Perceptions of Heart Rate Monitor Use in High School Physical Education Classes

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Abstract

Incorporating technology into the physical education curriculum is becoming a popular strategy in which teachers can assess, motivate, and provide feedback to students regarding their physical activity participation during class. The purpose of this exploratory study was to gain a greater understanding of high school students' perceptions of using heart rate monitors during physical education class. Qualitative data were collected through focus groups with students who had utilized heart rate monitors during the previous year of physical education class. Data were analyzed through inductive content analysis. Three major themes emerged from the data and indicated that 1) the use of heart rate monitors to determine physical education class grades, 2) students' perceptions of fitness levels, and 3) the consistency with which physical education instructors used heart rate monitors all impacted students' perceptions of heart rate monitor use in physical education classes. The Self-Determination Theory was utilized as the framework for presenting findings. The implications of these findings for teaching professionals are discussed and explain how the use of technology may impact student perceptions of physical education classes and how these perceptions affect motivation. Future studies should address how technology use can be implemented to facilitate levels of intrinsic motivation in physical education students.

The health of adolescents in the United States is quickly declining due in part to an increase in sedentary behaviors and a decrease in physical activity (Ogden, Flegal, Carroll, & Johnson, 2002). It is recommended that school age children participate in at least 60 minutes of moderate to vigorous intensity physical activity every day (Koplan, Liverman, & Kraak, 2005; Malina, 1996; National Association for Sport and Physical Education (NASPE), 1998, 2001, 2004; U. S. Department of Health and Human Services (USDHHS), 1996; U. S. Department of Agriculture, 2005). Participation in regular physical activity helps prevent excess adiposity, thus impacting the public health concern of the growing obesity epidemic (Ogden et al., 2002; USDHHS, 1996). The Youth Risk Behavior Surveillance Study (YRBSS) summaries of 2005 reported that only 35.8% of high school students participated in 60 minutes or more of moderate to vigorous intensity physical activity on at least five of the previous seven days and that 9.6% of high school students did not engage in any moderate to vigorous intensity physical activity during the seven days prior to completing the survey (Eaton et al., 2006).

The National Association for Sport and Physical Education (NASPE, 2004) has recommended that every student from kindergarten through twelfth grade should have the opportunity to participate in quality, daily physical education. Physical education enables students to develop knowledge, skills, and confidence that are important predictors of current and future participation in physical activity and sport experiences (Haywood, 1991). Only 3.8% of elementary schools, 7.9% of middle schools, and 2.1% of high schools provided physical education to students at levels meeting NASPE's National Standards for Physical Education recommendations of 150 minutes (elementary school) or 225 minutes (middle and high school)

per week for 36 weeks a year (Kolbe, Kann, & Brener, 2001; Lee, Burgeson, Fulton, & Spain, 2007; NASPE, 1998). Since the majority of U.S. schools are not meeting NASPE's recommendation of adequate instructional time, it is up to physical education teachers to maximize the time they have with students to provide experiential opportunities, meaningful content, and appropriate instruction.

Technology-based interventions in physical education curricula (e.g., pedometers, heart rate monitors, DanceDanceRevolution) have become popular in recent years as a means to motivate technologically savvy students to participate in physical education class. These monitoring devices can provide teachers with an objective method of assessing students' physical activity (Morgan, Pangrazi, & Beighle, 2003; Scruggs, Beveridge, Eisenman, Watson, Shultz, & Ransdell, 2003; Tudor-Locke, Lee, Morgan, & Beighle, 2006; Wilde, Corbin, & LeMasurier, 2004). Technology can be an important tool when used properly in the instructional setting, providing immediate, concrete feedback to the student and instructor regarding the student's execution of a skill or physiological response to exercise. For example, heart rate monitors can show students that they are exercising in their target heart range, which can be beneficial for levels of motivation (Pangrazi, Beighle, & Sidman, 2003).

