Benefits of Video Feedback on Low Performing Female Cadets in Physical Education: An Action Research Study

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Abstract

Learning novel physical motor skills can be frustrating for some cadet students in the military movement class at the academy. A lack of clear feedback further exacerbates the problem for students' skill development. This action research study examined the benefits of using video recording as augmented feedback to inform motor skill development in an applied gymnastics course at a service academy. Furthermore, it sought a more efficient method of providing female participants individualized feedback with the goal of decreasing the physical skill gap between the males and females at the academy. The primary aim was to identify the effects of video feedback on the instructor/student process for skill evaluation and skill improvement involving low female performers. The secondary aim was to examine the extent that giving video feedback promoted the ten female students' motivation to learn, use of deliberate practice, autonomy, and competence. Data analysis revealed skill improvement on at least one skill event in the participants. Findings demonstrated that students perceived video feedback as an effective method for enhancing skill improvement in gymnastics class. These findings indicate video feedback can be used to improve motivation, deliberate practice, competence, and autonomy. The ability to visualize performance cues for the students may also result in faster motor skill acquisition. The study suggests video feedback is an effective method of augmented feedback for students struggling with novel physical motor skill progressions.

Keywords: video feedback, augmented feedback, skill acquisition, female cadets, motivation, autonomy, competence

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Within the Physical Education Department at the academy, instructors are constantly seeking improvements and efficiencies within the curriculum and program of instruction. The core physical education classes are a graduation requirement. This means that every cadet at the academy must pass these classes to obtain a commission as an officer in the United States Army (Gist, 2016). The military movement class is one of the largest hurdles for the female cadets. However, this physically demanding course is a great indicator of future success throughout the physical program at the academy. As leaders, the academy is responsible for giving purpose, direction, and motivation to their students (Baghurst et al., 2015). One of the biggest challenges is motivating lowest performers to effectively use their practice time to improve their physical skills (Ellison & Woods, 2016). One of the greatest limiting factors to skill acquisition for students is the lack of quality feedback provided during instruction (Coelho, 2019; Turner & West, 2013). Performance based feedback is a key part to effective learning. The design of this study added to the existing sports and physical education literature on the benefits of using video feedback to inform motor skill development and improve student motivation (Potdevin et al., 2018).

While female cadets only make up about 24% of the students at the academy (PAO, 2019), females account for about 40% of the low performers and failures in the military movement class. According to the end of year report (Goetz, 2020), there were 68 course failures in the academic year 2019-2020. Goetz found that female students accounted for 27 of the course failures and failed the course at twice the rate of the enrolled males. The lower performing female students struggle to score points on many of the physically demanding tasks in the course. Low performing students lack intrinsic motivation and self-confidence (Erturan & Hulva, 2019) and are therefore less likely to use their free time to work on their skills. Given the minimal time for classroom instruction and modeling (Coelho, 2019), instructors seek ways to boaster student participation and buy-in so that they benefit from the feedback provided by instructors (Chatoupis & Vagenas, 2018).

This action research case study sought a more efficient method of providing female students individualized feedback with the goal of decreasing the physical skill gap between the males and females at the academy. The purpose of this study was to determine how video feedback effects skill performance in physical education classes and the perceived benefits of video feedback for the low performing females in an applied gymnastics class. The research questions guiding this study were:

1. What are female cadets' perceptions of video feedback for skill evaluation and skill improvement?
2. How do female cadets perceive video as an additional method of feedback?
3. How do female cadets perceive video feedback as a method to promote motivation for deliberate practice?
4. How do female cadets' perceptions of their skills change when video is added as an additional method of instructor feedback?

