ATHLETIC TRAINING EDUCATION JOURNAL
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www.natajournals.org
ISSN: 1947-380X
DOI: 10.4085/1204225

ORIGINAL RESEARCH

Athletic Training Student Active Learning Time With and Without the Use of Bug-in-Ear Technology

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Context: Clinical education experiences that actively engage students in patient care are important to the development of competent clinicians. It is important to assess athletic training students' time spent clinically and explore new technology that may facilitate more active learning during clinical education.

Objective: To assess athletic training students' active learning time with and without the use of bug-in-ear technology.

Design: Cross-sectional.

Setting: High school, rehabilitation clinic, and college/university clinical sites affiliated with 3 Commission on Accreditation of Athletic Training Education–accredited undergraduate athletic training programs.

Patients or Other Participants: Thirteen athletic training students (11 females, 2 males; 22.0 ± 1.8 years old, 1.8 ± 0.9 years enrolled in the current athletic training program) and 8 preceptors (5 females, 3 males; 35.4 ± 10.4 years old, 3.5 ± 2.9 years of experience as a preceptor) volunteered for this study.

Intervention(s): The principal investigator observed preceptor-student interactions on 2 control days and 2 days using bug-in-ear technology. Participants and the principal investigator assessed students' active learning time at each observation period using the Athletic Training Clinical Education Time Framework.

Main Outcome Measure(s): Minutes spent on instructional, clinical, managerial, engaged waiting, and down time as recorded on the Athletic Training Clinical Education Time Framework. Parametric (analysis of variance) and nonparametric (Wilcoxon signed-rank and Kruskal-Wallis) tests compared the perceived amount of time spent in each category between technologies and roles.

Results: Bug-in-ear technology resulted in less time on managerial tasks (8.2% ± 5.1% versus 14.6% ± 9.8%; $P < .01$) and instruction (10.7% versus 12.7%, $P < .01$). The researcher observed significantly more unengaged waiting time than both the students and preceptors (both $P < .01$) perceived.

Conclusions: Bug-in-ear technology may decrease managerial time and spoken instruction during clinical experiences. Preceptors and students significantly underestimate the amount of unengaged time spent during clinical education, which is of concern. Athletic training programs may also benefit from assessing and improving students' time spent actively learning during clinical education.

Key Words: Clinical education, experiential learning, clinical teaching, preceptor

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Full Citation:
Nottingham SL, Montgomery MM, Kasamatsu TM. Athletic training student active learning time with and without the use of bug-in-ear technology. *Athl Train Educ J.* 2017:12(4):225–233.

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INTRODUCTION

Clinical education experiences are important components of students' educational preparation,[1] professional development,[2] and socialization[3] as athletic trainers. In particular, engagement in actual patient care learning experiences creates meaningful experiences critical to the development of competent clinicians.[3,4] Researchers have found that during clinical education experiences athletic training students are unengaged 20% to 60% of the time whereas 30% to 59% of the time they are engaged in active learning tasks, such as clinical activities and educational instruction.[5–7] Remaining time is often spent on managerial tasks, such as custodial and preparatory tasks.[5–7] The activities and the amount of time spent engaged vary between clinical settings, student level, and types of clinical rotations.[5–8] Sufficient patient volume for students to participate in patient care is also pivotal to the learning experience.[3,8] Students describe that they learn best when actively engaged in hands-on learning with patients.[2,3] Students experience frustration when they believe their time is wasted or when they are not allowed to practice skills in the clinical setting.[9,10]

Existing research on engaged learning time has typically relied on student reflection in interviews[2,3] and surveys.[5,8] Students have been asked to use an active learning instrument to assess their experiences during 1 typical clinical education day[5] or reflect upon clinical experiences over several years of their education.[2,8] These studies have provided insight into students' activities and perceptions of meaningful clinical experiences[2,3,5,8]; however, perspectives of the preceptor[2] and objective observers[6] are limited. Miller and Berry[6] observed that students spend as little as 30% of their time engaged in active learning during clinical education, with the remaining time spent on unengaged time (59%) and managerial activities (10%). In a study of teachable moments in clinical education, Rich[11] found that preceptors and students identified the same teachable moments only 22% of the time. These findings suggest that perceptions of actual student activities during clinical education may vary between stakeholders, so it is valuable to obtain multiple perspectives on what is occurring during clinical education.