The use of technology is not without its limitations. There are a variety of measurement and practicality issues to consider when implementing technology into the curriculum (Welk, Corbin, & Dale, 2000). Cost, reliability, validity, ease of use, understanding of purpose, and durability of technology can potentially foster (or hinder) student learning and physical activity. The validity of utilizing heart rate monitors to assess physical activity in youth ranges from r = .42 to r = .71 when compared to other measures such as observation, accelerometers, pedometers, and self-report (Janz, 2002), and should therefore be used with caution. Woods, Karp, Hui, and Perlman (2008) suggested that physical educators who understand and feel competent with certain technologies incorporate their usage into their curriculum more. It is important for teachers and students alike to understand the technology and why it is being used. Although our literature review did not find any studies that assessed student or teacher perceptions of heart rate monitors specifically, there have recently been examinations of teacher perceptions of other types of physical activity technology, such as pedometers. McCaughtry, Oliver, Dillon, and Martin (2008) found that teachers' perspectives of using pedometers changed once the teachers implemented the technology into the lessons. While teachers initially believed there would be few obstacles to using the technology, they found several limitations from a practical and a class content standpoint. Measurement inaccuracy (step counts) and difficulties developing a systematic retrieval and return strategy presented barriers to the continuation of pedometer usage.

Due to the increased salience attached to technology use, and the potential impact it may have on levels of intrinsic and extrinsic motivation, it is crucial to understand student perceptions of technology in the physical education curriculum. These perceptions may have an impact on participation in physical activity throughout the lifespan, not just during class time or in the high school years. Specifically, the purpose of this study was to gain a greater understanding of high school students' perceptions of heart rate monitors during physical education class.

Methods

Procedure

This exploratory research was conducted in a medium-sized town in the Midwestern United States. The local school district serves approximately 1,200 9th to 12th grade high school students (62% Caucasian, 26% African American, 4% Asian, 3% Hispanic, <1% Native American,

4% unspecified). Thirty-six percent of students are eligible for free or reduced-price lunch based on family income. Approval for the study was obtained from the human subjects committee at the first author's university. The administrators and the physical education faculty at the target high school also approved the research protocol prior to the initiation of the study. A convenience sample of students who had participated in physical education class within the previous academic year was recruited for inclusion in this study. Students were given a cover letter explaining the purpose and protocol of the study, as well as an informed consent form to take home to their parent/guardian. Only students whose parent/guardian signed the informed consent form participated in the study. Students also provided written assent to participate in the study. Students who had signed consent and assent forms were randomly selected for the study and focus groups were conducted during class time. Participation was strictly voluntary and no grade or incentive was given to students for participating. Similarly, since students were still current participants in physical education classes in their high school, they were assured that their comments would not be individually identified or used against them in any way in order to encourage them to be as honest as possible during the focus group interview.

The physical education classes at the target high school were separated by gender, although in previous years the students had participated in co-educational classes. The single-gender classes were taught by teachers of the same gender. Class sizes ranged from 20-30 students, and met for approximately 60 minutes every day of the school week for 18 weeks of one school year. At times, the teachers would merge classes for activities or instruction. Merged classes were same-gender, thus resulting in class sizes of 40-60 students with two teachers. The physical education curriculum included a variety of physical activities, including team sports, fitness activities, and individual sports. The target high school received a Carol M. White Physical Education Program (PEP) grant (a federal grant to improve physical education programs), and Polarâ brand E200 heart rate monitors had been purchased for all students to wear during physical education class (U. S. Department of Education, 2008).

Participants

Four focus group interviews (twelve participants per focus group) with a total of 48 students (two female groups and two male groups) were conducted during physical education class time. All participants in the current study were sophomores, juniors, or seniors. Freshmen were not included because they had not had physical education the previous year at the high school. Each focus group interview lasted approximately 60 minutes and two tape recording machines were used to ensure that no comments were missed during the recording process.

In order for a focus group to be used as an effective qualitative research tool, the primary goals must be to generate data, rely on group interaction as the source of data, and utilize the researcher's active role within the group (Kvale, 1996). When conducted properly, focus groups can be a powerful research tool because focus group members may feel more comfortable talking with peers about the research topic, therefore providing more data in comparison to questionnaire research.

Focus groups were utilized as a means of data collection in the current study due to the manner in which the participants can freely explain their thoughts and motivations regarding the topic of interest. The selection of homogeneous focus groups (i.e., same-gender) was intended to foster more comfort among the participants in expressing their ideas with similar individuals (Morgan, 1996). Moreover, the facilitator of each group was the same gender as the group members in order to increase the comfort level of group members for discussion of any potentially sensitive issues that may have arisen.

