

Effects of Online Tutor Training Prior to Reciprocal Peer Tutoring in Secondary Physical Education

Ortaöğretim Beden Eğitiminde Karşılıklı Akran Öğretiminden Önce Çevrimiçi Öğretmen Eğitiminin Etkisi

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Abstract: Basic Life Support (BLS) is a sequence of actions that bystanders should perform in case of out-of-hospital cardiac arrest. BLS instruction is embedded in school curricula across Europe in related subjects such as physical education. This study examined whether online tutor training improves student behavior during reciprocal peer teaching of BLS and enhances retention outcomes. In reciprocal peer teaching students work in pairs, alternating between the roles of tutor and tutee. One hundred students (aged 12-13) were cluster-randomized into two groups. One group received an online content knowledge training on BLS (BLS); the other group received an extended version with additional training for effective tutoring behavior (BLS-B). Students were instructed to complete their training at home prior to participating in a 50-minute reciprocal peer teaching session during physical education class, followed by an individual BLS performance assessment one week later. Peer teaching behaviors were captured via video and audio recordings and analyzed using partial interval recording. BLS performance at retention was assessed using a validated protocol. Based on completion of the online training, three groups were analyzed: BLS, BLS with Benchmarks for tutoring (BLS+B), and the untrained group with students who did not complete their assigned online training prior to peer tutoring. During peer tutoring results showed no statistically significant task-related differences for student behavior. However, both trained groups outperformed the untrained group on the retention test. These findings support the use of cost-effective, pre-class online BLS instruction to improve learning outcomes for BLS using reciprocal peer teaching.

Anahtar Kelimeler: Basic Life Support, CPR, Kids Save Lives, Peer-Assisted Learning, Blended Learning

ÖZ: Temel Yaşam Desteği (TYD), hastane dışı kardiyak arrest durumunda çevrede bulunan kişilerin uygulaması gereken bir dizi eylemdir. TYD eğitimi, Avrupa genelinde beden eğitimi gibi ilgili dersler aracılığıyla okul müfredatlarına dahil edilmiştir. Bu çalışma, çevrim içi öğretmen eğitiminin, öğrencilerin TYD konusunda karşılıklı akran öğretimi sırasında davranışlarını iyileştirip iyileştirmediğini ve öğrenmenin kalıcılığını artırıp artırmadığını incelemiştir. Karşılıklı akran öğretiminde öğrenciler ikili gruplar halinde çalışır ve sırayla öğretmen ve öğrenci rollerini üstlenirler. Yüz öğrenci (12-13 yaş arası) küme-randomizasyon yöntemiyle iki gruba ayrılmıştır. Bir grup TYD konusunda çevrim içi içerik bilgisi eğitimi almıştır (TYD); diğer grup ise etkili öğretim davranışları için ek eğitim içeren genişletilmiş bir versiyon almıştır (TYD-B). Öğrenciler, beden eğitimi dersinde 50 dakikalık karşılıklı akran öğretimi oturumuna katılmadan önce evde çevrim içi eğitimlerini tamamlamaları için yönlendirilmiştir. Bir hafta sonra bireysel TYD performans değerlendirmesi yapılmıştır. Akran öğretimi davranışları video ve ses kayıtlarıyla kaydedilmiş ve kısmi aralık kaydı yöntemiyle analiz edilmiştir. TYD performansı, doğrulanmış bir protokol kullanılarak ölçülmüştür. Çevrim içi eğitimin tamamlanmasına göre üç grup analiz edilmiştir: TYD, öğretim için kriterler eklenmiş TYD (TYD+B) ve akran öğretimi öncesinde çevrim içi eğitimi tamamlamayan öğrencilerden oluşan eğitimsiz grup. Akran öğretimi sırasında öğrenci davranışları açısından istatistiksel olarak anlamlı bir fark görülmemiştir. Ancak, her iki eğitilmiş grup da kalıcılık testinde eğitimsiz gruptan daha iyi performans göstermiştir. Bu bulgular, TYD konusunda karşılıklı akran öğretimi yoluyla öğrenme çıktılarının geliştirilmesi için düşük maliyetli, ders öncesi çevrim içi TYD eğitiminin kullanılmasını desteklemektedir.