Considering the importance of clinical education and engaging clinical experiences,[3,4] athletic training programs may seek out additional tools and strategies that may promote quality clinical education experiences. One strategy for facilitating communication while promoting active learning may be bug-in-ear (BIE) technology. Bug-in-ear technology consists of the use of 2-way radios with earpieces that allow the instructor and student to communicate without a patient hearing their conversation.[12] Bug-in-ear technology allows a supervisor to observe a student from a distance, but maintains the ability for the supervisor to listen to the student and provide feedback.[12,13] For example, a preceptor entering electronic medical records in his or her office with a window can communicate with a student who is evaluating a patient in the main clinic area 15 ft away, while still maintaining supervision and the ability to intervene. Likewise, preceptors and students can accomplish separate tasks over a greater distance while still maintaining communication. Bug-in-ear technology has been used in teacher education,[12] physical education,[13] and medical education[14] for several decades. The use of BIE technology has been found to improve student confidence,[13] performance,[15] autonomy,[13] and instructor feedback delivery[15,16] during experiential learning. With these positive findings in other areas of hands-on education, there is potential for BIE technology to be used effectively in athletic training to promote active learning while maintaining communication. Therefore, we sought to investigate the use of BIE technology in athletic training clinical education. The primary objective of our study was to assess athletic training students' active learning with and without the use of BIE technology. Our secondary objective was to evaluate active learning time from the student, preceptor, and researcher perspectives to gain a greater understanding of the effect of this technology in athletic training clinical education.

METHODS

Setting

Institutional review board approval was obtained before the study commenced. This study was conducted at 3 Commission on Accreditation of Athletic Training Education (CAATE)-accredited undergraduate athletic training programs located in 1 National Athletic Trainers' Association district. Data were collected from 2 large public institutions (Carnegie Classifications R3 and M1) and 1 smaller private institution (Carnegie Classification M1). Within these institutions, 8 preceptor-student groups located at 7 different clinical sites were used. Clinical sites included 3 high schools (2 public, 1 private), 1 large university, 1 community college, 1 rehabilitation clinic, and 1 university club sports clinic.

Participants

We used a combination of purposeful and convenience sampling procedures for this study.[17] Due to the time-intensive, in-person field data collection procedures, we limited our potential participants to a convenience sample of athletic training programs within a 60-mi radius of the principal investigator's campus. Any CAATE-accredited program within this radius was eligible to participate. We recruited clinical education coordinators of 6 CAATE-accredited athletic training programs within the study radius; 4 clinical education coordinators expressed interest in participating. Those clinical education coordinators then solicited the interest of affiliated preceptors using a recruitment e-mail provided by the research team. A purposeful sampling technique helped to achieve a balanced group of 1:1 and 1:2 preceptor-student groups in a variety of clinical settings.[17] We found that initial participant groups typically included preceptors with 2 students; therefore, later recruitment efforts focused on the search for 1:1 preceptor-student pairs to provide a more balanced group of participants. Similarly, we wanted to have a sample that was representative of the variety of clinical practice settings. Once the research team confirmed the preceptor's willingness to participate, they recruited the assigned athletic training student(s) through e-mail. Students had to be currently enrolled in the accredited athletic training program to participate. All potential participants informally agreed to participate in e-mail communication before the principal investigator met with them on-site to discuss final study details and to sign the informed consent form.

Instrumentation

We used the Athletic Training–Clinical Education Time Framework (AT-CETF)[5,7] to categorize students' active learning time in our study (Table 1). We modified the instrument by updating headings to match the terminology used in the most recent National Athletic Trainers' Association educational competencies.[18] For example, "rehabilitation task" was revised to "therapeutic intervention task" and "evaluation task" was changed to "clinical examination task." We also reformatted the instrument and added additional examples of tasks within existing headings to improve readability and recording by participants. A second version, different only in formatting, was made to facilitate the researcher's recordings of real-time student tasks. Lastly, a general open-ended question was added to the instrument: "Was this a typical day? If not, please explain." After the instrument was modified, it was piloted with participants during 2 full days of actual interactions. Pilot participants were asked to comment on the clarity and applicability of the instrument and if any activities were not included in the AT-CETF. Pilot participants were satisfied with the instrument, so the same instrument was used for the actual study.