Literature Review

The two largest factors for inability to perform gross motor skills are a lack of physical abilities (Evans, 2013) or the lack of productive feedback (Roure et al., 2019). Research of Vanderhasselt et al. (2018) suggests that gender effects the prevalence of confidence and coping skills. Furthermore, current research suggests female students are less achievement motivated

compared to male students in physical education (So-Chen et al., 2016; Ulstad et al., 2019). Consequently, female students may respond by lowering their expectations for success in challenging tasks and avoiding the stressor (Yeung, 2011). Additionally, Yeung found that female students may be inclined to try harder to overcome the difficulties they encounter in the classroom. Outcomes from traditional gender stereotypes have contradictory findings. Berlin and Dargnies (2016) found female students are more apt to cope and avoid in the presence of stressors due to a fear of failure. They reported that female students displayed greater degree of effort in challenging tasks. Vanderhasselt et al. (2018) found that emotional based coping, avoidance of problems brought about by stressful situations, predicted higher levels of anxiety and depression. Research suggests that some females appear more apt to cope and avoid due to a fear of failure.

A limiting factor to skill acquisition for students is the lack of quality feedback during instruction (Turner & West, 2013). Augmented feedback is a vital part to learning (Kangalgil & Özgül, 2018). According to Smith (2011), instructors must present augmented feedback to the learner as often and as soon as possible after an attempt to enhance the evaluation of movement and reinforce the memory representation. Providing clear and concise feedback will help students properly practice and develop the desired physical skills (Hatzipanagos & Warburton, 2009). Efficiency will generate more time to spend on skill mastery (Smith, 2011). So-Chen et al. (2016) concluded instructors need to seek efficient teaching methods to achieve course goals and to provide their students with correct information to enhance learning, behavior, knowledge, and positive student attitudes. Erturan (2014) found the nature of teaching styles, type of feedback, time spent on the task, size of the class, and the nature of learning content are the most crucial factors that are related to teaching effectiveness. In addition, instructors need to foster an effective teacher-student interaction that provides a participatory environment for all students (Griffin et al., 2013). Overall, effective feedback should increase student motivation (Cecchini et al., 2019) while giving positive reinforcement of goals (Baghurst et al., 2015) and showing the correct and incorrect actions in the execution of a skill (Hattie & Timperley, 2007). Instructor feedback enhances student learning (Sharma et.al., 2016) through an evaluation of their contributions, discrepancies, and how to fix their errors (Berlin & Dargnies, 2016).

Physical education teachers are in a unique position to capitalize on the use of video in the classroom (BenitezSantiago & Miltenberger, 2016). Potdevin et al. (2018) found video modeling and video feedback are effective tools to aid trainers. Boyer et al. (2009) examined the use of expert video modeling combined with video feedback of performance execution of three complex gymnastic skills. While the athletes were not able to achieve perfect performance during the study, the gymnasts all demonstrated increases in skill performance and improved skill retention after the intervention. Video analysis gives a degree of freedom and choice for the student's feedback reception (Laughlin et al., 2019). Students can also incorporate select peer feedback to go with the review of video recordings (Potdevin et al., 2018) to review their own trials and self-assess, thus taking charge of their learning process (Laughlin et al., 2019). Video analysis for every lesson and every skill is not practical. However, video analysis can serve as an effective tool for supporting quality instruction and assessment of skills.

Four theoretical frameworks that underpinned this research were (A) social learning theory (Bandura, 1977; Chng & Lund, 2018); (B) self-determination theory (Baghurst et al., 2015; Drost et al., 2018; Ryan & Deci, 2000); (C) motor learning theory (Schmidt, 1975; Sharma et al., 2016); and (D) theory of feminism (Avci, 2016; Corey, 2009).

Methodology

Action research design connects theory to practice and has a connection to school improvement (Mertler, 2017). This study used a mixed-methods approach utilizing data from instructor observations, pre/post-test questionnaires, semi-structured interviews, video recordings, and student self-assessments. Through extreme case sampling, the low performing female students (N=10) within the 8-week gymnastics course were provided video feedback on their graded attempts of three gymnastic skills.