Anahtar Kelimeler: Temel Yaşam Desteği, CPR, Çocuklar Hayat Kurtarır, Akran Destekli Öğrenme, Harmanlanmış Öğrenme

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INTRODUCTION

We investigate the use of Reciprocal Peer Teaching in delivering Basic Life Support (BLS) education within secondary school physical education. BLS refers to a sequence of actions that bystanders should perform when a person suffers from out-of-hospital cardiac to maximize chances for survival ([Perkins et al., 2021](#)). It contains checks for safety, consciousness and breathing, a call for specialized help, and the performance of cardiopulmonary resuscitation ([Perkins et al., 2021](#)). Out-of-hospital cardiac arrest has an incidence of 67 to 170 cases per 100,000 European inhabitants, with the majority occurring at home, which means that bystanders often need to provide BLS until the arrival of emergency medical services ([Schroeder et al., 2023](#)). Bystander BLS is crucial, as research at the European level shows that the rate of survival to hospital discharge doubles when cardiopulmonary resuscitation is started by a bystander compared to when it is started by emergency medical services ([Grasner et al., 2020](#)). There is an international consensus that training schoolchildren to perform BLS is a key element in increasing a population's capability and willingness to provide BLS when needed ([Schroeder et al., 2023](#)). As a result, guidelines by the European Resuscitation Council state that "Training schoolchildren to teach BLS should be mandatory by law all over Europe and elsewhere" ([Perkins et al., 2021](#)). Based on the findings that out-of-hospital cardiac arrest is a leading cause of death worldwide, and that teaching BLS is an effective population-level intervention, learning BLS is now embedded in the standards of related school subjects, typically in physical education, in multiple countries ([Bottiger & Van Aken, 2015](#); [Schroeder et al., 2023](#)). As of 2021 in Europe, BLS education for schoolchildren was mandatory by law in six countries (Belgium, Denmark, France, Italy, Portugal, and the United Kingdom), and recommended in 24 additional countries (including Turkey, Greece, and most of Western Europe) ([Semeraro et al., 2021](#)). A survey amongst 4273 schoolteachers in Flanders reported that only a minority of them was willing to teach BLS ([Mpotos et al., 2013](#)). Self-reported barriers for schoolteachers are

lack of knowledge, time and resources ([De Smedt et al., 2019](#); [Mpotos et al., 2013](#)). The time to teach BLS is often severely limited making research on increasing the effectiveness of BLS-education important. Reciprocal peer teaching has proven to be an effective instructional model to teach BLS with limited face-to-face time (i.e. one lesson of 50 minutes) in secondary education physical education ([Iserbyt & Madou, 2021](#); [Iserbyt et al., 2017](#)).

Peer Assisted Teaching in Physical Education

Peer assisted teaching strategies are often used in physical education settings in schools ([Jenkinson et al., 2014](#); [Ward et al., 2005](#)). In these strategies peers are used to influence student-learning outcomes, for example by using them as a component of instruction. These strategies have shown positive outcomes on physical activity, physical education behaviour, health and nutrition behaviour, psychosocial and anthropometric measures and skill performance ([Jenkinson et al., 2014](#)). In a 2005 review, Ward and colleagues concluded that peer teaching can be an effective instructional strategy to help students learn motor skills in a variety of grade levels (i.e. from third grade through high school). These findings were later corroborated in a review on the topic by [Jenkinson et al. \(2014\)](#). Notably, both reviews identified a variety of methodologies used (e.g. a variety in peer assisted learning strategies or school contexts) as a limitation preventing the generalizability of findings on peer assisted teaching strategies in physical education. One specific format of peer assisted teaching occurs when students are being arranged in pairs and alternate between the roles of tutor and tutee to maximize each other's learning. This strategy has been labelled reciprocal peer tutoring by [Metzler \(2017\)](#) or 'the reciprocal style of teaching' in Mosston and Ashworth's Spectrum of teaching styles ([Mosston & Ashworth, 2008](#)). During reciprocal peer tutoring, the tutee carries out the task while the tutor provides instructional support both during and after the tutee's learning attempts (e.g. offering immediate and continuous feedback, highlighting the

source of errors, and providing cues for improvement) ([Metzler, 2017](#); [Mosston & Ashworth, 2008](#)).

Tutor Training

Reviews on peer-assisted learning in physical education show that in most studies some training was provided to peer tutors, although the training varied in quantity, quality, content and duration ([Jenkinson et al., 2014](#); [Ward et al., 2005](#)) and sometimes details on the training were not reported at all ([Ward et al., 2005](#)). Typically when tutor training was reported participants were taught desired tutor behaviours such as providing instruction and feedback to peers ([Ward et al., 2005](#)). Research across various peer tutoring formats in physical education has convincingly demonstrated that training tutors to provide instruction during peer tutoring leads to higher instructional quality compared to not training them ([Cicero & Lafont, 2007](#); [Ensergueix & Lafont, 2010](#); [Farias et al., 2018](#); [Iserbyt et al., 2023](#); [Legrain et al., 2003](#)). Furthermore, several studies have shown that reciprocal peer tutoring, when preceded by tutor training, leads to superior motor performance compared to peer tutoring without such training ([Ensergueix & Lafont, 2011](#); [Ensergueix & Lafont, 2010](#); [Lafont et al., 2005](#)). In their work with ninth-grade students during table-tennis units, [Ensergueix and Lafont \(2010, 2011\)](#) examined the effect of training tutors prior to reciprocal peer tutoring. For this purpose they organized 2-hour peer-tutor training sessions outside of class time focussing on five aspects of tutor behavior: (a) observe the tutee, (b) remind and demonstrate what must be done, (c) allow time for questions, (d) comfort and encourage the tutee, and (e) congratulate the tutee when successful. Results showed superior motor performance for participants who completed the tutor training compared to untrained peer tutoring groups and individual practice control groups ([Ensergueix & Lafont, 2011](#); [Ensergueix & Lafont, 2010](#)). Also, trained tutors scored higher on a declarative knowledge test and a measurement of coaching skills (i.e. identifying errors and formulating appropriate advice) ([Ensergueix & Lafont, 2011](#)).