Bug-in-Ear Technology and Training Video. One objective of this study was to evaluate the influence of BIE technology on active learning. The BIE technology used in this study included 2-way radios (HYT TC-3; Hytera, Shenzhen, China) with press-to-talk earpieces (Pryme G-Loop audio kit; Pryme Radio Products, Brea, CA) (Figure 1). Each participant clipped the radio to his or her belt and wore an external earpiece wire-connected to the radio. To talk, participants pressed the button on their earpiece wire and spoke into the microphone, allowing anyone with an earpiece and active microphone on that channel to hear the speaker. Therefore, if 2 students were using the technology and the preceptor spoke to 1 student, the second student would also hear and understand the comments.

A BIE training video was developed to provide an accessible training and resource module for research study participants based on feedback we received from earlier pilot testing of our procedures. The 7-minute video explained the technology, how it could be used in clinical education, and equipment setup and cleanup. Three scenarios mimicking real patient care situations were included in the video to provide research study participants with real-life examples for integrating the BIE technology into students' clinical education experiences. The scenarios included examples for facilitating supervised autonomy in the clinic and athletic practice environments, in addition to providing feedback without the patient knowing. The video emphasized that preceptors should always be within visual and auditory proximity, with the ability to intervene on behalf of their student and patients.

Data Collection Procedures. Data collection for this study occurred between September and November over a 12-week period. Study procedures are illustrated in Figure 2. Full participation in this study lasted 3 weeks for each group; therefore, groups were staggered throughout the fall semester. To measure actual active learning time spent by students during clinical education experiences, the principal investigator observed and audio recorded each participant group in real time on 4 days over the course of the study. Observations followed the methods detailed in a study completed by Nottingham and Henning.[19] Participants were wired with lapel microphones (100-P Series; Sennheiser, Wedemark, Germany, and Pro 88W; Audio-Technica US, Stow, OH) that transmitted to an earpiece and audio recorder (Zoom H2; Samson Technologies, Hauppage, NY) worn by the principal investigator. As participants were audio recorded, the researcher observed and recorded AT-CETF activity with a stopwatch (Adanac 3000; Marathon, ON, Canada) from about 15 to 20 ft from participants, depending on the facility size and participants' location within the facility. This distance allowed for a clear visual and auditory pathway with minimal influence on participants. If the preceptor and student(s) were ever separated, the principal investigator continued observation of the student. The researcher listened to audio communication in real time to assist with taking notes and tracking student activities.

As the researcher observed participants, student activity using the AT-CETF was also recorded in real time. The researcher version of the AT-CETF categorized the amount of time each student completed a task category in minutes. At the end of each observation, students and preceptors completed their version of the AT-CETF. The student and the preceptor individually estimated the amount of time that the student spent on each activity listed in the AT-CETF.

During the first week of participation, the principal investigator observed each participant group's interactions for 2 full days. After the second observation day, participants were e-mailed the BIE training video and instructed to use the technology for the following week. This time allowed participants to adjust to using the technology and correct any technical glitches before researcher observation resumed.[13,15] Participants were instructed to contact the investigators with any questions or concerns; otherwise, there was no interaction with the researcher during the week. Participant groups used the technology for an average of 5.3 $\pm$ 1.0 days of clinical experiences. During the third week, the researcher repeated the observations while participants used the BIE technology.

Data Reduction and Analysis

Data Reduction. Students, preceptors, and the researcher recorded the amount of time spent (in minutes) during each of the clinical experience sessions. Because the total length of each session varied, minutes spent in each category were normalized as a percentage of the total time spent (% time) during each session. The 14 items were reduced to 5 categories: (1) instructional, (2) clinical, (3) managerial, (4)

