The Sport Concussion Education Project. A brief report on an educational initiative: from concept to curriculum

Special article

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Current research on concussion is primarily focused on injury identification and treatment. Prevention initiatives are, however, important for reducing the incidence of brain injury. This report examines the development and implementation of an interactive electronic teaching program (an e-module) that is designed specifically for concussion education within an adolescent population. This learning tool and the accompanying consolidation rubric demonstrate that significant engagement occurs in addition to the knowledge gained among participants when it is used in a school curriculum setting.

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Key Words • concussion • mild traumatic brain injury • education • student • youth athlete

Athletic and recreational concussions are a significant health concern among young people, owing to the developmental vulnerability of this population. The Centers for Disease Control and Prevention (CDC) estimate that approximately 1.7 million traumatic brain injuries (TBIs) occur per year, of which the majority are classified as minor TBI (mTBI) or concussion, and that these injuries occur predominantly among children and adolescents.16 The number of secondary school athletes who are diagnosed with sport-related concussions is rising—current estimates suggest that more than half of young athletes will experience some type of concussive injury before graduating from secondary school.21,22 This increased prevalence is likely due to a combination of increased injury reporting and higher rates of injury that result from more highly conditioned, hard-hitting athletes participating in full-contact practices and games.2,21 Insufficient concussion identification and treatment and the significant long-term health and social implications of concussion have been well documented in the literature.8,9,22-24,28,30,31

Despite improved public awareness of this injury, identified in a CDC report to the US Congress in 2002 as an important health problem and referred to as “the silent epidemic,”22 prevention and treatment guidelines have met with considerable resistance among adults (e.g., parents, coaches, and administrators) who are responsible for providing young athletes with a safe and positive sporting environment.5,11,12 This resistance appears to result from 3

Abbreviations used in this paper: CDC = Centers for Disease Control and Prevention; HCEP = Hockey Concussion Education Project; TBI = traumatic brain injury.

This article contains some figures that are displayed in color online but in black-and-white in the print edition.
factors: 1) lack of correct standardized concussion knowledge; 2) inaccurate incidence reporting; and 3) prioritizing winning athletic contests over injury prevention.

Children and adolescents do not reliably recognize their own concussion symptoms, or those of others. Similarly, children and youth are unlikely to report having sustained a potential head injury even with symptoms of headache, dizziness, or amnesia. Youth may also be hesitant to report concussive symptoms because they do not know what they may mean, or because of concern about how these reports will be received by their coach. Evidence, in fact, indicates that concussion education increases the likelihood that secondary school athletes will notify their coach of concussion symptoms.

The foregoing illustrates that concussion education (on prevention, accurate recognition, and appropriate treatment) is an essential component of concussion management. Public education is a significant conduit for informing the next generation of athletes, coaches, and parents concerning this serious problem, and concussion education has had moderate success in increasing knowledge and awareness. The current literature suggests that there is some evidence supporting the use of interactive computer programs, such as e-modules, for concussion education purposes. In the present study, we further analyze the use of e-modules as education tools for students.

Project Development

E-Module

An e-module is a series of student familiar scenarios, presented in an electronic form, that are both age and language appropriate. For this project, each scenario contains multiple learning concepts concerning concussion injury. Students are asked to both listen to and watch the scenario either individually or in a group environment and then to answer questions concerning the learning points stressed in that particular scenario. After a student has answered the question set, the correct answers are given, followed by a brief explanation and reinforcement of the concepts covered.

Our current e-module has evolved over several iterations within the Hockey Concussion Education Project (HCEP) and is freely accessible to the public and educational institutions at www.sportconcussionlibrary.com. The purpose of the e-module is to provide an interactive learning platform for improving concussion knowledge, based on the most recent information concerning concussion from the Consensus Statement on Concussion in Sport: The 4th International Conference on Concussion in Sport, held in Zurich, November 2012 (2012 Zurich Consensus Statement).

2010 E-Module Versus DVD Study

In 2010, a group of randomly selected junior-level hockey players were exposed to the first version of the interactive e-module and were compared with an equal number of individuals within the study group who were exposed to a DVD (a passive versus an interactive experience) containing similar information, and a control group of participants who were not exposed to either the e-module or the DVD.