Interview schedule. The focus group interview

schedule contained three sections designed by the researchers and one female physical education teacher from the target school. The Interview Guide Approach was utilized in conducting the focus group interviews (Patton, 1990). This approach allows the researchers to adhere to a series of predetermined questions while still allowing the freedom to engage in probing questions and casual conversation. The result of this method is a systematic, yet comprehensive approach for gathering data from several different focus groups. The first section consisted of questions about the student's experiences with physical education classes and the structure of the most recent class. Building rapport between the facilitator and participants, as well as establishing a flow to the group discussion format, was the goal of this portion of the interview.

The second section of the focus group interview consisted of questions pertaining to the students' perceptions of heart rate monitors in physical education classes. Probe questions included:

1. Tell me the good things about wearing a heart rate monitor during your physical education class.
2. Tell me the bad things about wearing a heart rate monitor during your physical education class.
3. Do you think you were more active during physical activity class because you used a heart rate monitor? Why or why not?

The facilitator of each of the focus groups asked follow-up questions and probed the group when necessary for clarification purposes or to extract more relevant information from participants. Probe questions generally took the form of repeating a group member's comment followed by a request to expand on the concept. For example, "Amanda, you said that you didn't like the heart rate monitors, can you talk more about what you didn't like about them?"

The last section of the focus group interview consisted of conducting a member check (Erlandson, Harris, Skipper, & Allen, 1993) that permitted the participants to make additional comments, clarify responses, and ask any questions following a summary of the group responses. Students were thanked for their participation in the study at the conclusion of the focus group.

Data Analysis

The content analysis procedures for exploration of the data gathered in the focus group was similar to those employed in previous qualitative investigations within the physical activity domain (e.g., Gould, Eklund, & Jackson, 1992; Scanlan, Stein, & Ravizza, 1989; Weiss, Smith, & Theeboom, 1996). First, all focus group interviews were transcribed from tape recordings verbatim by the authors within one week of the interviews; each author transcribed two focus groups. The authors independently read all four focus group transcriptions until they were familiar with the content of the entire focus group data.

The following steps were taken to increase data credibility and "trustworthiness," the confidence the researcher has in the truth of the findings (Creswell, 2003; Krefting, 1999; Kvale, 1996). An inductive content analysis was conducted to examine the data. Independently, each author identified and coded raw data themes (i.e., quotations) that represented the basic units of analysis for the study. Coding was based upon the research questions for the study. The data were analyzed to determine what particular themes emerged. Consensus validation of the themes and supporting quotations ensued until researchers reached agreement on the themes represented by the raw data.

After the authors identified themes, supporting quotations, and findings, an external auditor from a separate university, with a research focus on children's physical education participation, reviewed the data analyses and findings. The auditor provided confirmation that the researchers' findings were indeed derived from the data. Lastly, a second external auditor reviewed the

transcriptions, data analyses, and findings and concurred that the researchers' results were reflective of the data collected.

Results

The current study was designed to explore student perceptions of using heart rate monitors during physical education class. The data gathered from the focus group interviews yielded over 70 pages of transcribed information from the audio recordings. Three distinct, yet interconnected themes emerged from the inductive content analysis of data: 1) the use of the heart rate monitors to determine physical education class grades, 2) the importance of students' perceptions of fitness levels, and 3) the consistency with which physical education instructors used heart rate monitors.

Self-Determination Theory

Once the themes were identified, the researchers framed the findings within an appropriate theory. A theory used to explain motivation in both educational and physical activity settings is Self-Determination Theory, which seeks to explain the role of extrinsic motivators in the development and maintenance of intrinsic motivation (Deci & Ryan, 1985, 1991; Deci, Vallerand, Pelletier, & Ryan, 1991).

Intrinsic motivation exists when an individual is motivated to participate in an activity for personal satisfaction or enjoyment. Engaging in an activity such as jogging because of the physical sensations that occur (e.g., sweating) would be an example of intrinsic motivation. Experiencing positive outcomes, positive feedback, such as when a teacher tells a student, "Great Job!", and allowing individuals to make choices related to their achievement activities are all factors that affect intrinsic motivation.

People may also be motivated by external (or extrinsic) factors, such as to receive a trophy or t-shirt. Extrinsic motivation can be interpreted as being either informational or controlling. If the extrinsic rewards are seen as informational (i.e., the external sources provide the individual with information about her competence level), then their self-determination may be increased. However, if the rewards are interpreted as controlling, for example, an athlete who receives a college scholarship and believes that a coach is able to control him with that scholarship, individuals may have lower self-determination, and thus, lower intrinsic motivation.