Besides training tutors, research shows that instructional guidance in terms of role definition and role switching might impact students learning during reciprocal peer tutoring. Notably in the context of learning BLS through reciprocal peer tutoring, [Iserbyt \(2013\)](#) analyzed behaviors and verbal interactions in structured (i.e., participants received clear guidance on role definition and switching) versus unstructured dyads in a laboratory setting with undergraduate physical education students. In this study, task cards were provided to tutors as an instructional aid during peer tutoring. The structured condition demonstrated significantly higher percentages of motor time on task and task-card-based instruction, and this group subsequently outperformed the unstructured group on a two-week retention test. Additionally, evaluative activities, such as students verbally rehearsing BLS while recapitulating the sequence on a manikin, were positively correlated with post-intervention BLS performance ([Iserbyt, 2013](#)).

Blended Learning

In this study tutors were trained online before assuming the role of tutor during reciprocal peer tutoring. Using pre-course e-learning as part of a ‘blended’ learning strategy to teach Basic Life Support (BLS) is recommended by the European Resuscitation Council (ERC) ([Greif et al., 2021](#)). This approach, during which instructional content is provided online prior to face-to-face classes, is also referred to as a flipped learning method. In physical education contexts, it has been shown to positively influence student variables such as learning achievement, motor skill development opportunities, and motivation ([Østerlie et al., 2022](#); [Sargent & Casey, 2019](#)).

Purpose of the Study

The purpose of this study was to improve peer teaching for BLS during secondary physical education. We investigated the effect of two online tutor trainings on students’ behavior during reciprocal peer

tutoring and their learning outcomes on a retention test. Participants were asked to complete one of two online trainings before attending a physical education class in which they practiced BLS using reciprocal peer tutoring. One group received an online training focusing on common content knowledge for BLS (referred to as the ‘BLS group’), while the other received an identical training with additional benchmarks for effective tutoring (referred to as the ‘BLS+B group’). The benchmarks guided participants to deliver frequent instruction and feedback and to stay on task within the dyad. The independent variable in this study was the type of online training and whether or not it was completed prior to the physical education class. The dependent variables were the learning behaviors of tutors and tutees during reciprocal peer tutoring and participants’ individual performance on a BLS retention test. We investigated if completing an online training on BLS content knowledge prior to reciprocal peer tutoring affects the frequencies of task-related interactions between students during peer tutoring and their performance on a retention test. Also, we investigated if including benchmarks for effective tutoring in the online training affects time-on-task and task-related interactions during peer learning and the performance on a retention test. We hypothesized that completing an online training on BLS content knowledge prior to reciprocal peer tutoring would lead to higher frequencies of task-related interactions between students during peer tutoring and to higher performance scores at retention. Additionally, we hypothesized that including benchmarks for effective tutoring in online training would result in greater time-on-task, more frequent task-related interactions, and higher performance scores at retention.