Findings showed that both forms of intervention produced a positive and sustainable improvement that approached statistical significance compared with the results of knowledge testing in the control group. The control group demonstrated a longitudinal negative nonsignificant trend with respect to concussion knowledge retention. The complete methodology and results of this HCEP 2009–2010 education pilot project have been previously reported.

2013 Secondary School Pilot of E-Module

The most recent concussion project sampled Grade 9 students from a sampling frame of 4 Ontario secondary schools (358 students, 13–14 years old). The current version of the e-module was further developed, appropriately modified, and incorporated into the health and physical education course within these secondary schools. This resulted in a response rate for the study of 83.5%. All participants completed a baseline concussion knowledge test, and a crossover design was then used to assess the knowledge gain resulting from exposure to the e-module. The amount of knowledge gained was significantly greater among participants who were exposed to the e-module before follow-up testing (95% CI 4.44%–7.56%) than among participants who were exposed to the e-module after follow-up testing (95% CI 0.39%–3.43%). The complete methodology, statistical analysis, and results are presented in the Appendix and Table 1.

Although the knowledge gains were small within this early validation study (possibly due to ceiling effects on the concussion knowledge test), this study suggested that e-modules are an engaging method of content presentation and may provide a foundation for discussion and knowledge consolidation within this topic. Future studies are required to investigate long-term retention of this knowledge as well as qualitative information that includes the impact on attitudes and objectively measured behaviors. The current elementary and secondary school versions of the e-module as well as the learning consolidation rubric will be accessible at www.sportconcussionlibrary.com after publication.

Current E-Module Utilization

After the initial pilot phase, the e-module and the

<table>
<thead>
<tr>
<th>Session &amp; Condition</th>
<th>No. of Participants</th>
<th>Percentage of Correct Answers (mean ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>control</td>
<td>153</td>
<td>82.30% ± 12.75%</td>
</tr>
<tr>
<td>experimental</td>
<td>146</td>
<td>82.55% ± 11.44%</td>
</tr>
<tr>
<td>Session 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>control</td>
<td>153</td>
<td>84.21% ± 12.76%</td>
</tr>
<tr>
<td>experimental</td>
<td>146</td>
<td>88.55% ± 10.19%</td>
</tr>
</tbody>
</table>
curriculum learning consolidation rubric (Fig. 1) are to be revised in response to feedback from practice leaders within the school board, physical education teachers, and Grade 9 and elementary school students. During the 2014–2015 school year, the e-module and a learning consolidation rubric are being implemented across all schools within the Halton District School Board (Ontario, Canada) as part of the Grade 9 physical education programs. Furthermore, modified versions of the e-module have been developed to align with the language level and learning needs of elementary school children (Grade 3 and 6 curriculums, Ontario, Canada), and this version will be piloted in 5 Halton District School Board elementary school safety and personal health programs in the fall of 2014, for wider distribution in the 2014–2015 school year. This strategy reflects the fact that individuals at various

<table>
<thead>
<tr>
<th>Physical Activity Strand</th>
<th>Specific Expectation:</th>
<th>Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Expectation:</td>
<td>• participate regularly in a balanced instructional program that includes a wide variety of enjoyable physical activities that encourage life long participation</td>
<td>• Signs/Symptoms: basic physical, cognitive, emotional</td>
</tr>
<tr>
<td></td>
<td>• demonstrate safe practices regarding the safety of themselves and others</td>
<td>• Prevention</td>
</tr>
<tr>
<td></td>
<td>• identify the factors that affect choices of activities with potential for lifelong participation and enjoyment</td>
<td>- Equipment: Helmet/ mouthguard</td>
</tr>
<tr>
<td></td>
<td>• apply guidelines and procedures related to safe participation in physical activity</td>
<td>- &amp; safe practices</td>
</tr>
<tr>
<td></td>
<td>• demonstrate behaviour that minimizes risk to themselves and others</td>
<td>• Treatment: steps to diagnosis and recovery</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Active Living Strand</th>
<th>Specific Expectations:</th>
<th>Understanding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Expectations:</td>
<td>• identify requirements, including basic equipment, preparation and specific safety issues that maximize performance and participation in recreation and sport activities</td>
<td>• When you know you have a concussion</td>
</tr>
<tr>
<td></td>
<td>• apply guidelines and procedures related to safe participation in physical activity</td>
<td>• Implications of signs &amp; symptoms</td>
</tr>
<tr>
<td></td>
<td>• demonstrate behaviour that minimizes risk to themselves and others</td>
<td>• Short term restrictions and implications e.g., complete rest (no videos/no texting etc.), effect on grades, social activities, social relationships etc.</td>
</tr>
</tbody>
</table>