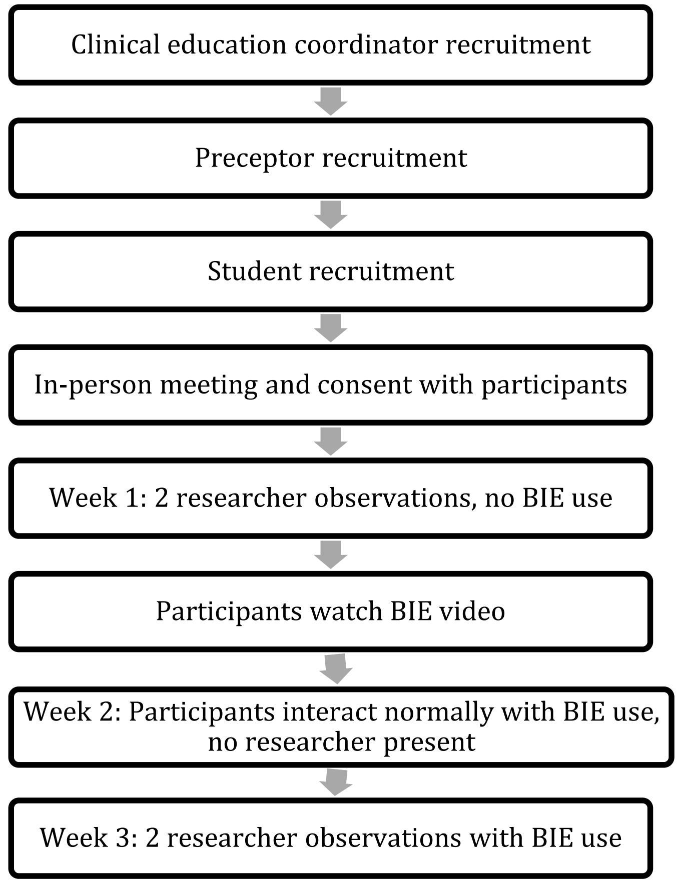
Table 1. Active Learning Clinical Education Time Framework[a]

Category	Description
Instructional time	Includes the following categories:
Spoken instruction	Discussing issues related to athletic training (eg, surgical procedures, treatment protocols, evaluation procedures).
Practical instruction	Modeling, learning, or practicing an athletic training skill/behavior before applying it to an athlete or another student with supervision from a preceptor.
Observational instruction	Auditory or visual learning related to athletic training without kinesthetic engagement in an activity. Includes accessing resources such as a book or article.
Educational evaluation	Includes formal evaluation of student and/or preceptor.
Clinical time	The amount of time in which athletic training students are actively performing athletic training clinical tasks (skills/behaviors) during their clinical field experience. Includes the following categories:
Prevention and health promotion	Preparing and performing skills such as taping; bandaging; flexibility; environment assessment; fluid replacement; preparticipation physical exams; fitting and constructing protective equipment; and educating coaches, athletes, and patients to minimize the risk of injury
Therapeutic intervention	• Therapeutic exercise: actively preparing, conducting, or supervising therapeutic exercise or rehabilitation programs (eg, range of motion, strengthening, joint mobilizations, proprioceptive neuromuscular facilitation patterns, functional activities) • Therapeutic modalities: actively preparing or performing therapeutic modalities (eg, ultrasound, massage, e-stimulation, traction, phonophoresis, biofeedback) • General management: administering treatment for general injury or illness or discussing treatment options with athlete or another health care professional (eg, cleaning of wounds, dressing changes, application of topical solutions, psychosocial issues, viral or bacterial infections)
Clinical examination and diagnosis	Performing or discussing an assessment of an athlete's or patient's injury or illness.
Acute care	Performing athletic training skills/behaviors to treat an acute or immediate injury (eg, soft tissue, sprain, strain, dislocation, nerve injury) or intervening during a life-threatening situation (eg, stabilizing a potential cervical injury, dealing with an athlete in shock, diabetic coma, hypo- or hyperthermia, taking vital signs, activating emergency medical services, transporting injured athletes)
Health care administration	Performing skills such as recording patient data and injury assessments, documenting patient treatment, writing coaches' reports, insurance filing, physician referrals, appointments, and budgets.
Managerial time	The amount of time spent performing tasks associated with prepreparation and postpreparation of athletic events or facility management. Includes the following categories:
Custodial task	Ensuring a sanitary facility (eg, cleaning treatment tables and laundry, trash pickup, reorganization, putting away equipment).
Preparation task	Restocking, filling water coolers, ice bags, ice cups, bringing water to a practice field, setting up cooler or blood-borne pathogens station.
Unengaged waiting time	Refers to the amount of time students are not actively performing any cognitive, psychomotor, or affective skills/behaviors related to athletic training. The 2 components comprising unengaged time are down time and transition time. Includes the following categories:
Down time	Examples include doing homework, reading the newspaper, personal socialization with patients and other athletic training staff/peers, horseplay, inattentiveness during athletic practices, dressing, and rest room breaks.
Transition time	Examples include waiting for an athlete/patient and walking to/from facilities/activities.
Engaged waiting time	The amount of time spent attentively observing athletic practices for potential injuries or environmental hazards where one may have to perform an athletic training skill/behavior.

