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3

Abstract

4 Assessment of physical literacy poses a dilemma of what instrument to use. There is
5 currently no guide regarding the suitability of common assessment approaches. The purpose
6 of this brief communication is to provide a user's guide for selecting physical literacy
7 assessment instruments appropriate for use in school physical education and sport settings.
8 While recommendations regarding specific instruments are not provided, the guide offers
9 information about key attributes and considerations for the use. A decision flow chart has
10 been developed to assist teachers and affiliated school practitioners to select appropriate
11 methods of assessing physical literacy. School PE and sport scenarios are presented to
12 illustrate this process. It is important that practitioners are empowered to select the most
13 appropriate instrument/s to suit their needs.

14

15

Introduction

16 There is growing international interest in the concept of physical literacy because of the
17 claimed benefits to physical (Gately, 2010; Tremblay, 2012; Tremblay & Lloyd, 2010),
18 behavioral, psychological, and social outcomes for young people (Edwards, Bryant, Keegan,
19 Morgan, & Jones, 2017). Assessment of physical literacy is now becoming important to
20 address (Tremblay & Lloyd, 2010), but to date, this has proven difficult because numerous
21 agencies have sought to define the construct of physical literacy in different ways (Dudley,
22 Cairney, Wainwright, Kriellaars, & Mitchell, 2017; Shearer et al., 2018). A recent review by
23 Edwards et al. (2017) recommended that researchers declare their philosophical approach
24 and their definition of physical literacy before adopting any measurement approach. The
25 purpose of this paper is to provide physical educators a guide to assessing physical literacy
26 using the Australian Sports' Commission's approach to defining physical literacy (Keegan,

27 Barnett, & Dudley, 2017). As such we first briefly cover the Australian definition of physical
28 literacy, developed in 2016-2017.

29 **Australian Definition of Physical Literacy**

30 A detailed articulation of the Delphi research project undertaken in this process can be
31 found in this special issue (Keegan et al., 2019). In this process, four defining statements
32 were proposed, as follows: *Core* - Physical literacy is lifelong holistic learning acquired and
33 applied in movement and physical activity contexts; *Composition* - It reflects ongoing
34 changes integrating physical, psychological, cognitive, and social capabilities; *Importance* - It
35 is vital in helping us lead healthy and fulfilling lives through movement and physical activity;
36 and *Aspiration* - A physically literate person is able to draw on their integrated physical,
37 psychological, cognitive, and social capacities to support health promoting and fulfilling
38 movement and physical activity, relative to their situation and context, throughout the
39 lifespan. As such, this approach implies that the concepts of learning and movement,
40 lifespan, and holistic perspective are the critical attributes (Arends & Kilcher, 2010).

41 The defining statements led to the need to assess the physical, psychological, cognitive
42 and social learning domains. Within the same Delphi study (Keegan et al., 2019), these
43 broad learning domains were operationalized into measurable and discrete elements, drawing
44 a metaphor from the way that chemical elements can combine to form more complex
45 compounds and mixtures. To support this model, we required a learning taxonomy that was
46 capable of application across all four learning domains (and elements). The authors
47 identified the Structure of Observed Learning Outcomes (SOLO) taxonomy (Biggs & Collis,
48 1982) as highly relevant and it was adopted by the expert panel as it had already shown
49 efficacy in the assessment of learning within physical education (PE) (Dudley, Goodyear, &
50 Baxter, 2016). Put simply, the SOLO taxonomy classifies learning progression complexities
51 regardless of context. At first, an individual learns one aspect of any given task
52 (unistructural), then several aspects but unrelated (multistructural). Next, students learn how

53 to integrate them into a whole (relational), and finally they learn to generalize that whole to
54 as yet untaught applications (extended abstract; Biggs & Collis, 1982). Thirty-two elements
55 of physical literacy were identified by the ASC project (Keegan et al., 2017) that could be
56 explained in terms of SOLO progressions, under each of the four discrete learning domains
57 (see Figure 1).