METHOD

Participants and Setting

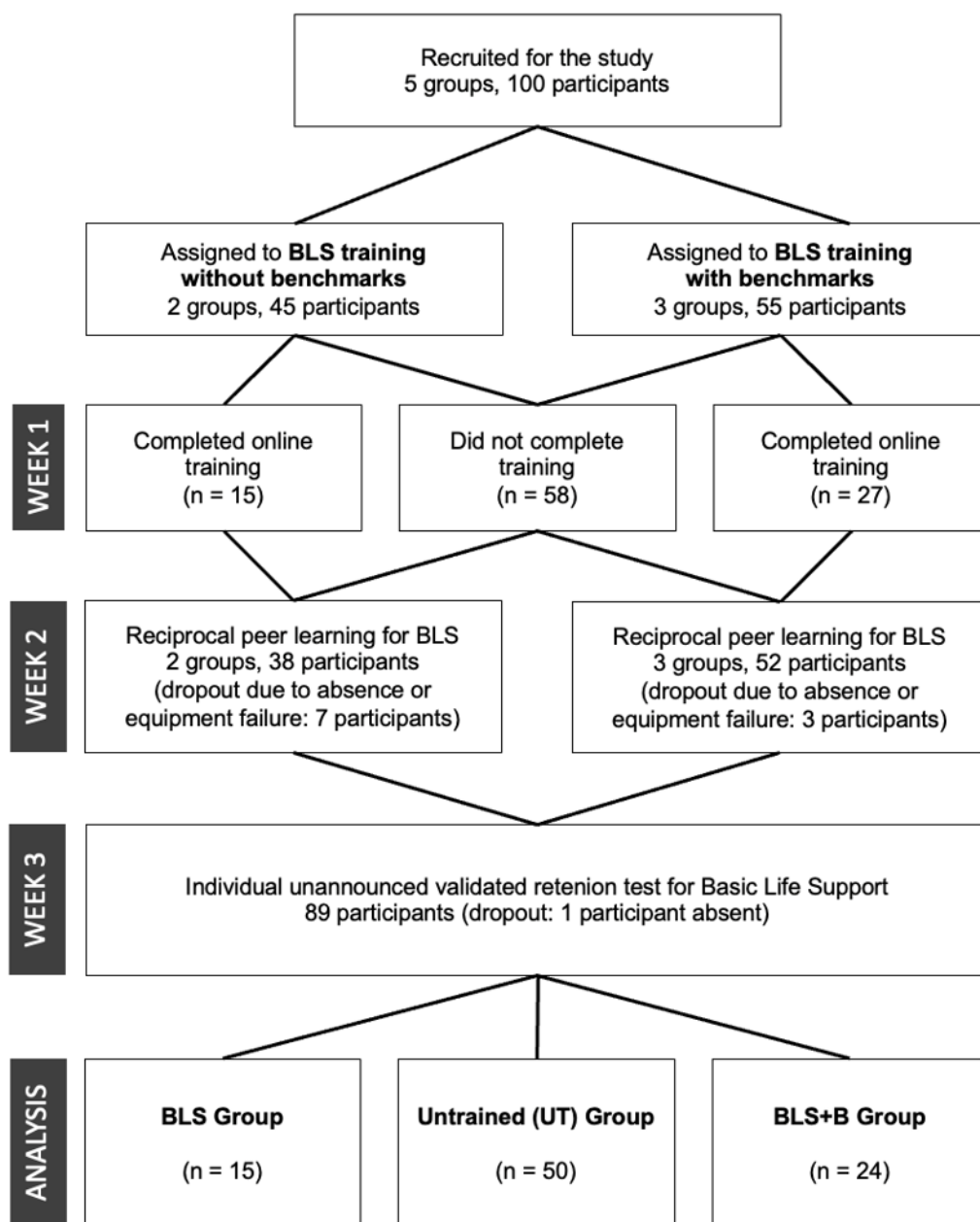
One hundred children (45 female, 55 male, age: $M = 12-13$) were recruited for this study. All participants were part of a general secondary education track in a school in Flanders, Belgium. According to

educational standards in this region learning to perform BLS is part of the physical education curriculum. The sample comprised of five groups (mean group size = 20) and all groups were taught by the same teacher (male, age = 30 years). All participants had access to the online learning management system of the school and researchers were allowed to use this platform for instruction. The teacher had extensive experience in teaching BLS using reciprocal peer teaching and was blinded to the randomization and the results of the online learning module.

Study Design

This cluster randomized controlled trial was approved by the leading authors' university and the secondary schools' principle. Also, all parents provided consent for their children to participate.

The study lasted three weeks, and participants progressed through it in one of five groups (Figure 1). Prior to the start of the study, each group was assigned one of two online training programs via the school's learning management system: a basic life support training (BLS) or a BLS with benchmarks training (BLS+B). In accordance with the school's policy on homework for physical education, the online trainings were announced as voluntary but recommended. Based on the completion of the online training, three groups were retained for data analysis: (a) students who completed the BLS training; (b) students who completed the BLS+B training; and (c) the untrained (UT) group, which included all students who did not complete their assigned online training.

Figure 1: Flow of Participants Through the Study

Week One: Online Learning

At the start of the study, all participants were instructed to complete their assigned online training before practicing BLS. Training was considered complete when all quiz questions were answered correctly. The online training platform provided immediate feedback after each question and permitted an

unlimited number of attempts. Participants were asked to complete the online training outside of class time (e.g., at home) within a seven-day period.