[a] Modified from Berry et al.[5]

Figure 1. Bug-in-ear technology.

Figure 2. Study procedures. Abbreviation: BIE, bug-in-ear.



unengaged waiting time, and (5) engaged waiting time (Table 1). We then expressed the time spent in each category as the average amount of time (%) spent over both observation sessions for BIE and control, resulting in 5 dependent variables for each technology.

Statistical Analysis. Because the researcher quantified the amount of time spent in each AT-CETF category with a stopwatch in real time, we used her observations to compare the time spent in each category between the BIE technology and control sessions with the assumption that the real-time quantification would be more accurate than the student's or preceptor's recall of time spent at the end of the day.

To determine the effect of BIE technology on time spent on various clinical activities, data for each of the 5 categories were first inspected for normality[20] to meet the assumptions for parametric testing. Paired samples *t* tests compared the average % time spent in the managerial and unengaged waiting categories. The Wilcoxon signed-rank test was chosen as the nonparametric analogue to the paired samples *t* tests for the instructional, clinical, and engaged waiting categories because they did not meet the assumption of normality.[21]

Additionally, because each category of clinical activity is composed of varying numbers of activities (Table 1), in the event of a significant test, we repeated the test on each of the constituent activities, when expressed as a percentage of time spent in its respective category. A priori significance level was set at $P < .05$.

To compare the perceptions of time spent in each clinical category between the student, preceptor, and researcher, a 1-way analysis of variance (ANOVA) was performed on the clinical, engaged, and unengaged categories. Post hoc *t* tests with Bonferroni corrections were performed for an overall significant ANOVA. The nonparametric Kruskal-Wallis test, which is the nonparametric analogue to the ANOVA, was performed for the instructional and managerial categories since these data from 1 of the groups did not follow the normal distribution. All analyses were performed in SPSS 24.0 (IBM, Armonk, NY).

RESULTS

A total of 21 participants from 3 athletic training programs participated in the study. Student participants (n = 13) included 11 females and 2 males with an average age of 22.0 ± 1.8 years and an average of 1.8 ± 0.9 years enrolled in their current athletic training program. Preceptor participants (n = 8) included 5 females and 3 males with an average age of 35.4 ± 10.4 years and an average of 3.5 ± 2.9 years of experience as a preceptor. The researcher and 8 preceptors observed 13 students' clinical experiences. Thirty-two total observations were completed for this study: 4 observations (2 control and 2 BIE) for each of the 8 groups, averaging 4.65 hours each and totaling 149 hours of observation (Table 2). One student participant missed her scheduled clinical experience during a control day and another student participant missed during her BIE day. The data acquired during the single session were used to represent the data for their

Table 2. Length of Observations for Each Group by Setting[a]

Institution	Group	Setting	Control		Bug-in-Ear		Total
			Day 1	Day 2	Day 3	Day 4	
Thornfield	1	Community college	5:15	3:48	5:06	3:14	17:23
	2	Private high school	4:35	5:03	6:04	4:00	19:42
	3	Club sports clinic	5:00	3:36	7:23	5:15	21:14
Pencey	1	Division I university	3:04	4:52	3:40	3:54	15:30
	2	Division I university	4:12	6:56	3:17	3:56	18:21
Walden	1	Rehabilitation clinic	4:45	5:22	4:58	5:08	20:13
	2	Public high school	3:52	3:47	4:00	5:30	17:09
	3	Public high school	5:39	6:22	2:19	5:00	19:20
Total time							148:53

[a] Time is shown in hours:minutes.

respective control or BIE days. Descriptive statistics for % time spent in each category are displayed in Table 3.

The paired samples *t* test revealed that less time was spent on managerial tasks when BIE was used compared to control sessions (8.2% ± 5.1% versus 14.6% ± 9.8% total time; $t_{(12)} = 3.3$, $P < .01$). There was no difference in percent of total time spent on unengaged waiting (22.0% ± 12.2% versus 16.1% ± 5.8% total time; $t_{(12)} = -1.7$, $P = .11$).