Setting and Participants

The research site was a four-year military service academy. The school enrollment was 4,400 with 20% women (PAO, 2019). The study occurred during the 8-week, 19-lesson military movement course that exposed cadets to a variety of basic movement skills, with 28 physical skills being taught and tested. Each 50-minute session consisted of roughly two skills per lesson with structured time for a master demonstration, teaching the skill progression, free-practice time, and testing (Coelho, 2019). The military movement class is a graduation requirement that all students must complete during their freshman year to obtain a commission in the United States Army.

The student to teacher ratio in the class was 10:1. Each class had between 35-40 students. The average class consisted of about 30 males and 5-10 females. Extreme case sampling was used to select the lowest performing females in the class (those who actively displayed avoidance and poor coping techniques during skill practice time). Ten female students who met this criterion and were currently enrolled in the military movement course volunteered to participate in the study. There was no extra incentive to take part in the study beyond the potential benefits of the intervention. All participants returned signed copies of the informed consent prior to engaging in the study and were assigned unique IDs. The age range of the participants was 18-23 with an average age of 19.30 (SD=1.40). The majority (66.7%) of the participants were Caucasian with the remaining having a diverse mix of ethnicities. No additional demographic information was collected. The participants also described their overall fitness level at a range from *fair* to *excellent* with a median of *fair* and had no limiting physical profiles that inhibited their ability to complete the requirements of the course.

Intervention

The study coincided with an eight-week quarter of the academic year to align with a class in session. The study took place over the course of six weeks during the additional instruction time outside of the regularly schedule class time. The program of instruction for the class included additional instruction periods scheduled throughout the quarter. The purpose of the additional instruction sessions was to provide lower performing students within the gymnastics course an opportunity to practice, review video feedback on their graded attempts of three gymnastic skills to identify performance deficiencies, and retest on their class skills. The procedures for the intervention were divided into three stages: pre-test, test, and post-test.

The pre-test stage included all the activities the participants performed prior to participation in the intervention. The method of skill progression was in accordance with the instructor manual (Coelho, 2019). Participants also completed the pre-test questionnaire. The test stage began once the students had received all the lessons covering the selected skills and covered all the graded attempts during the intervention with the use of video feedback and instructor feedback to influence skill acquisition. The participants learned the performance cues of the selected skills during the class periods. The students were provided a master demonstration followed by progressions of each skill. After each graded attempt, the participants

were allowed three minutes of deliberate practice time to work on their deficiencies prior to taking their next graded attempt of the skill. Effective use of practice time during the study was defined as a participant using the practice time to actively work on any of the components of the assigned skill. Verbal cues on the points of performance that the student needed to fix to earn a higher score on the skill were provided by the instructor. The instructor also replayed video of the attempt with the student to identify performance deficiencies. Once the student felt comfortable with the skill, they were able to make one or two graded attempts with instructor feedback on each attempt. Once the attempts are made for all three skills, the final stage of the intervention, the post-test stage, occurred. At this point, the participants completed the post-test questionnaire and individually met with the lead researcher for a semi-structured interview concerning the process and the intervention.

Data Collection

This study used multiple methods of data collection including pre/post-test student questionnaires, instructor observations, semi-structured interviews, video recordings of graded attempts, and student self-assessments. All participants completed three attempts of three separate gymnastics skills: cartwheel, rope climb, and shelf mount.

