner writing, peer-to-peer

350 learning/ peer interaction, and critical thinking – these conclusions however have to be treated

351 tentatively because of research designs based on single cases and a lack of pre-intervention

352 data (cf. Hew & Cheung, 2013). Hence it is not always clear if learning gains can be attributed

353 to blogs alone, as blogs are often scaffolded with additional guidance and support. For example,

354 Olofsson, Lindberg and Huage (2013) observed that it was difficult to assess the impact of

355 blogs as a singular approach when it was part of podcasted lectures, course readings and other

356 learning resources. Furthermore, Fakude (2014) observed that in implementing blogs as a

357 reflective and collaborative tool with student nurses, while initially useful as a platform for

358 sharing reflections, not all participants were comfortable using the technology and its use was

359 impaired by limited engagement.

Social Media

Social media have been used for a range of activities, these include discussions and question and answer, sharing materials, providing support, and organising groups. In their review Hew and Cheung (2013) suggest social media can assist in developing conversations between educators and learners and between learners. So far, no research has been able to link changes in learners or learning to the use of social media specifically as opposed to the increased engagement with tutors through, for example course design. In a sport related study, Goodyear, Casey and Kirk (2014a) looked at the interactions between five physical educators and a facilitator over a two-year period. The authors investigated social media as a means for a facilitator to support multiple teachers in a virtual location overcoming issues of time and cost. The researchers used social media to support in-school activity, and the authors claim this use became a form of inter- and intra-professional reinforcement leading to the development of professional learning and supporting pedagogical change. As with the wider literature, the research design means that causality is difficult to establish, that is, not the technology alone but the level of support could be responsible for the positive findings.

VLE/MOOC

Massive, open online courses is positioned in the wider educational field as difficult to tell if they "constitute a revolution in higher education or just a fad" (Steffens, 2015, p. 52). Kartensi's (2013) review considered 100 studies on the use of MOOCs and found that the advantages of MOOCs are associated with traditional distance learning (e.g. increased accessibility of course material, asynchronous access, access materials multiple times, self-paced), that success rates among MOOC participants is in general low, assessment and links to certification are problematic, and it is difficult to ensure learning support, requiring learners to be highly autonomous. Flavin (2016) suggests that MOOCs are most suitable for those with a grounding in the subject with up to 85% of participants already having a degree – while specifically targeted MOOCs compromises the openness aspect of MOOCs. Democratising access to resources is not the same as access to education (Flavin, 2016). The MOOCs may be useful to support CPD where the outcome of learning adds value to existing professional practice – thus limiting the openness to organisational contexts.

Web 2.0 and Blended Approaches

390 Papasterigiou & Gerodimos (2013) used a web-based multimedia course to teach PE teachers
391 to teach basketball. A blended learning approach using the web-based course in combination
392 with face-to-face instruction was significantly more effective than conventional face-to-face
393 alone. Russell *et al.* (2014) implemented a blended online 'physical activity and wellness'
394 course to replace a previously delivered 'face-to-face' programme. The authors reported
395 positive effects associated with distance learning, that is increased accessibility of course
396 material and asynchronous access, students able to access materials multiple times and for
397 students to be self-paced through the programme. Szabo & Schwartz (2011) blended on-line
398 discussion forums into a 'traditional' face-to-face delivery and reported that this developed
399 learner's critical thinking skills and improved the quality of written reflections. The authors
400 suggesting that on-line tasks need to be purposeful and connected – intervention from the
401 instructor is required, modelling comments, asking higher order questions and prompting
402 learners to sharer reflections and experiences.

403 Kori *et al.* (2014) reviewed thirty-three articles that considered blended technology
404 supporting reflection in teachers described as 'technology-enhanced learning'. The authors
405 considered 'technical tools', some kind of instrument that supported reflection, with the tools
406 identified as video, blogs and e-portfolios. Video was used to situate learning, develop habits
407 of reflection and develop self-awareness – which aligns with the reported work in coaching.
408 For example, Walters *et al.* (2015) used a qualitative case study to examine how a learner-
409 generated video assessment developed critical thinking and engagement with theoretical
410 concepts, interview data along with improved grades suggested this was the case. However,
411 the authors pointed out importantly that the alignment of learning strategies and assessment
412 methods were the drivers for learning 'transformation' rather than the technology alone. In a
413 different sport related study, Goodyear, Casey and Kirk (2014b) used a co-operative learning
414 model with video to teach an eight-lesson basketball unit to adolescent girls 'disengaged' from
415 physical education. The findings suggested that the use of technology supported the learning
416 design and an opportunity for participants not to engage in the physical aspect of learning the
417 sport – the authors suggesting that partial engagement has the potential to provide a gateway
418 to full participation. Similarly, Casey and Jones (2011) used video for eight weeks with a class
419 of year seven mixed gender students identified as 'disengaged/underachieving'. The video was
420 used with the primary purpose of increasing engagement. The authors reported that the use of

421 video provided a support to the learning environment and a support for discussion and
422 engagement with disaffected students.