The Wilcoxon signed-rank test identified significant differences in the median amount of time spent in the instructional category. Less time was spent on instructional activities when BIE was used compared to the control sessions (median = 10.7% versus 12.7% of the total time; $Z = -2.4$, exact $P = .01$). No significant differences in time spent were observed during the clinical (median = 4.3% versus 36.2% of total time; $Z = -0.80$, exact $P = .46$) or engaged waiting (8.9% versus 11.3% of the total time; $Z = -0.2$, exact $P = .90$) categories.

When investigating the individual activities (Table 1) that may have driven the differences in the managerial category, a paired samples *t* test revealed no significant differences in the proportion of managerial task time spent doing custodial (55.4% ± 29.9% versus 63.3% ± 25.0% total managerial time; $t_{(12)} = -1.2$, $P = .27$) or preparatory (44.6% ± 29.9% versus 36.7% ± 25.0% total managerial time; $t_{(12)} = 1.2$, $P = .27$) tasks. This indicates that the larger proportion of time spent on managerial tasks during the control session could not specifically be attributed to either custodial or preparatory tasks.

When comparing the activities within the instructional category between the control and BIE sessions, the Wilcoxon signed-rank test identified a greater proportion of median time spent on spoken instructional time during the control condition compared to the BIE session (median = 65.9% versus 34.8% of total instructional time; $Z = -2.8$, exact $P < .01$). There were no differences in proportion of the total instructional time spent between control and BIE sessions for the other activities (practical instruction [median = 4.5% versus 3.0% of total instructional time; $Z = -0.67$, exact $P = 0.56$], observational instruction [median = 26.4% versus 35.0% of total instructional time; $Z = -1.6$, exact $P = .11$], or educational evaluation [median = 0.0% versus 0.0%; $Z = -1.5$, $P = .16$]).

When comparing the perceptions of proportion of time spent in each category between students, preceptors, and the researcher, the ANOVA revealed a significant difference between groups in their perceptions of % time spent in the unengaged waiting category during both the control ($F_{2,36} = 7.4$, $P < .01$) and the BIE ($F_{2,36} = 8.7$, $P < .01$) sessions. The post hoc *t* tests indicated that the proportion of the total time

Table 3. Descriptive Statistics (Means ± SD and 95% Confidence Intervals) for Average Time Spent (% Total) During Clinical Experiences in Control Sessions and Experimental Sessions Using Bug-in-Ear Technology as Observed by Students, Preceptors, and the Researcher

	Student (N = 13)	Preceptor (N = 8)	Researcher (N = 1)
Control			
Instructional	24.8 ± 13.7 (16.5, 33.0)	21.1 ± 11.8 (14.0, 28.2)	16.1 ± 11.1 (9.5, 22.8)
Clinical	42.2 ± 12.4 (34.7, 49.7)	44.5 ± 16.5 (34.5, 54.4)	40.7 ± 22.1 (27.4, 54.1)
Managerial	12.8 ± 10.9 (6.2, 19.3)	15.1 ± 14.4 (6.4, 23.8)	14.6 ± 9.8 (8.7, 20.5)
Unengaged waiting	10.5 ± 5.0 (7.5, 13.6)	7.8 ± 5.8 (4.3, 11.3)	16.1 ± 5.8 (9.2, 20.1)
Engaged waiting	9.7 ± 9.2 (4.2, 15.3)	11.5 ± 9.7 (5.6, 17.3)	12.5 ± 11.9 (5.3, 19.7)
Bug-in-ear			
Instructional	23.2 ± 13.3 (15.2, 31.2)	26.5 ± 13.7 (18.2, 34.7)	13.3 ± 12.6 (5.7, 21.0)
Clinical	39.6 ± 23.1 (25.6, 53.5)	36.7 ± 18.1 (25.8, 47.6)	43.7 ± 24.5 (28.9, 58.5)
Managerial	9.6 ± 7.5 (5.1, 14.2)	12.0 ± 7.9 (7.2, 16.8)	8.2 ± 5.1 (5.1, 11.3)
Unengaged waiting	11.3 ± 7.3 (6.9, 15.7)	8.6 ± 4.8 (5.7, 11.5)	22.0 ± 12.2 (14.6, 29.3)
Engaged waiting	16.3 ± 15.0 (7.3, 25.4)	16.3 ± 20.0 (4.3, 28.3)	12.8 ± 13.6 (4.6, 21.0)