58 ****INSERT FIGURE 1: Model of physical literacy construction****

59 **Deciding on an Assessment Approach to Physical Literacy**

60 A recent systematic review documented that, in every existing assessment approach to
61 the measurement of physical literacy, decisions had been made to prioritize the measurement
62 of certain elements according to the purpose of the assessments, and the areas of physical
63 literacy which were of most interest to the user (Edwards et al., 2018). Green, Roberts,
64 Sheehan, and Keegan (2018) highlighted the challenging nature of the task to produce one
65 form of monitoring that clearly meets all elements of the physical literacy concept.
66 Considered separately, many of the elements within each domain of the ASC model are well-
67 documented in terms of measurement options (Keegan et al., 2017). It is beyond the scope of
68 this brief report to review all of the potential assessments that could align with each domain
69 of physical literacy. Essentially, there are many suitable options for measuring the learning
70 domains and combinations of elements of physical literacy. Nevertheless, when deciding
71 which assessment method to use, and why, teachers and researchers are offered little
72 guidance on which assessments to use, and how (or whether) they can be reconciled against
73 physical literacy.

74 In the remaining part of this paper, we present a decision-making guide for the
75 assessment of physical literacy (in this case, using the Australian definition) specific to the
76 context of school physical education (PE). The intention is to outline key considerations that
77 will help when deciding what assessment approach to use. Similarly, previous guides to
78 assessment of physical activity (Dollman et al., 2009) and sedentary behavior (Hardy et al.,

79 2013) in children and young people were not to provide recommendations of specific
80 instruments to use when assessing physical activity and/or sedentary behavior, but rather to
81 guide users to select the most appropriate method for their intended purpose. We note that
82 almost all assessment and measurement techniques used by practitioners can be viewed
83 simultaneously as reflecting important elements of physical literacy, while also not
84 adequately capturing the entirety of the concept. Rather than dismissing all existing measures
85 in response to the latter concern, our proposed approach encourages PE teachers to reflect on,
86 position, and evaluate their measurement approaches, in relation to physical literacy. Rather
87 than asking, ‘does this measure adequately quantify physical literacy’, we ask: ‘how can each
88 measurement approach be reconciled with, and useful within, a physical literacy approach?’.

89 Having a measure of physical literacy that is viewed as reliable, valid, and trustworthy
90 for any specific population is clearly important. Nevertheless, even if the measure is based
91 on the best available scientific reliability and validity evidence, there are always further
92 considerations that can and should be made. Such further considerations, according to
93 Dollman et al. (2009) and Hardy et al. (2013), include aspects such as the purpose of the
94 data collection and the age of the population in question. As such, there is no ‘perfect’
95 measure, but rather the most reliable (i.e., consistent) and valid (i.e.,
96 interpretable/understandable) measure that circumstances and resources allow.

97 In the subsequent section, we provide three scenarios that are relevant to the context
98 of PE. Tremblay and Lloyd (2010, p. 26) have advocated the:

99 ...comprehensive and objective measurement of physical literacy as a means to
100 elevate the importance of physical education, increase the robustness of physical
101 education assessment, improve monitoring and evaluation of physical education
102 curricula, and provide important surveillance evidence needed to assist with resource
103 allocation by decision-makers.

104 Indeed, PE may be considered as an important means of developing physical literacy.
105 The main purpose of the three example scenarios is to illustrate a decision-making process,
106 therefore what we have provided in these sections should not be considered exhaustive, but
107 rather a starting point for those interested in the content area. Each example scenario is
108 structured with nine decision-making steps. These steps were developed from those in
109 previous guides (Dollman et al., 2009; Hardy et al., 2013), but adapted to the Australian
110 definition of physical literacy.

111 **Scenario 1**

112 *A secondary school PE teacher has identified motivation issues within the*
113 *basketball unit of instruction.*

114 Motivation, in terms of the scenario presented, can be seen as an integration of the
115 psychological and cognitive dimensions. The psychological domain relates to moods,
116 feelings, and attitudes. The cognitive domain covers conscious and unconscious knowledge
117 and understanding, including problem-solving and decision-making, awareness of rules and
118 tactics, appreciation of healthy and active lifestyles, and processing of feedback and
119 reflection. The nine steps provided below are reflected in Figure 2.