Ultimately, a person who is highly intrinsically motivated is considered to have higher self-determination toward an activity than a more extrinsically motivated person. Individuals with a greater sense of self-determination toward physical activity are more likely to be motivated to engage in the behavior (Deci & Ryan, 1985, 1991). Individuals who are more intrinsically motivated to be physically active (compared with those who are more extrinsically motivated) have a greater likelihood of maintaining a physically active lifestyle (Chatzisarantis & Biddle, 1998; Kimiecik, 1998). Furthermore, research has indicated that higher levels of self-determination can maintain or increase intrinsic motivation in physical education classes (Goudas, Biddle, & Fox, 1994) and is correlated with both positive affect (Standage, Duda, & Ntoumanis, 2005) and physical activity levels (Vierling, Standage, & Treasure, 2007). The findings from the data analyses, categorized into three themes, and their impact on student motivation as described within the context of the Self-Determination Theory are described in the following sections.

Use of Heart Rate Monitors to Determine Physical Education Grades

One of the most salient perceptions reported by the participants was the impact the heart rate monitors had on their physical education grades. Some of the physical education teachers utilized the heart rate monitors as a means to evaluate student performance in class and assign grades. Grades were based upon a student achieving a required number of beats per minute, and then

maintaining that heart rate for a specific period of time (i.e., more than 22 minutes in a 55-minute class period). The required number of beats per minute was based upon national age- and gender-based standards and therefore, beats per minute served as an indirect extrinsic motivator for students in the physical education classes because it affected their participation grade.

Several participants noted the use of the heart rate monitors in this manner as a negative aspect of the physical education classes. One participant stated that his reason for being physically active during physical education class was, "because you have to get like a certain amount of time [on the heart rate monitor] and if you don't get that time, then you get a bad grade." Many students were worried if they did not keep their heart rates above a certain number of beats per minute for 22 minutes total, they would not receive a "good grade" (i.e., an A) for the day. This was particularly problematic for some participants, because there was an underlying assumption that participating in physical education should "automatically" result in a good grade. One student stated, "cause we all have to get our good grades, especially like for sports and everything, but it [using the heart rate monitors] takes a lot of the fun out of it." Many participants noted the perception that the heart rate monitors were making the class harder than it was "supposed to be." One girl said, "PE is supposed to be like an easy grade to most people because they've got harder classes like honors science classes that's harder than PE, so they're not gonna worry about [it]."

Although the participants did report engaging in the desired behavior of increased cardiovascular activity during class, the motivation was primarily extrinsic in nature, as opposed to internally motivating. The students' concerns over whether they received a good grade in physical education class dictated their physical activity levels in class. Their physical activity levels outside of class were not reported to be self-sustaining over time (i.e., participants reported that using the heart rate monitors in class did not make them want to increase their physical activity level outside of class).

Impact of Students' Perceptions of Fitness Levels

A second, interconnected theme related to the grading structure that emerged from the raw data was the impact of the individual student's fitness level on perceptions of the heart rate monitors. As stated previously, target heart rates (used to determine physical education grades) were not individually determined. Rather, these target rates were based on national age- and gender-based standards, regardless of individual level of cardiovascular fitness. For example, the target heart rate for an entire class of sophomores was based exclusively upon age-based norms.

According to the manufacturer's protocol (Polarâ), a 16-year-old student should maintain a heart rate at 70-80% of maximal heart rate, which equates to 204 beats per minute, bpm). The target heart rate range would be 143-163 bpm for all sophomores in that physical education class. Physical activity assessment researchers warn educators of adopting standardized protocol for educational settings (Sirad & Pate, 2001; Welk, 2002). Since multiple factors such as age, gender, fitness level and stress level influence heart rate, it is not recommended that a "one size fits all" approach be used to assess large groups. Because of the teachers' use of a standardized assessment protocol, the amount of exertion required for each student to achieve this target heart rate was seen as unequal, since participants perceived that those who were more fit had to work harder to increase their heart rates to the required levels. A female focus group member stated:

> Heart rate monitors were kind of a burden to me because it was like you had to get your heart rate up 'cause if it went down you had to stop whatever it was you were doing so it would be active all through PE…it's hard to get your heart rate up, and it's harder to keep it up because you're in shape so, it's hard when you do

> exercise to keep it up it's harder cause you're more in shape than others.