423   Kori *et al.*'s (2014) review showed that added predefined guidance and tutor interaction
424 increases effectiveness of the use of technology. The authors identified prompts, guiding
425 questions, and predefined guidance as giving structure and setting limits to learning – while
426 giving depth to critical thinking, helping cement new knowledge and support learning
427 activities. Human interaction took the form of interaction with peers, tutors or mentors.
428 However, most of the research evidence supporting this approach – as with the coaching
429 research – is derived from self-report or participant perceptions. Research that has compared,
430 for example, online blogging with peer comments to traditional essay writing with small group
431 discussion has found no significant difference in student learning. Therefore, technical support
432 alone may not be effective in supporting learning and predefined guidance and human
433 interaction is needed. However, such was the variability of findings there is no conclusion
434 about what type of support works best (Kori *et al.*, 2014). As Lu and Churchill (2014) pointed
435 out, increased social interaction afforded by a social networking environment can be short
436 lived, individual-centred and casual. These authors state that for enhancement to take place
437 there is a need to prescribe learning tasks that show examples of good practice, including
438 authentic tasks, and rewarding good efforts. The authors also argue that a blended approach
439 through multi-channel social interactions support diverse media preferences. The results
440 reported in the literature further highlights the need to consider the wider pedagogical scaffold
441 in which technology fulfils an integral function; that is the interaction between the learner, the
442 learning environment and the intended learning outcomes and the potential role of technology
443 in facilitating these. In addition, while some empirical data are presented some research only
444 presents argumentative discussions that lack empirical support or evidence.

445 **Discussion**

446 This review of literature has identified a number of issues that warrant closer scrutiny.
447 Specifically, these relate to methodological, conceptual and practical issues related to TEL in
448 coaching. The review demonstrates clearly that "educational technology is not a homogenous
449 'intervention' but a broad variety of modalities, tools and strategies for learning" (Ross,
450 Morrison & Lowther, 2010, p. 19) that is often used in a 'mixed' or 'blended' fashion.
451 Therefore, this next section of the review considers the ways in which TEL is conceptualised,

452   different forms of evidence used to substantiate claims about TEL, and practical issues related

453   to implementing TEL in coaching.

454   *Methodological Issues*

455   The lack of a structured research agenda and longitudinal methodologies means that there

456   remains a scarcity of published work in coaching that links evidence of the application of

457   technologies to enhancements in learning. As a result, observed outcomes can be attributed to

458   a 'novelty effect' where participants react positively to any new intervention regardless of its

459   merit (cf. Hew & Cheung, 2013), an issue identified in research in sport (Casey, Goodyear &

460   Armour, 2016). The question of how 'improvement' is measured and defined also remains,

461   with authors commonly identifying deeper and critical thinking and peer interaction as

462   outcomes equated with learning (e.g. Mendenhall & Johnson 2010; Lu & Churchill, 2014), an

463   approach similarly reported in the coaching literature. Indeed, very few studies in the sport,

464   coaching or wider educational literature attempted to explain changes in *learning* as a result of

465   a TEL intervention, with much of the focus on improving peer-to-peer and tutor interaction

466   and learner 'engagement' and 'learning' assumed to be a by-product or proxy of these

467   outcomes. The absence of empirical research that tracks learning through sustained exposure

468   to TEL environments is clear and provides stimulus for further research.

469   As a result, research designs are often reflective of a deterministic expectation that

470   technology by itself will bring about changes in learning and practice (cf. Kirkwood & Price,

471   2014). Across the coaching literature (and the wider educational field) much literature has been

472   essentially descriptive and promotive (Hastie *et al.*, 2010) with most articles simply reporting

473   the utility of using technology, with examples of contexts and suggestions for use. Increased

474   flexibility for learners supports operational goals and does not inform about learning, but can

475   be taken as a proxy for learning by participants (Kirkwood & Price, 2013). The relatively

476   modest body of work in coaching attempted to highlight how technology was used, what

477   activities were most valuable, and what advantages/disadvantages the technology presented for

478   the learners' experience, or attitudes toward a particular technology. While useful, these

479   outcomes do not demonstrate that technology has enhanced or contributed to 'learning' as the

480   studies typically rely on self-reports of perceptions and attitudes by tutors and students.