120 **Step 1.** Identify the *elements of importance* under the psychological (i.e., motivation)
121 and cognitive (i.e., purpose and reasoning) domains.

122 **Step 2.** Identify the teacher's *interest* in this scenario. For example, the teacher may
123 highlight *engagement and effort during training* as being of particular concern based on
124 her/his observations of some of the student's effort and compliance with instructions.

125 **Step 3.** Identify the *context* for this scenario, which in this case is *flat land-based*.

126 **Step 4.** Identify the *purpose*. In this scenario, the teacher is concerned with some
127 students in class who appear to have lost their motivation for training. Thus, it can be
128 considered as an individual/clinical/school/class assessment.

129 **Step 5.** Identify the *target age/developmental group* of the class, which in this case is
130 adolescent.

131 **Step 6.** Identify the *SOLO level* of interest. In this scenario, we are interested in
132 moving the students from multi-structural to relational, or perhaps the extended abstract
133 category.

134 **Step 7.** Identify the most suitable *method* (measurement/assessment) available. For
135 example, motivation cannot be directly measured, but must be either inferred from behavior
136 or evaluated using questionnaires, surveys, or interviews, each of which can be subdivided
137 into quantitative (e.g., rating scales, psychometric validation) or qualitative approaches
138 (descriptions of behavior, feelings, attitudes, and thoughts through observational analyses).
139 In this case, we may have a reflective, less authoritarian, teacher who is interested in the
140 students' perceptions. The teacher then must consider whether the students should write in a
141 diary or log, be interviewed one-on-one, or complete a questionnaire. A diary or log may be
142 more appropriate if the teacher wants to gain a general idea of motivation over time. If there
143 is access to a research group and resources, a written survey option might be appropriate.
144 The Sport Motivation Scale (SMS; Pelletier et al., 1995) was validated in athletes with a
145 mean age of 18. The scale is based on Self-determination Theory (Deci & Ryan, 1985) and
146 assesses contextual intrinsic and extrinsic motivation as well as amotivation in relation to
147 sport. This is an important distinction when it comes to assessing motivation. For example,
148 more extrinsic motivation may be a bad thing, so when it comes to motivation more is not
149 necessarily better. Such a questionnaire would fit with the interest of the teacher in relation
150 to a specific task or activity within the understanding that motivation can differ towards
151 different activities/pursuits, however, the scoring and interpretation of the responses may still
152 require careful interpretation.

153 **Step 8.** Consider that the *number* of the participants (class) is feasible with the
154 method chosen.

180 **Step 2.** Identify the teacher’s *interest* in this scenario. The teachers are interested in
181 how competent students think they are in catching and throwing.

182 **Step 3.** Identify the *context*, which in this case is *flat land-based*.

183 **Step 4.** Identify the *purpose* of the assessment. For this example, the teacher is
184 interested in whether the girls improve their perceptions of object manipulation competence.
185 Thus, it can be considered for the purpose of understanding a small group of learners during a
186 lesson.

187 **Step 5.** Identify the *target age/developmental group* for this scenario, which is primary
188 aged school children.

189 **Step 6.** Identify the *SOLO level* that is suitable for this scenario. In this case,
190 understanding which of the girls are at the unistructural level, versus those who are not, is
191 important.

192 **Step 7.** Identify the *method* (measurement/assessment) that is most suitable. As it is
193 not possible to assess self-perception objectively, the ‘subjective’ box is highlighted. The
194 next decision is to consider whether the girls should use a diary or log, be interviewed one-
195 on-one, or complete a survey. Considering the age of the children and the likely literacy level
196 (Harter & Pike, 1984) the teacher highlights ‘interview’ and then ‘pictorial.’

197 **Step 8.** Consider that the *number of participants* is feasible with the method chosen.
198 In this case, brief interviews with approximately half of the class of children would appear to
199 be an acceptable time commitment.