The content of the first online training module (BLS) focused on the knowledge required to perform BLS when alone, as a trained BLS provider, assisting an adult victim. ([Olasveengen et al., 2021](#)). It consisted of a segmented videoclip of a correct BLS procedure with 10 quiz questions to check for understanding. The videoclip showed a correct sequence of the different steps of the procedure (i.e. safety check, check for consciousness, check for breathing, a call for help and how to perform compressions and ventilations) from a similar point of view a tutor would have during reciprocal peer tutoring.

The second online training (BLS+B) contained the same BLS-related content as the first. Additionally, it included online instruction on benchmarks for effective tutoring during peer learning. These benchmarks were selected based on previous work on tutor training in physical education ([Ensergueix & Lafont, 2011](#); [Ensergueix & Lafont, 2010](#)) and evidence suggesting that the provision of peer instructions and time-on-task are important for learning BLS through reciprocal peer tutoring ([Iserbyt, 2013](#)). In practice, participants in this condition received instruction and five quiz questions on: (a) giving instructions to a partner during peer tutoring using an instructional aid (see below); (b) providing frequent feedback during peer tutoring (i.e. up to 6 times per minute); and (c) instructing their partner to continue practicing throughout the peer tutoring session.

Week Two: Peer Tutoring

During scheduled physical education classes, students learned BLS through reciprocal peer teaching. In this model, students work in pairs, alternating roles as tutor and tutee. Each pair was provided with one manikin and one iPad as instructional aids. The iPad ran an application called StartnHart, specifically

designed to support BLS instruction through reciprocal peer teaching. This strategy was used in previous research with children ([Iserbyt & Madou, 2021](#); [Iserbyt et al., 2017](#); [Madou et al., 2023b](#)). The application showed a videoclip of a correct BLS performance (i.e. identical to the clip in the online training) with attentional cues pointing out important actions (e.g. a red arrow showing correct hand placement) and a checklist for peer assessment.

For each of the five groups an identical 50-minute lesson was organized following a fixed structure based on previous literature ([Iserbyt et al., 2017](#); [Madou et al., 2023a](#); [Madou & Iserbyt, 2020](#)). The lesson started with a standardized instruction explaining the instructional model. Participants were allowed to choose who they worked with as research suggests this is an appropriate pairing technique for peer teaching when the goal is to encourage learners to give and receive feedback ([Ernst & Byra, 1998](#)). Tutees were instructed to kneel next to the manikin to practice the BLS procedure. Tutors were instructed to stand across the manikin, hold the iPad in their hands and help their partner by providing instruction and feedback. Next, all student pairs practiced BLS for a total of 20 minutes switching between the roles of tutor and tutee. The teacher cued students when they needed to switch roles (i.e. every five minutes) in line with research showing the benefits of using structured dyads ([Iserbyt, 2013](#)). Following the 20 minutes of practice all participants were instructed to perform a peer assessment. During this assessment the tutee performs a complete BLS performance while the tutor completes the checklist in silence. Following the procedure student pairs go through the results together. To ensure implementation fidelity, a researcher was present during each class to verify that the teacher adhered to the planned instructions and maintained the intended timing. For this purpose, a checklist and a stopwatch were used. No deviations from the protocol were found.

During the entire lesson all iPads were running a voice recording application capturing all verbal

interactions taking place within each student pair. Participants were aware they were being recorded as this was indicated on the top of the screen. During each lesson a 360°-camera was placed in the middle of the gymnasium recording all student pairs during practice.

Week Three: Assessment

The third week all participants were tested individually and unannounced. Performance was measured using an established, validated protocol ([Whitfield et al., 2003](#)). Following standardized instructions, each student was individually asked to perform a basic life support (BLS) procedure on specialized equipment (© Laerdal QCPR connected to SimPad Plus). All sessions were video recorded. Assessments took place in a separate room where students were alone with the manikin. A member of the research team intervened after either three cycles of chest compressions and ventilations or a maximum duration of three minutes. ([Iserbyt et al., 2017](#); [Madou et al., 2023a, 2023b](#); [Madou & Iserbyt, 2020](#)).

Data Collection

After week one the researchers could consult the learning management system of the school to collect data on the completion of the online training of all participants. After week two, data were available for each of the five lessons, documenting the students' learning behaviour during reciprocal peer tutoring. These data included: (a) a 360° camera recording offering a visual overview of all student pairs, and (b) individual audio recordings for each pair, captured via iPads that were used by each student pair as instructional aid. All audio tracks were segmented into 6-second intervals to enable partial interval recording of specific peer tutoring behaviours (see dependent variables). Partial interval recording is a time-sampling method in which an interval is marked if the target behaviour occurs at any time during that interval. ([Cooper et al., 2020](#)). All tracks were coded by two trained observers and 33% of the sample was used to measure inter-rater reliability. Observers were