Pre-Post Test. The study used the earlier work of Standage et al. (2005) and their assessment of self-determination theory in school physical education for the pre/post-test questionnaire measures of autonomy, perceived competence, and motivation. Measures of autonomy included six items that corresponded to the participant's level of familiarity and comfort with the selected skills. During the pre-test stage, prior to each attempt, students provided an estimate of their projected score on the attempt with measures of competence assessed using six items that were modified from the perceived competence subscale of the 18-item Intrinsic Motivation Inventory previously created by McAuley et al. (1989). Measures of motivation to learn were captured using 10 items, four items to assess levels of intrinsic motivation, four items to assess a lack of motivation, and two items to assess levels of extrinsic motivation. The questionnaire used a 5-point Likert scale (1= Strongly disagree to 5 = Strongly agree). Additionally, the distinct types of motivation were assessed using the Perceived Locus of Causality scale developed by Goudas et al. (1994). The nine items were divided into three subscales that examined intrinsic, extrinsic, and a lack of motivation for the military movement class. The scores from these three subscales were used as indicators for motivation. A high score in a subscale reflects a strong indication of agreement with the motivational methods. A low score in a subscale reflects a lack of agreement with the motivational method.

Instructor Observations. Observations of the participant's active use of their deliberate practice time was recorded on a researcher created data sheet. The number of practice attempts that each student took was noted on the same data sheet. Notes on whether the participant spent time viewing their video feedback again during the practice session was also captured on the data sheet.

Semi-Structured Interviews. Semi-structured, one-on-one interviews were conducted with the participants before and after the intervention. Twelve open-ended questions were used to measure the benefits the cadets identified during the intervention. The interviews also assessed how giving video feedback impacted the instructor/cadet process for skill evaluation and improvement.

Video Recordings. The instructor video recorded each graded attempt of the skills using standard video recording settings on the participant's phone to inform the student about their quality of movement during the execution of the physical task. The instructor focused the feedback on the

visual depiction of the verbal cues of the skill being tested. The participant then viewed the recording of their attempt with the instructor to identify the key areas for skill improvement. Using the video recording, the instructor visually showed the student what elements of the skill were performed correctly, incorrectly, as well as gave the participant a grade for the attempt. ***Assessments***. Cadets provided an estimate of the score they felt they would get when they performed the skill for a grade prior to each attempt execution. The students also provided a rating level to address their previous experience and comfort level with each task prior to the first attempt. The experience level was based on a 5-point Likert scale (1= *I have never heard of the exercise* to 5 = *I am an expert*). The attempt score was also collected based on the performance scores of the participants. Data for each participant was collected at the end of each session for performance on the task.

Data Analysis

The quantitative data were collected from the questionnaires and assessments. Quantitative data were analyzed to illustrate the rate of skill acquisition and improvement as well as the level of motivation of participant. The scores were analyzed for each skill using repeated measures ANOVA to investigate changes in the mean over the course of three or more points in time. A Pearson's correlation coefficient was used to measure the statistical relationships. Qualitative data was analyzed for themes through content analysis to reflect participants perceptions, feelings, attitudes, and opinions of the study's intervention.

Results

On the pre-test, measures of autonomy corresponded to the participant's level of familiarity and comfort with the selected skills. The participants indicated a median value of familiarity of slightly familiar with the cartwheel, very familiar with the vertical rope climb, and moderately familiar with the shelf. The participants indicated a median comfort level of neutral with the cartwheel, comfortable with the vertical rope climb, and uncomfortable with the shelf. The participants' self-confidence and competence responses indicate a mixed level amongst the group. Most of the group (90%) felt they would be able to perform the skills well on their third graded attempt. However, the group was split concerning their satisfaction of their performance of the skills. Only 40% of the group agreed they would be satisfied with their performance while 30% disagreed. The participants overwhelming believed the class would boost their confidence. Most of the group (90%) felt they would be confident on the skills after working on the tasks in class. When comparing their performance on the skills with their peers, only 30% of the group felt they would do well compared to their peers. The participants indicated an elevated level of support for intrinsic motivation. Nearly all participants (90%) agreed that they find "pleasure and satisfaction" in learning new things. Most of the group (90%) agreed they go to the class to "prove to themselves" they can complete the class. However, only 30% of the participants agreed that military movement class teaches "things that interest me." The participants also indicated an elevated level of support for extrinsic motivation for the course where 60% of the group agreed the course would help them "better prepare for military career." Additionally, only 40% of the group agreed that success in the class will make them "feel important." The participants also indicated a low level of support for a lack of motivation for attendance and participation in the military movement course. The bulk of the group (80%) felt like they understood the purpose of military movement and why they needed to take the course. Likewise, 70% of the group did not feel like the class was a "waste of time." However, 20% of the group agreed that they did not "understand what they are doing" in the class. Overall, the group indicated an elevated level of motivation to attend the class and saw the value and importance of taking the class.