200 **Step 9.** Consider the *cost*. For this scenario, the cost is higher than in the previous
201 scenario, as time to interview the primary-aged children needs to be considered as opposed to
202 a method where the children complete their own survey. These questions encourage us to
203 reconsider our earlier decisions, but for this example, the chosen methods are feasible. This
204 leads us to a potential pictorial instrument (Barnett et al., 2016), which measures object
205 control perception.

206 **Scenario 3**

207 *A high school physical education teacher wants students to develop a greater game*
208 *understanding specific to an invasion game (cognitive domain).* Invasion sports such as
209 basketball, netball, soccer, handball, and water polo are those where the main objective is to
210 maintain possession in order to specifically penetrate an opposition's territory and score
211 (Bunker & Thorpe, 1982). In this third scenario, now that the process has already been
212 presented twice, no figure is provided, nor are separate step headings presented. The learning
213 domain in this scenario is mainly cognitive but as the teacher will be looking for visible
214 manifestations of the students' ability to apply tactical cognitive skills in conjunction with
215 their physical skills, the physical learning domain is relevant as well.

216 The *elements* of importance are tactics (cognitive domain), and flat land-based
217 movement and object manipulation (both part of the physical domain). When combined into
218 a compound representation, we are looking to characterize: (a) tactics-movement (e.g.,
219 finding space, losing defenders, or marking attackers); (b) tactics-object manipulation (e.g.,
220 moving the ball into space, changing the focus of attack, or containing an opposition's
221 attack); (c) movement-manipulation (e.g., running with the ball or kicking/throwing the ball
222 while moving); and (d) the combination of all three (e.g., using movement of the self and the
223 ball to manipulate the opposing defense, or reacting to the opposition's play with a view to
224 preventing them from scoring and winning the ball back). The teacher's *interest* in this
225 movement compound within tactics is the student's ability to read the play and make
226 decisions. The *context* of the measurement/assessment is *land-based* and the *purpose* is at
227 the class level. The age/developmental group is high school, and SOLO level is acquisition
228 and accumulation (see Keegan et al., 2017).

229 The *method* of assessment will be objective and require the teacher to use direct
230 observation measures of each student's performance (or a sample of students within a class)
231 in relation to the complexity of the invasion game providing the context. Given the focus is

232 on the execution of tactical decision-making and not just the performance outcome,
233 prescribed criteria need to be enacted in order to capture the evidence associated with intent
234 of the decisions the students are making. The *number of participants* is not large, average PE
235 class size. Direct observation can be considered higher in *cost* than a survey measure due to
236 the time involvement, but still feasible for a PE teacher.

237 Based on these three scenarios, it is clear that there is not an ‘ideal’ approach to
238 measurement, but rather the instructors are empowered to make informed decisions regarding
239 how to assess physical literacy, and how this assessment might fit into the broader
240 conceptualization of the concept. In these examples we assume that the teachers’ own
241 assessment requirements are more central and meaningful to them than attempting to
242 faithfully measure a complex construct, yet by detailing how their local and highly specific
243 assessment is, in fact, readily reconciled with physical literacy, then their assessment can
244 become contextualised, aligned, and more meaningful in the long-term.

245 **Limitations of this assessment approach**

246 There are assumptions within the Australian definition of physical literacy that might
247 make it challenging for this assessment approach to be used for other definitions. For
248 example, the ASC approach attempted to distinguish between the learning potential (held by
249 everyone) versus the aspiration to become self-regulating and flourish through physical
250 literacy (Keegan et al., 2019). Notably, the Australian framework was novel in invoking the
251 SOLO taxonomy to structure assessment, and the metaphor with elements and compounds to
252 represent diverse movements and attributes. Edwards et al. (2018) discussed broad
253 approaches (idealist and pragmatic) to understanding the concept of physical literacy, which
254 typically affect the assessment approach adopted. From the idealist perspective, physical
255 literacy is holistic (i.e., consisting of interconnecting parts that only make sense as a whole),
256 and therefore the domains of physical literacy should, ideally, not be isolated (Jurbala, 2015).
257 As measurement often entails being able to reduce concepts, measuring the domains of