481   Determining perceptions can provide useful information in terms of the value and interest of

482   technology in the design, implementation or operational improvement of pedagogical

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483 environments. However, when considering participant 'learning' the research has so far failed

484 to demonstrate evidence of participants' changes in knowledge as a result of technology

485 integration. The underlying assumption in much of the research is that expressions of attitudes

486 can be equated with learner enhancement – however on a closer inspection it is "inappropriate

487 to conflate attitudes with learner development" (Kirkwood & Price, 2013, p. 542) – making

488 judgements about effectiveness difficult.

489   A common research approach in education involves comparing the outcomes from

490 teaching one group using technology with those of a non-intervention group or 'control' who

491 are taught with more conventional means such as classroom instruction (Kirkwood & Price,

492 2013). However, the coaching literature often relies on 'single group' research designs, where

493 reported changes in learning are not necessarily due to the manipulation of the technology,

494 hence increasing the difficulty of attributing changes to the intervention. True experimental

495 comparisons however, are not easily achievable in coach education settings and results in

496 quasi-experimental approaches being adopted where the pedagogy is not just technologically-

497 enhanced but the nature of the intervention supplements or changes the mode of teaching.

498 Causality is then difficult to attribute if variables are not held constant – when additional or

499 supplementary resources or tools are provided any enhancement observed might simply be

500 attributable to the additional inputs or time spent on task rather than the technology being the

501 mediating factor (Kirkwood & Price, 2014). Moreover, learning has a temporal nature, in that

502 deeper or richer understanding, for example, may not present itself until sometime after the

503 intervention. Therefore, perspectives regarding evidence are not just methodological. They also

504 encompass different views about learning, where this may be characterised as qualitative

505 changes in development relative to the individual, or quantitatively in terms of 'exit

506 behaviours' that are the same for everyone. Therefore, concepts of evidence are linked to

507 fundamental beliefs about coaching and learning and what constitutes evidence (Price &

508 Kirkwood, 2014).

509 *Conceptual Issues*

510 Casey *et al.* (2016) suggest that few educators are able to incorporate technology into the

511 pedagogical context in purposeful ways, which means that in coaching, technology mediated

512 teaching and/or learning is not a mainstream practice. Part of the problem is the lack of clarity

513 around what is meant by 'technology' and is often taken to focus on the role of technology as

514 a supportive mechanism for already-existing educational activities (Bayne, 2015; Flavin,

515 2016). As Bayne (2015) suggests, technological variety and multiplicity are 'black-boxed' and
516 separated from the social context and not understood as social objects – and the underlying
517 assumptions are simplistic and 'common-sense'. The assumption in much of the existing
518 literature is that technology can enhance pre-existing objectives (a perspective characterised
519 by instrumentalism), and learning can be transformed by the immanent pedagogical value of
520 technology simply by using them. There is, therefore, an inherent conservatism in the discourse
521 where enhancement assumes the efficacy of the pre-existing pedagogical practices which are
522 not in need of radical shift or displacement but can simply be made better by the application of
523 technology (Bayne, 2015) – there is a danger in coaching that technology could be used as a
524 substitute for poor coach education practice – that is, 'doing things better, rather than doing
525 better things' (cf. Kirkwood & Price, 2014). Rather than reconstruct educational programmes,
526 the assumption is improvement and consolidation via the utilisation of technology (Bayne,
527 2015). This means that applying technology uncritically within established pedagogical models
528 is problematic because the technology gets manipulated to suit existing pedagogy and is
529 subsumed within an existing pedagogical model (Flavin, 2016). Therefore, there is a gap
530 between the features of technology and the use of technology – with the technology offering a
531 more efficient method but is ultimately static in developing learning as existing pedagogies are
532 relocated to the technology.

533   Another conceptual issue with the use of technology to enhance coach learning is the
534 difficulty with generalising findings across contexts. Thus, while interventions often focus on
535 the specific application of a technology, details of the teaching and learning interactions, and
536 the social context in which it is situated, are required to understand the context of
537 implementation. In addition, the term 'enhanced', while widely used, is frequently used in an
538 unconsidered and unreflective way with its meaning taken for granted. Therefore, there is a
539 need to avoid the tendency to 'glorify' the capacity of technology to impact learning,
540 conceiving technology as a 'super tool' (Casey *et al.*, 2016; Price & Kirkwood, 2014).
541 Moreover, the impact on learning will be dependent on how learning is conceived and
542 understood. Decisions about when to use technology, what technology to use and for what
543 purposes cannot be separated from theories and research on learning, instruction, and
544 assessment (Lawless & Pelligrino, 2007). Technology is only as good as "the pedagogical
545 methods it employs" (Ferster, 2014, p.176).