spent was underestimated by both students (control = 10.5% ± 5.0% versus 16.1% ± 5.8% of total time, $P = .048$; BIE = 11.3% ± 7.3% versus 22.0% ± 12.2% of total time, $P = .01$) and preceptors (control = 7.8% ± 5.8% versus 16.1% ± 5.8% of total time, $P < .01$; BIE = 8.6% ± 4.8% versus 22.0% ± 12.2% of total time, $P < .01$) compared to the researcher. There were no differences in perceived proportion of time spent during the other categories (P value range: .72–.86).

DISCUSSION

Our primary findings were that when students and preceptors used BIE technology, the students spent significantly less time on managerial tasks (eg, water preparation) and received less spoken instruction from their preceptors. Additionally, both students and preceptors underestimated the amount of time spent on unengaged waiting (eg, down time). Considering the importance of engaging clinical experiences to professional development as athletic trainers,[2] it is important to ensure students are engaged as much as possible in meaningful active learning during clinical experiences. This study adds to our understanding of students' active learning time during clinical education.

Bug-in-Ear Technology and Active Learning Time

Bug-in-ear technology has been used in other experiential education settings to improve students' confidence, autonomy, and hands-on experience.[13–16] Given these promising findings in teacher education and medical education,[13–16] we sought to explore the impact of BIE technology on active learning time spent by athletic training students. We found the use of BIE technology significantly reduced the time students spent on managerial tasks, specifically preparation tasks such as filling water coolers and setting up practice fields. Considering that these tasks do not contribute to the development of athletic training competency, this is a positive influence of BIE technology. While these basic skills are important to the daily function of athletic training, which students should be able to perform, redirecting some of this time to patient interactions may be more beneficial for student learning. It is possible that these slight changes in activity time were not attributed to BIE technology, but rather the week that passed between the control and BIE observation weeks. Students may have simply become more efficient with preparatory tasks over time, or perhaps there were more opportunities for engaging in observation of their preceptor, the athletic training clinic, or athletic practice. Berry[7] found that active learning time increased as a student progressed through weeks of the clinical experience, suggesting time might simply influence student responsibility during clinical education. Thus, our findings may have been due to the influence of time rather than the BIE technology.

We also found that the use of BIE technology slightly reduced the amount of spoken instruction preceptors provided to students. Considering that students perceive instruction to be a valuable component of clinical education experiences,[11,22,23] this is potentially a negative influence of BIE technology. However, although statistically significant, the 2% reduction in instructional time observed equates to about 5.5 minutes over the course of the average 4.65-hour session observed. It is difficult to conclude whether this has a real impact on student learning. However, this reduction may be reflective of an effect of BIE technology where an unplanned teachable moment may be lost due to this more efficient communication method in which the preceptor and student do not have to be in close proximity at all times. Future studies should explore the value of preceptor instruction in relation to other activities completed during clinical education experiences.

When comparing active learning time with and without BIE technology, our results also demonstrate that the amount of time students spent in each category varied widely between clinical experiences (Table 3). These differences may be attributed to the type of clinical setting, where previous researchers[5–8] have noted differences in active and engaged learning between clinic, secondary school, and intercollegiate athletics environments. Likewise, differences in time spent may also be attributed to different preceptors' approaches to student interactions.[2,3] Additionally, participants reported that 22% of the days recorded were "atypical." Examples of an "atypical" day as described by participants were "it was a football game day" and "practices were more spread out because there were no classes today." These atypical days likely influenced the range of student experiences in addition to the variability between settings. These varying experiences speak to the value of providing students with diverse clinical education experiences throughout their professional preparation.[7,24] Clinical education coordinators should consider the active learning opportunities available in different settings when planning students' clinical experiences. Future research should examine the variability of active learning between different settings and preceptors more extensively.

Time Spent During Clinical Education

Several authors[5–7] have previously identified that students spend 30% to 59% of their time during clinical education on active learning activities such as the provision of patient care and instructional interactions with their preceptors. Our finding of students spending about 57% of their time on active learning activities is comparable to the report by Berry et al[5] of participants spending 59% of their time engaged in active learning. Other studies have found athletic training students spent 41%[7] and 30%[6] of their time on active learning tasks.