The participants were asked to predict their attempts just prior to making each of their three video recorded attempts. The predicted scores were based on their previous exposure to the skill during the class instruction and deliberate practice sessions. The mean predicted score for all video recorded attempts of the cartwheel was 2.37 (SD=1.61). The mean predicted score on the vertical rope climb was 3.67 (SD=1.69). The mean predicted score on the shelf was 3.70 (SD=1.90). After the students provided their predicted performance scores, they completed one graded attempt of the skill. The graded attempt was recorded using the student's video recording application on their cell phone. The mean graded score for all video recorded attempts of the cartwheel was 1.47 (SD=1.53). The mean graded score on the vertical rope climb was 3.13 (SD=2.16). The mean graded score on the shelf was 3.33 (SD=2.14).

Using a repeated measures ANOVA, the findings indicate there was a statistically significant increases in scores within the group for the cartwheel and the shelf. Video feedback had a statistically significant effect on the performance of the cartwheel, $F(2, 18) = 21.50$, $p < .001$. Additionally, the participants significantly increased their performance on the shelf, $F(2, 18) = 3.58$, $p = .049$. Contrary to the cartwheel and shelf, the participants did not significantly increase their performance on the vertical rope climb, $F(2, 18) = 2.62$, $p = .10$. However, the group did increase their mean score on the vertical rope climb from their first attempt, M= 2.90, to their final attempt, M= 4.10. Moreover, the students made significant adjustments to their predicted scores on the shelf between attempts, $F(3, 27) = 4.23$, $p = .014$. The group did not make significant adjustments to their predicted scores on the cartwheel, $F(3, 27) = 2.57$, $p = .075$, or the rope, $F(3, 27) = 2.28$, $p = .10$. While the changes in the group's predicted outcomes were not statistically different for the cartwheel or rope, the difference between the predicted and actual scores for the individuals within the groups improved significantly for the cartwheel.