Another girl commented that, "some people just walk up and down stairs. And they, you know, just don't have to do hardly any activity and it's [heart rate] up, and other people have to sprint to keep it up high enough to get points." One male participant made the following recommendation, "I think they should make it more like personalized for each person. Like maybe have like a special workout for each person. Everyone has different levels, but they all have the same workout plan, and it just doesn't work very well."

Students did, however, understand that when they became more physically fit, they had to exercise harder to elevate their heart rate into the standardized heart rate zone. There was a perception that being in shape was equivalent to punishment in the form of increased physical activity. The prevailing belief was that the fit students had to run more than the unfit students, and if they failed to do so, their grade would suffer. One female participant explained:

> I know if you're too in shape or something and you don't do the cardio and you can't get all your 22 minutes, you get punished for it, but like I don't really think we should get punished for already being in shape. I don't see that as a bad thing normally. We're not frowned upon for that. But, like in PE…I would get yelled at all the time by [the teacher] because I didn't get my time in, and I stopped caring because I wasn't motivated anymore because all I did was get yelled at. I didn't really think that was fair, 'cause there was [sic] people…they would sneeze and seriously get their heart rate up and I'm over here, like, running, so I don't know. I just don't think we should get punished for that.

Some of the participants who were initially less fit also disliked the heart rate monitors, even though they were able to get their heart rates into the target zone relatively easily. One female noted that she no longer liked the heart rate monitors, because she now had to work harder to get her required number of minutes. She said, "[At first] I got points easier and faster. I don't like it that much now. My heart rate monitor used to go up real quick, but now it's harder for me to keep it up. I don't like it." Ironically, the fact that this individual's heart rate was not going up as quickly as it originally did indicated that she was getting more physically fit, although she actually saw this as a negative experience.

Interestingly, the participants who did report that they liked using the heart rate monitors in physical education classes self-reported lower levels of physical fitness (i.e., they were not athletes or they reported that they were not physically active). These individuals did note the informational value of the heart rate monitors. One female participant noted, "It's just cool to wear them. To see how your heart rate goes up and down." Another girl concurred, "Two years ago, I didn't even like PE. But now, I am more interested in it." These statements support the importance of the heart rate monitors as an informational source for some students in physical education settings, particularly for those who may be less familiar with their own level of fitness.

Consistency of Heart Rate Monitor Use

The third theme that emerged from the data was that student perceptions were influenced by the consistency with which physical education teachers used the heart rate monitors. Participants reported discrepancies in the different teachers' promotion and implementation of the heart rate monitors within their own individual classes. Focus group data indicated that while the school and physical education department administrators were fully supportive of the implementation of technology into the physical education curriculum, some of the physical education teachers were much less committed to using the heart rate monitors consistently. These instructors, according to the participants, used the heart rate

monitors only sporadically and did not appear to value their use, while other teachers required their students to not only use the monitors, but to frequently check their individual heart rates during class activities. Not surprisingly, there was a perception that students in some teachers' classes did not have to work as hard, and this was perceived as being unfair. Interestingly, the participants reported that the male teachers were less likely to use the heart rate monitors, while the female teachers were more dedicated to using them to assess performance. This finding is particularly important given the structure of the physical education classes at the target high school.

Female participant perceptions. At the time that the focus groups were conducted, the sampled high school offered separate physical education classes for male and female students. Female faculty members taught girls' physical education classes, and male faculty members taught boys' physical education classes. The use of the heart rate monitors, while prescribed by the physical education department overall, was not applied consistently across classes. As a result, female participants in the current study reported feelings of frustration with their physical education classes. Along with this frustration came lowered levels of enjoyment and motivation. One female participant noted:

> Yeah, we [girls] would like be walking around like, 'I hate PE, I hate PE,' and they [boys] would be like, 'Oh, we love it.' And that's 'cause they don't have to do anything. Like, they'll sit down there and seriously sometimes they don't even play basketball, and we're up here like running and stuff and they're just like…it's just…we got gipped.