trained to assess peer tutoring behaviours (see below) during a one-hour workshop in which they evaluated video recordings of dyads practicing BLS using reciprocal peer tutoring. The videos used for observer training were not part of the study sample. Inter-observer reliability as measured by Cohen's Kappa was 82.2%. The third week all students were assessed for their BLS performance individually and unannounced using a scoring protocol (see Appendix) based on the Cardiff test ([Whitfield et al., 2003](#)). For this assessment a full body Laerdal QCPR manikin was used connected to a Simpad plus computer collecting data on the quality of chest compressions and ventilations. Also, all videotaped assessments were examined by two independent trained observers. Variables that were part of the scoring protocol but could not be retrieved by the manikin software (e.g. check for safety or call for help) were coded by the observers. Inter-observer agreement calculated using Cohen's Kappa with 33% of the sample exceeded 90% agreement.

Student Peer Tutoring Behaviour

For all participants the following dependent variables were collected during reciprocal peer tutoring using partial interval recording ([Cooper et al., 2020](#)) with 6-second intervals: (a) the role they assumed (e.g. tutor or tutee), (b) the subskill they were practicing as a tutee (e.g. chest compressions), (c) the type of verbal interaction they had with their partner as a tutor (see Table1). For verbal tutor interactions the interval was scored as 'BLS instruction' when a student verbally instructed the tutee regardless of the tutee performance (e.g. reading something out loud from the instructional aid). An interval was coded as 'Skill Analysis' when a student verbally interacted with the tutee to correct errors or enhance performance based on an observation of the tutee's actions. Skill analysis (i.e. observing performance, discriminating correct from incorrect performance, diagnosing performance and determining next steps in instruction) is an established practice for physical education teachers ([Ward et al., 2021](#)). However,

within the context of reciprocal peer tutoring, this responsibility is transferred to peer tutors as part of the instructional model ([Metzler, 2017](#)).

Student Retention Test Performance

For all participants the following dependent variables were collected at the assessment by the manikin software: (a) the total number of chest compressions, (b) the number of compressions with correct hand placement (%); (c) the average compression rate (number per minute); (d) the average compression depth (mm); (e) the total number of ventilations (f) the average ventilation volume (ml). The following variables were collected at the assessment by two trained observers: (a) check for safety; (b) check for consciousness; (c) check for breathing; d) call for help; (e) continuation of BLS. Finally, all variables were combined using the Cardiff protocol (2003) into a the total BLS score (see Appendix) and converted to a percentage ([Whitfield et al., 2003](#)).

Data Analysis

Statistics were performed using IBM SPSS (version 29.0). Normality was assessed using the Shapiro–Wilk test across all dependent variables. As several variables significantly deviated from normality ($p < .05$), we report medians and interquartile ranges to report on students' behaviour during reciprocal peer tutoring and their learning outcomes on the retention test. Given that the variables are not normally distributed and we are comparing unequal and small sample sizes Kruskal-Wallis was used to compare conditions. Post-hoc analysis of detected differences was performed using pairwise Mann–Whitney U tests with significance values adjusted by the Bonferroni correction for multiple tests. A $p < .05$ is considered significant.

RESULTS

Based on the results of the online training, three groups were created for comparison of the dependent

variables: the BLS+B group (n = 24); the BLS group (n = 15) and the UT group (n = 50).

To examine the effect of online tutor training on student behaviour during reciprocal peer tutoring, a summary of peer tutoring behaviours is presented in Table 1. A Kruskal-Wallis test showed no statistically significant differences between groups for student behaviour variables during reciprocal peer tutoring, except for the percentage of time spent being silent as a tutor, $\chi^2(2) = 6.86$, $p = .032$. For this variable, post-hoc pairwise comparisons indicated that the UT group scored significantly higher compared the BLS+B group ($p = .025$) but not compared to the BLS group ($p = .056$).

Table 1: Median Percentage of Reciprocal Peer Tutoring Time Spent as a Tutor/Tutee Note