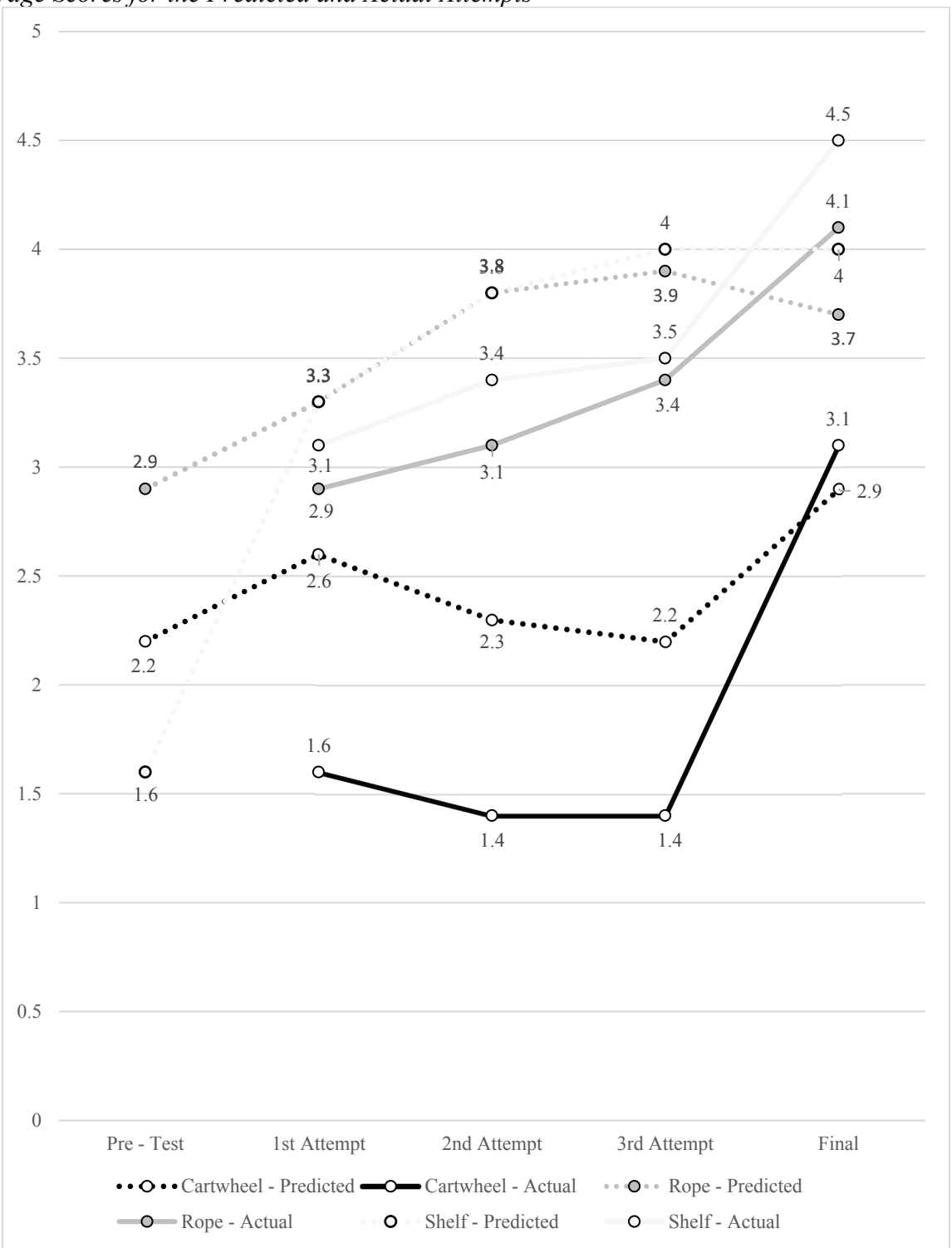
The participants overestimated their abilities on the cartwheel by an average of 1.0 point on their first attempt and underestimated themselves by an average of 0.20 points on their final attempt. The improvement in their accuracy of predictions on the cartwheel was significant, $F(2, 18) = 14.48$, $p < .001$. The participants had overestimated their abilities on the vertical rope climb by an average of 0.40 points and underestimated their skills by an average of 0.40 points on their final climb. The group did not significantly improve the accuracy of their predictions on the vertical rope climb, $F(2, 18) = 3.23$, $p = .063$. While the group did make significant changes to their predictions on their performance of the shelf, they did not significantly improve the accuracy of their predictions, $F(2, 18) = 2.16$, $p = .14$. The group went from overestimating their skills on the shelf by an average of 0.20 points to underestimating their scores by 0.50 points.

Overall, the group saw their mean scores improved in each skill. The group had a mean score increase of 1.50 (SD=.71) on the cartwheel. The group had a mean score increase of 1.20 (SD=1.69) on the vertical rope. Additionally, the group had a mean score increase of 1.40 (SD=.97) on the shelf (see Figure 1).

The Pearson's r correlation analysis for the cartwheel revealed limited correlation between the number of practices and the final score, r=0.37, as well as the relationship between practices and score improvement, r=0.52. However, for the vertical rope climb there was a strong positive correlation found between practices and score improvement, r=0.88, $p < .001$. There was minimal negative correlation found for the shelf between practices and score improvement, r=-0.19, and nearly no correlation between practices and their final score, r=-.05.