**Concussion Study – Curriculum Connections and Assessment**

**Fig. 1.** Curriculum learning consolidation rubric. Copyright 2013 Paul S. Echlin. Used with permission. Available for the free use of educational institutions at http://www.sportconcussionlibrary.com/content/hscep-halton-student-concussion-education-program via the link labeled “Curriculum Connections and Assessment.” PA = physical activity.
stages of learning and with different levels of responsibility (e.g., students, athletes, physicians, coaches, and therapists) may require different strategies.1,2,3,4

Discussion

The introduction of concussion information during the critical developmental period spanned by elementary and secondary school correlates with the time that students are introduced to competitive sporting activities and are at significant risk of TBI. A longitudinal educational program that is developed collaboratively with educators is likely to be better received and to provide greater utility than those developed exclusively by external organizations without direct educator consultation.

The present study also found that the e-module education tool developed through this project demonstrated significant engagement during the data collection process, as well as leading to a short-term increase in knowledge acquisition. The development and implementation of a longitudinal consolidation component may improve long-term retention of the information.1

According to current theory, learning requires more than a single, passive provision of isolated knowledge units. Effective learning requires repetition, reassessment, identification of the current barriers, and identification of the most effective learning strategy for the targeted group.2,3,4,7 Thus, early and repeated education concerning concussion (at the elementary and secondary school levels) is one method to further consolidate future behaviors. These educational efforts will be enhanced by leveraging currently available internationally recognized concussion education organizations and their associated programs, as well as appropriate use of emerging on-line tools.3,4,6,7

Although this e-module–based modality of knowledge transfer seems to be effective for Grade 9 students, there is still no evidence as to which teaching modality is most appropriate for delivering concussion education.3,5 Individuals at various stages of learning and with different levels of responsibility (e.g., students, athletes, physicians, coaches, and therapists) may require different strategies.1,2,3,4 Furthermore, concussions are complex functional impairments that impact physical function, psychological and intellectual variables, and social environments.2,3

The provision of knowledge through an e-module–based education program may be only one of many approaches to the larger problem.4 Future research should focus on delving deeper into the complex and critical issues associated with concussions.4 This can be accomplished with the use of various psychological models of behavior change (e.g., Theory of Planned Behavior, Attitude Social Influence Self Efficacy Model, and Health Action Process Approach).3,8

Finally, common misconceptions about concussion and poor adherence to current clinically accepted treatment guidelines (e.g., the 2012 Zurich Consensus Statement) need to be targeted.2,26 Improving educational initiatives is one way of decreasing the incidence of this injury. Increased awareness will be important for early identification of injury, improved documentation of injury, and better monitoring during treatment.
within the sample and obscure the effects of the intervention. Accordingly, before completing an analysis of the results, the difficulty level of each item within the sample was assessed by determining the percentage of correct responses during the first session. Items were excluded from further analysis if more than 85% of participants correctly answered the question. The remaining items were averaged to create a unit-weighted composite knowledge score.

A 2-factor split-plot analysis of variance was then used to evaluate this dependent variable, with condition (experimental vs control) and time (pretest vs posttest) as independent variables. The interaction between condition and time was of primary concern within this study, and the effectiveness of the educational intervention was examined through the use of simple main effects designed to evaluate the change from pretest to posttest within the experimental and control groups.

**Results**

Evaluation of the item difficulty scores for the 25 items on the knowledge test revealed that 13 of the 25 items had difficulty ratings that were less than 0.85 during the first testing session. These 13 items were aggregated in a unit-weighted composite at each time period. Means and standard deviations for scores on the knowledge test are presented in Table 1.

The 2-way interaction of time and condition was statistically significant (F [1,297] = 11.297, p < 0.05). Examination of the simple main effects suggests that the pretest to posttest change was statistically significant for both the treatment and the control groups. This change was, however, significantly greater among participants within the treatment group (95% CI for the difference: 4.44%–7.56%) compared with the control group (95% CI for the difference: 0.39%–3.43%). This suggests that the treatment group demonstrated a significantly greater increase in “concussion knowledge” between the 2 testing sessions than did the control group—and this suggests that the educational intervention was successful.

**Acknowledgments**

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