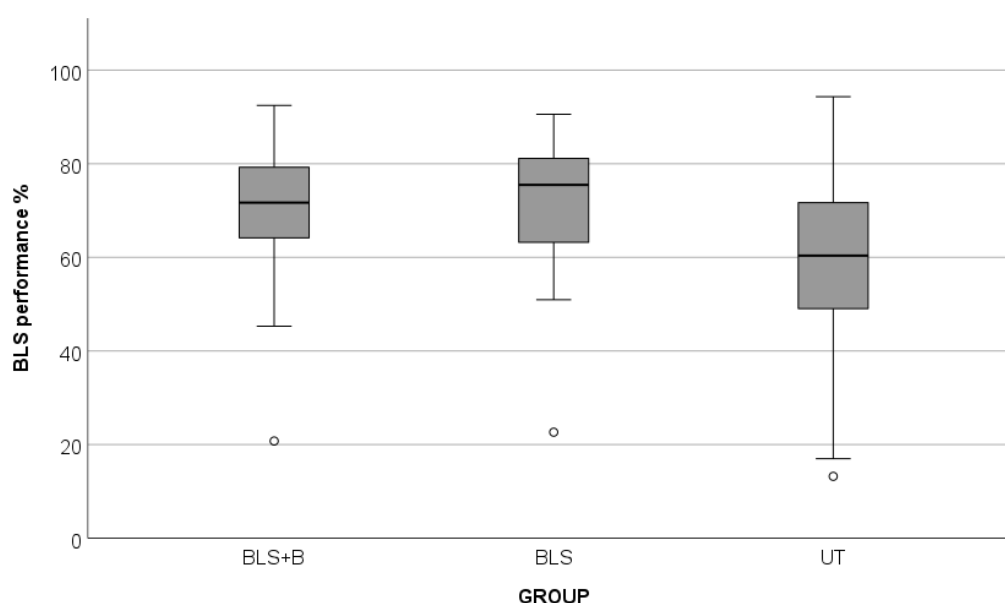
	Bls+B Group	Bls Group	Ut Group
Role Assumed			
Tutor	47.0 (8)	50.0 (2)	50.0 (6)
Tutee	48.0 (9)	50.0 (2)	49.0 (6)
No role	2.5 (6)	0.0 (0)	0.0 (3)
Tutee practice topic			
Check safety	5.0 (4)	7.0 (2)	7.0 (3)
Check consciousness	6.5 (4)	7.0 (3)	6.0 (3)
Check breathing	10.0 (7)	11.0 (7)	12.0 (4)
Call 112	5.0 (3)	6.0 (5)	6.0 (4)
Chest compressions	27.0 (12)	33.0 (8)	31.0 (8)
Ventilations	21.0 (9)	16.0 (9)	15.0 (9)
Other	22.0 (13)	18.0 (11)	19.0 (14)
Tutor Interactions			
BLS Instruction	22.5 (16)	25.0 (11)	21.0 (13)
BLS Skill Analysis	7.0 (5)	5.0 (3)	5.0 (5)
Other	42.0 (13)	38.0 (11)	36.0 (14)
Silent	27.0 (17)	30.0 (8)	38.0 (19)

Values reflect median percentages of time spent: (a) in the role of tutor or tutee, (b) practicing a subskill as a tutee, and (c) verbally interacting as a tutor.

To investigate the effect of online tutor training on students' outcomes on a BLS retention test, a

comparison of BLS performance scores can be found in Figure 2. A Kruskal-Wallis test detected statistical differences between groups for BLS performance, $\chi^2(2) = 8.95$, $p = .011$. Post-hoc pairwise comparisons indicated that the UT group scored significantly lower compared to the BLS+B group ($p = 0.13$) and the BLS group ($p = 0.23$)

Figure 2: Boxplot Showing the Distribution of BLS Scores on a One-Week Retention Test Across Three Groups



BLS+B, BLS, and UT. The central line in each box represents the median and the edges represent the interquartile range (IQR). Pairwise Mann–Whitney U tests revealed statistically significant differences between the UT group and both the BLS+B and BLS groups.

DISCUSSION

The purpose of this study was to investigate the effect of two online tutor trainings on students' behaviour during reciprocal peer tutoring and their learning outcomes on a retention test. First, we

investigated if completing an online training on BLS content knowledge prior to reciprocal peer tutoring affected the frequencies of task-related interactions between students during peer tutoring. Our hypothesis was that completing such training prior to peer tutoring would lead to higher frequencies of task-related (i.e. BLS-related) interactions between participants. The results indicated no statistically significant differences, suggesting that the groups did not differ in their verbal interactions on the topic of BLS during peer learning. Although the untrained group exhibited the greatest number of silent intervals, the small sample size limited the ability to draw reliable conclusions about this outcome.

Second, we investigated if completing an online training on BLS content knowledge prior to reciprocal peer tutoring affects BLS performance on a retention test. Our hypothesis was that completing an online training on BLS content knowledge prior to reciprocal peer tutoring would lead to higher performance scores. The results support this hypothesis, showing that students who completed either form of online content knowledge training (BLS or BLS+B) scored significantly higher on the retention test compared to the untrained group. Given the age of our participants (i.e. 12 – 13), and the established finding that children younger than 12 are generally not physically capable of performing high-quality CPR ([Semeraro et al., 2021](#)), we believe the trained group achieved good results when compared with similar research using the same method ([Iserbyt et al., 2017](#)). For comparison, in a similar context, with the same age group and with a comparable scoring protocol, Iserbyt and colleagues reported average BLS scores of 57% and 62% immediately after the lesson, whereas in the present study online-trained participants achieved 72% and 75% after a one-week retention interval. A potential selection effect should be considered when interpreting these results. Students who voluntarily complete homework may also be more likely to engage more purposefully during class, which could contribute to better retention outcomes. Nonetheless, the absence of group differences in peer learning behaviour, combined with the