While it is promising that students are spending the majority of their time engaged in active learning during clinical education, students are still spending a significant amount of time on tasks unrelated to patient care or clinical learning. These small differences between the current and previous studies[5–8] may be attributed to the different study designs and modifications to the AT-CETF rather than an actual change in behavior over time. Additionally, athletic training education has undergone several changes since these studies, including transitioning from an internship to a curriculum route to certification in 2004, possibly influencing the change in student experiences. Regardless of the slight differences, applying hands-on patient care during clinical education experiences is important to the students' development as clinicians.[3,4] Engaging clinical experiences help students gain confidence, develop critical thinking skills, and familiarize themselves with the athletic training profession.[2,3,22] Clinical education coordinators should work with preceptors and students to maximize active learning time spent during clinical education.

Actual Versus Perceived Time Spent

While students', preceptors', and researcher's time estimates on the AT-CETF were usually in agreement, we did find that students and preceptors significantly underestimated the amount of unengaged waiting time students spent during clinical education experiences. These differences occurred both with and without the use of BIE technology. At the time of this study, no previous research had been conducted comparing actual versus perceived time spent on active learning during clinical education. However, Rich[11] conducted a study on preceptors' and students' identification of teachable moments during clinical education. She found that preceptors and students identified identical teachable moments only 22% of the time.[11] These findings suggest that preceptors and students may not be fully aware of their activities spent during clinical education experiences. This may be because they are focused on task completion rather than student learning opportunities, not communicating regularly during clinical education experiences, or not reflective regarding how they spend their time throughout the day. Clinical education coordinators may consider formally assessing students' time or informally observing students' behaviors during site visits to provide another perspective on students' time spent during clinical education. This information can then be used as a basis for discussion in preceptor meetings and workshops to help improve students' active learning time during clinical education.

LIMITATIONS AND FUTURE RESEARCH

While the design of our study provided extensive detail of the participants included in the study, the small number of participants may limit the generalizability of results to the broader population of athletic training programs. Specifically, this study was conducted within 3 undergraduate athletic training programs in 1 geographic area, potentially limiting the generalizability of the findings to master's level athletic training programs with different preceptor and student demographics than those included in this study. We also captured students' active learning over a 3-week time period at various times during the fall semester; active learning experiences may change at different points in a semester or year. Examining the use of BIE technology at different times of the year, and with a counterbalanced design, may provide a greater understanding of its application to athletic training clinical education. We also recognize that the majority of our student and preceptor participants were female and white. While this does align with the national demographics of athletic trainers,[18] we acknowledge that these experiences may differ from those of males and participants of other ethnicities.

Participant behavior may have been influenced by participation in the research study, the presence of the researcher, and the novelty of BIE technology. Differences in perceived active learning time may have been attributed to the fact that the researcher recorded this in real time whereas participants reported this at the end of the day. Future research on active learning would be strengthened by examining a more diverse group of participants and programs across the country, in addition to looking at how active learning changes over the course of a semester, academic year, and progression through the athletic training program.

CONCLUSIONS

Engaging clinical experiences that provide ample time for hands-on patient care and active learning are crucial to the development of athletic trainers.[2] Students in our study spent over half of their time during clinical education engaged in active learning, with the remaining time spent on managerial tasks, waiting time, and down time. While these proportions may be reflective of typical athletic training practice, planning experiences that emphasize patient care skills should supersede experiences set up to simply mimic the time patterns of real-life clinical practice (including long periods of waiting, down time, and unengaged waiting) with the goal of assimilating students into the profession. We maintain that it takes less time for a student to learn the typical daily practices of athletic training than it does to gain competency in athletic training skills and knowledge. Students and preceptors significantly underestimated the time students spent on down time, which is of concern considering that unengaged waiting time has no educational value and may be a detriment to students' experiences.[8,9] Clinical education coordinators and preceptors should consider evaluating how their students are spending clinical education time to maximize their educational experiences. Bug-in-ear technology may be used to decrease the amount of time spent on managerial tasks, but may negatively impact spoken instruction delivered by the preceptors. Clinical education coordinators and preceptors should weigh the pros and cons of using BIE technology before integrating it into their athletic training programs.

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