Figure 1

Average Scores for the Predicted and Actual Attempts



Data analysis revealed skill improvement in the participants. Overall, all the participants improved their task score on at least one event. Furthermore, half of the participants increased their task score on all three events. All the participants identified the video feedback as helpful

for improving at least one of their skills. Within the group, 70% of students reported an increase in perceived competence, 90% reported an increase in autonomy, and 80% of the students reported an increase in motivation. Overall, 90% of the participants recommended the future use of the video feedback in the performance of each of the performance skills.

Major themes that emerged during the qualitative data analysis included clarity of the feedback, changes in self-awareness, changes in deliberate practice, and changes in performance. The participants identified many benefits from the use of video feedback to inform their skill development. Video helped provide greater clarity for the knowledge of performance cues for the student as well as a better understanding of their deficient components of the skill. The video feedback was also shown to increase the accuracy of their predicted performance. Another significant finding from the study was the increase in self-regulation and autonomy that also lead to an increase in the use of deliberate practice time. The participants also experienced an increase in their motivation to learn while identifying support for both intrinsic and extrinsic motivational levels for the class. The study also found video feedback was beneficial for the participants' increased self-awareness and the participants preferred video feedback as their method of instructor feedback in physical education classes.

Implications for Practice

This study aimed to improve the feedback process used in the military movement class at the service academy by generating data concerning the efficiencies and effectiveness of video feedback. The findings from this study support video recordings also offer multiple benefits that could assist physical education instructors as well as students seeking a more efficient and effective feedback process. Instructors are encouraged to utilize video feedback throughout the physical education curriculum to enhance instruction for lower performers within the program. The findings of this study also suggest video feedback is an effective method of augmented feedback for students struggling with novel physical motor skill progressions. These findings demonstrated that students perceived video feedback as an effective method for enhancing skill improvement in their gymnastics class. Video feedback helped the study participants provide greater clarity for the knowledge of performance cues as well as providing them a better understanding of their deficient components of the skill. Additionally, these findings indicated video feedback could be used to improve motivation, deliberate practice, competence, and autonomy. The utilization of video feedback was shown to improve participants task scores as well as increase the accuracy of their predicted performances. Finally, the participants found video feedback to be their preferred method of feedback for learning physical skills. They found video feedback to be more beneficial than instructor verbal cues on all performed skills. The augmented feedback provided them a clear understanding of their current ability level as well as an improved understanding of the areas required to improve. Suggesting that the ability to visualize performance cues for the students may also result in faster motor skill acquisition.

Another suggestion for the implementation of video feedback is to incorporate peer feedback into the process. Allowing a partner feedback loop reduces the requirement for the instructor to serve as the lone source of feedback in the learning process. A peer could video record a practice attempt and then review the footage with the student. Reviewing the video should help students gain awareness of the key components of the skill while seeking methods for how to improve upon their deficiencies. In addition to helping reduce the time requirements of reviewing video during the class period, students could have their attempts recorded and then review the footage after class on their own time.

Limitations

The study relied on self-reported ratings for perception of feedback effectiveness. The study also included only the lowest performing female members of the class. Higher performing students may not see as much benefit from video feedback regarding their skill development or as a source of motivation. Another limitation of the study was a small sample size of ten participants which decreased statistical power of the study and is not representative of the student population at large. However, the small sample size was selected due to the population of available participants for the study. Finally, the study examined a unique population and unique set of skills. While the fitness levels of the selected participants may be below average of their peers at the academy, they have an average level of fitness when compared to their peers at other universities. The selected skills are unique to the requirements of the military academy and are not a common skill found in many physical education courses.

Compliance with Ethical Standards

Conflict of Interest: The authors declare they have no conflict of interest.

Research Involving Human Participants: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent to Participate: Written, informed consent was obtained from individual participants included in this study. No identifying information about these participants is included in this article.

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