Female participants also discussed the lack of enjoyment they experienced because of how the heart rate monitors were implemented in the curriculum. Although the teachers' intentions were to be helpful, the girls perceived the teachers as overbearing and controlling. Physical education was no longer considered a fun class to take, as it once was in previous years. One girl stated:

> My freshman and sophomore years we did stuff every day, but it was fun. Like, we really did work hard, we…I don't know. Well, I think it was 'cause last year we got grants for the machines and everything, so our teachers really wanted to use them. They went psycho. Yeah, they were like, really serious.

Another female participant concurred, "I think they should just make PE fun so people will want to do it, not so much about rules, like [it was] in elementary school." A third female participant indicated:

> That [previous years of physical education without technology] was…actually a lot of fun and we actually did, like, try. We would be tired after we got done with PE and we still had fun and…wanted to go to PE. Now it's kind of like, 'Man, I have to go to PE now. I have to go do heart rate monitors and pacers [a timed shuttle run completed for fitness testing purposes] and everything like that.'

Students who had teachers who were more rigorous in their implementation and monitoring of technology use actually experienced a greater degree of extrinsic motivation, but overall were not intrinsically motivated to utilize the heart rate monitors. Moreover, students whose teachers did not closely monitor the heart rate monitors expressed greater levels of enjoyment in the physical education classes. A female participant summed up this discrepancy by stating, "the boys stay down there and play basketball the whole time. They didn't have to wear their heart rate monitors until like the last two weeks." Another female student agreed:

> …they [the boys] didn't do it at all. The boys didn't do any of the fitness testing, and they didn't have to wear the heart rate

> monitors, and the girls were wearing them everyday.

Although the girls' belief that the boys did not "ever" wear the heart rate monitors was inaccurate according to the boys (male participants reported that they were only required to use them two days per week, as compared to five days per week for the female classes), the girls' perception that the boys had more "fun" in physical education class impacted the girls' enjoyment and sense of fairness across the curriculum. The perceived unfairness between the classes negatively affected the girls' intrinsic motivation.

Male participant perceptions. The boys believed that the girls' teachers did more to actively motivate the girls to be physically active through the use of the heart rate monitors; however, the boys also recognized that the girls did not enjoy physical education as much as they did. The boys saw physical education as "fun." However, as one of the male focus group members stated, "I don't think the girls like PE as much." Another male participant concurred, "Before we started doing the heart rate monitors, they [female classes] were doing them. And I just remember them all saying they hated PE. I mean, we didn't do anything, we just, you know, played games."

Male participants reported that they did not have the same expectations to adhere to regarding the use of the heart rate monitors in their classes as did the female students. One male participant noted:

> Our coaches, you know, they don't really, like, check up on us that much. They'll just at the very end, they'll be like, 'All right, what's your time [that the heart rate was above the required level],' you know? But with the girls…their teachers would always be constantly coming up to them, being like, 'where are you at now? Where are you at now?' You know, making sure they're not cheating.

These findings from both female and male participants underscore the importance of utilizing technology in a consistent manner to encourage positive affect and intrinsic motivation among students in the physical education setting. It is crucial for students to perceive that all teachers value the importance of using technology as an intervention to improve physical activity levels. Any disparity in the utilization of technology among teachers may lead to student perceptions that use of technology is not valued equally by the teaching staff. Teachers have been consistently found to have a significant impact on student academic motivation (Deci & Ryan, 1985; Deci et al., 1991). Research in physical education classes has also found support for the influence of teachers on student levels of motivation (Goudas, Biddle, Fox, & Underwood, 1995; Theeboom, De Knop, & Weiss, 1995), as well as actual physical activity levels (Hannon & Ratliffe, 2005).

Discussion

This study sought to describe high school students' perceptions of using technology, specifically heart rate monitors, during physical education class. Focus group data were transcribed and analyzed, and important themes were identified regarding student perceptions of heart rate monitor use, as well as the impact of the teacher use and value of the heart rate monitors. This discussion will focus on explaining how technology impacted student perceptions of physical education classes.