258 physical literacy separately would be inconsistent with the holistic viewpoint. In contrast, a
259 pragmatic approach maintains that it is important to have measures that link to best practice
260 and evidence. We suggest these two approaches do not need to be mutually exclusive. While
261 acknowledging the holistic nature of physical literacy, we recognize that we may not assess
262 physical literacy in its entirety through measurement of its component elements, and our
263 guidelines encourage teachers to also recognise this constraint. Nonetheless, in so doing we
264 can at least assess the elements, which contribute significantly to physical literacy; the more
265 of these elements in any operational approach to assessment, the more complete the resulting
266 characterization of physical literacy.

267 **Conclusion**

268 Those who are interested in assessing physical literacy need a process to select the
269 methods that best fit their intention, needs, and resources. We have provided a nine-step
270 approach to stimulate thinking about decision making around assessing physical literacy
271 using the Australian definition of physical literacy. In using the Australian definition of
272 physical literacy, we have constructed a measurement model based on measuring
273 combinations of ‘elements,’ which means, to some readers, the approach we have offered
274 permits users to overlook or ignore the holistic nature of physical literacy, as originally
275 proposed. In contrast, however, we proposed this measurement approach - based on
276 acknowledging a wide range of elements - as an option for resolving the apparent tension
277 between idealist-and-pragmatist assessment approaches. Our approach encourages and
278 supports users in considering and incorporating measures pertaining to all four domains:
279 physical, psychological, cognitive, and social. Further, our approach makes it clear that if
280 one chooses to measure an isolated aspect of physical literacy, then important aspects could
281 be being missed, and thus, requires decision-makers to weigh up whether this compromise or
282 loss is necessary/acceptable. To illustrate the process, we used scenarios applicable to
283 teachers. The scenarios demonstrate that deciding on an assessment approach for physical

284 literacy is possible by working through the guided steps. What is essential to consider is the
285 way that these measurement tools are implemented. Thus, the environment, the climate
286 created, and the pedagogy used are future crucial considerations. It is apparent that the data
287 gained by working through these scenarios could theoretically be used as formal assessment
288 for reporting to PE curricular outcomes. It is important to acknowledge though, that our
289 approach might be complex for PE teachers to easily use. If our approach was provided via a
290 website resource with links to common assessments of the different elements of physical
291 literacy, this might make the approach more feasible. Data analysis and synthesis may also
292 be a challenge, but with new data analysis techniques perhaps it is possible to represent
293 physical literacy in nodal ways (borrowing from social network analysis) which could show
294 the growth in a population's physical literacy and the number of interrelated networks that
295 form part of it. Various other modelling approaches exist outside of exclusively looking for
296 linear factors/functions, and we would argue that these are more likely to be suitable for the
297 quantitative and qualitative assessment of physical literacy as these modelling methods
298 become more widespread and accepted within this field.

299 In many countries around the world, policy and assessment standards in health and PE
300 seek to promote healthy, empowered and self-regulating children, more capable of living
301 healthy and fulfilling lives. Implicitly, such policy documents guide against merely
302 emphasising sporting skills and competitive success, but rather using PE and sport to foster
303 healthy habits, skills, and beliefs ranging from safe equipment use to ethics and connection to
304 community. Such aspirations are consistent with the 'aspiration' defining statement of
305 physical literacy in the ASC's approach (Keegan et al., 2017). We contend that assessment
306 of physical literacy is also important beyond school PE, and should be considered in the
307 broader education, sporting, recreation, and health contexts. Appropriate evaluation of
308 physical literacy will facilitate investigation into physical literacy levels, into whether
309 cultures or subgroups in the population differ in their physical literacy levels, and most

310 importantly, if they do, what can be done to address inequities. This is an ambitious
311 undertaking and raises new challenges such as how data can be collected, collated, and
312 shared.

313 FIGURE 1: Model of physical literacy construction

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316 FIGURE 2: Scenario 1 – Psychological and Cognitive

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318 FIGURE 3: Scenario 2: Physical and Psychological

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