substantial performance gap associated with completing the online content knowledge training, appears to underscore the effectiveness of the online training. These findings highlight the value of teaching content knowledge prior to peer learning (i.e. flipped learning), demonstrate a cost-effective online approach to doing so, and align with European BLS education guidelines recommending pre-course e-learning for BLS education ([Greif et al., 2021](#)).

Finally, we aimed to investigate if including benchmarks for effective tutoring in the online training affects time-on-task and task-related interactions during peer learning and the performance on a retention test. We hypothesized that including benchmarks for effective tutoring in the online training would result in greater time-on-task, more frequent task-related interactions, and higher performance scores at retention. The results revealed no statistically significant task-related differences during peer tutoring or at the retention test. Notably, the high number of students who did not complete the online training limited statistical power.

A strength of this study is the detailed report on a cost-effective teaching intervention to teach a socially important skill such as BLS in a 50 min physical education class. Where previous work on tutor training in physical education often prepared students for their role as a tutor using expert-led ‘coaching workshops’ ([Ensergueix & Lafont, 2011](#); [Ensergueix & Lafont, 2010](#)) we present a cheap and infinitely scalable online approach. A methodological contribution is the use of partial interval recording as a method to investigate the learning behaviour of tutees (i.e., how much time do they spend practicing which motor skills) and tutors (i.e., what is the content and duration of their verbal interactions) during reciprocal peer learning in physical education. Given the high inter-observer reliability and the deliberately chosen short interval (i.e., 6 seconds), we conclude that partial interval recording is a feasible, valid, and reliable method for documenting peer learning behaviour.

A limitation of this study was the large number of students who did not complete the online training before attending the physical education lesson. Although the training was recommended, it remained voluntary in accordance with school policy. A formal a priori power analysis was not conducted. The high number of students who did not complete the assignment led to small sample sizes in the other groups, limiting our ability to draw conclusions about the impact of teaching benchmarks as an independent variable.

CONCLUSION

This study demonstrates the value of providing students with online training prior to learning Basic Life Support (BLS) through reciprocal peer teaching. The online approach offers a cost-effective method for preparing secondary school students to serve as tutors during reciprocal peer tutoring.

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APPENDIXES

Appendix1: Scoring protocol Cardiff Test (Whitfield et al., 2003)

Topic	Score	Data origin E = Expert S = Software
1. Safe approach	2. Performed 1. Not performed	E
2. Check consciousness by shaking gently at shoulders	3. Performed 2. Not performed 1. Performed potentially dangerous	E
by shouting aloud	2. Performed 1. Not performed	E
3. Check breathing by opening airway	4. As instructed on IPAD 3. Other and effective 2. Visibly attempted 1. Not performed	E
look, listen, feel: actions	4. Correct 3. Not correct 2. Not effective 1. Not performed	E
look, listen, feel: time	4. 8-12 seconds 3. 1-7 seconds 2. >12 seconds 1. Not performed	E
4. Call 112	3. Performed 2. Called unspecified help 1. Not performed	E
5. Chest compressions Total amount of compressions after three cycles	4. 85-95 3. >95 2. 1-84 1. Not performed	S
Average compression depth (mm)	5. 50 or >50 4. 40-49 3. 19-39 2. 1-18 1. Not performed	S
Compressions with correct hand position (%)	6. 100 5. 85-99 4. 70-84 3. 55-69 2. <55 1. Not attempted	S
Average compression rate (rate/min)	6. 90-110 5. 109-120 4. 80-89 3. >120 2. <80 1. Not performed	S

6. Ventilation Total amount of ventilations after three cycles	7. 11 6. 7-10 5. 4-6 4. 1-3 3. >11 2. Attempted 1. Not performed	S
Average ventilation volume (ml)	7. 500-600 6. 300-499 5. 600-800 4. 1-299 3. >800 2. Attempted 1. Not performed	S
Ventilation: compression ratio	6. 2 : 30 (2 : 28-32) 4. Other 3. Compression only 2. Ventilation only 1. No ventilation nor compression	S
7. How long would you continue to resuscitate? (oral question)	4. 3 items correct 3. 2 items correct 2. 1 item correct 1. No item correct	E
8. Performed all BLS items	2. Yes 1. No	E
9. Performed all items in the correct sequence	2. Yes 1. No	E