Within the sampled high school, heart rate monitors were used in some classes as a medium through which to assess student performance. In this setting, the heart rate monitors were used as identified extrinsic motivators. Identified motivation exists when individuals have a partially internalized level of motivation to complete a task (Deci & Ryan, 1985). In this case, a specific extrinsic motivator (i.e., the number of beats per minute recorded on the heart rate monitors) is seen as a means to an end (i.e., a good grade), which provides motivation to achieve the correct number of bpm, but does not

allow for the individual to achieve an internalized level of motivation for the task. Cognitive evaluation theory states that use of extrinsic motivators has been found to lower levels of intrinsic motivation (Deci & Ryan, 1985). According to Maltby and Day (2001), extrinsic motivation can eventually lead to intrinsic motivation over time. However, the Self-Determination Theory suggests that individuals who begin exercising for extrinsic reasons (e.g., a grade) may not fully develop intrinsic motivations (e.g., fun and enjoyment) to exercise over time because their motives do not become internalized (Deci & Ryan, 1985). This is particularly problematic, given that one of the intended consequences of physical education classes is to foster a lifelong appreciation for physical activity. Several participants in the current study reported that the use of heart rate monitors in physical education classes did not make them want to be active outside of class. Ferrer-Caja and Weiss (2000) also state that extrinsic motivators (i.e., grades) decrease a student's intrinsic motivation. Additionally, individuals who possess higher levels of intrinsic motivation report higher levels of enjoyment than do individuals with lower levels of intrinsic motivation (Dishman et al., 2005). Furthermore, Dishman et al., found that enjoyment of physical activity during school leads to increased physical activity among students.

Not all students realized that the heart rate monitors were used to monitor physical fitness. The students primarily equated the fluctuations in their heart rates with a grade, rather than physiological improvement. Ironically, the increased effort required to move the heart rate into the target zone (as fitness levels increased) was seen as negative and undesirable situation, rather than a beneficial condition. Furthermore, the students who were more physically active reported liking the heart rate monitors less, while the less active students enjoyed the monitors more. This finding is consistent with previous research indicating that less skilled elementary school students connected more with pedometer use than more skilled students (McCaughtry et al., 2008), and suggests that some students may be more receptive to use of heart rate monitors than others.

Heart rate monitors can be used as a beneficial and appropriate tool to objectively monitor a student's heart rate, and thus can be used as a means to estimate fitness level. However, the implementation of heart rate monitors in physical education classes should be approached in a consistent and careful manner so that their importance and value are made clear to students. The heart rate monitor may be more useful when utilized as a positive means by which a student can self-assess individual progress. When the heart rate monitors are used as an extrinsic reward (e.g., a good grade) or as a means by which to punish students (e.g., receiving a bad grade or having to "work harder"), their potentially beneficial outcomes may not be sustainable. Intrinsic motivation is more strongly linked to adherence to and maintenance of a behavior as opposed to extrinsic motivators in a variety of achievement domains including both educational (Deci, Koestner, & Ryan, 2001) and physical settings (Ferrer-Caja & Weiss, 2000). Student responses also indicated that physical education was not as enjoyable since the heart rate monitors had been introduced. As one boy stated, "we used to play, now it's not as fun."

There are three practical implications for this research. First, it is important to be aware of the potentially negative implications associated with using technology to assign a student's grade.

While it is important (and typically an administrative requirement) for teachers to assess their students' performance and to assign them a letter grade, the association of technology with extrinsic motivators such as grades may actually result in the unintended consequence of lowered intrinsic motivation. Secondly, creating individualized uses for technology may help engage more students and improve interest in the task. Focusing on self-improvement, rather than absolute measures of success, can help to improve

motivation and enjoyment among all students.

Lastly, failing to establish consistency in the usage of technology across different classes or teachers may lead to anger or frustration, which may be detrimental to a students' enjoyment of physical activity, thus impacting physical activity participation.

While the use of technology in physical education instruction and assessment has become more commonplace in current educational climates, it is important to be aware of how students may interpret the information gained from them. When the technology is seen as controlling (such as needing to keep heart rates above a specific rate for a certain number of minutes to receive a desired grade), students may be less receptive to their use. Furthermore, teachers may recognize different levels of intrinsic and extrinsic motivation among students of varying fitness levels. Heart rate monitors might help teachers to motivate students that otherwise have difficulty connecting with physical education. These findings also emphasize the benefits of individualized programs to help more active students set fitness goals for themselves, which may increase the informational quality of the heart rate monitors.

Physical educators are faced with cultivating a positive learning environment for their students so that the students can learn and practice the skills they need to become and stay physically active. Students who have positive experiences in physical education are more likely to be physically active outside of the classroom (Nicaise, Fairclough, Amorose, & Cogerino, 2007). Technology has great potential for creating a meaningful connection with students, but implementation of these tools must also be carefully and consistently applied for the maximum benefits to be realized.

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