546 *Practical Issues*

547 Although most TEL applied to coaching projects are relatively small-scale and context-
548 specific, the cumulative lessons learned can provide a useful indication of the benefits of
549 integrating technological tools and resources into coach education and development contexts.
550 From the review, practical benefits of TEL were identified as a means of supporting
551 collaborative learning and peer-support across large cohorts, as technology can enhance
552 communication, knowledge and resource sharing, and engagement in learning environments.
553 Indeed, the addition of technology provides opportunities for flexible, diverse and interactive
554 approaches to assessment, and can be conceptualised as 'learner-centred' in that learners can
555 self-regulate the management of learning activities through asynchronous and flexible access
556 to learning materials (Keppell, Suddaby & Hard, 2015; Lu & Churchill, 2014).

557 However, it must be noted also that technology integration can present a number of
558 practical and logistical challenges. Casey *et al.* (2016) argue that while there is a generation of
559 active users and consumers of technology, some educators are resistant and struggle to integrate
560 technology in pedagogically sound or innovative ways. For example, there are specific costs
561 to using technology: site licence, administration, technical support, hardware, technology
562 infrastructure, course development, tutor and learner training. The time and effort to overcome
563 possible resistance to new technology and procedures is also a cost factor (Flavin, 2016). In
564 addition, there is limited research to support the notion of a 'digital native' with the picture
565 more nuanced depending on confidence and whether a passive or active user of technologies –
566 use of technology in learning when not specifically structured is logistical rather than
567 participatory (Flavin, 2016). Research evidence also suggests learners, while enthusiastic users
568 of some technologies (e.g. social media), would not be in favour of these as a teaching tool –
569 suggesting learners practice demarcation in the use of technology (Bayne, 2016).

570 **Conclusions**

571 Technology-enhanced learning environments afford opportunities to expand our existing
572 models of coach development, but, do not impose the explicit conditions for learning (cf.
573 Hannafin & Land, 1997). Technology can be used to compliment traditional learning
574 environments by providing parallel synchronous and asynchronous learning spaces (de Andres
575 Martinez, 2012). Importantly, effects on 'learning' are not necessarily related to the
576 technologies themselves but how the technologies are used, as "technologies are not a silver
577 bullet and will not independently or autonomously improve learning performance" (Hew &
578 Cheung, 2013, p.58). Thus, when considering the use of technology in coach education,

579 pedagogical and instructional strategies need to be developed alongside technologies as

580 pedagogical design is the major factor impacting learning in a TEL environment, including

581 how both tutors and learners are required to adjust to TEL environments compared to

582 traditional 'classroom delivery' (Hsu *et al.*, 2012).

583 In technology-enhanced learning environments, the processes associated with

584 understanding and the contexts in which it occurs are linked. They emphasize not only

585 assimilation but the development of meta-knowledge for both solving existing problems and

586 generating new ones. Through experience, learners become increasingly facile with available

587 tools and resources, and skilled in assessing how and when to employ them (Hannafin & Land,

588 1997). An effective learning environment encourages learners to use its resources and tools to

589 derive problems, vary solutions, and "expand the boundaries of their understanding" (Hannafin

590 & Land, 1997, p. 187), the review suggests that there needs to be a clear alignment in the

591 pedagogical environment between the learners, the learning outcomes and the modes of

592 technological transmission utilised to achieve these. Technology-enhanced environments often

593 provide the conceptual scaffolding and means (e.g. platforms, resources and tools) to promote

594 personal and individual reflection. In this sense technology should be thought of as an enabling

595 tool to promote learning (Hannafin & Land, 1997). However, facilitating coach learning

596 remains a complicated practice that requires the interweaving of many kinds of specialised

597 knowledge. In their application to coach development, TEL can potentially provide interactive

598 environments that enable individuals to address unique learning interests and needs, study

599 multiple levels of complexity, and deepen understanding (Hannafin & Land, 1997).

600 Furthermore, it is suggested that the use of TEL establishes the conditions that "enrich thinking

601 and learning, and use technology to enable flexible methods through which the processes can

602 be supported" (Hannafin & Land, 1997, p. 168). However, the evidence base that supports this

603 in coaching is currently fragmented and weak. Consequently, apart from isolated studies,

604 comparatively little understanding of the role, function and impact of technology in the design

605 of coaching specific learning environments has evolved.

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