IJHEP | International Journal of Higher Education Pedagogies

ISSN: 2669-2333
Volume 5, Issue 4

# Wait a Minute? Uniting Physical Exercise and Data Science in Higher Learning

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## ABSTRACT

**Purpose**: This study explores the design and implementation of a novel Data Science course that integrates physical activity and physiological data collection. The course, scheduled twice weekly, combines a 30-minute physical exercise session with data collection activities focusing on metrics such as temperature, three separate heart rates, blood pressure, Functional Movement Screening (FMS), nutritional assessment using MyPlate.gov categories, urinalysis, and other metrics. The primary objective was to provide students with practical experience in data science by engaging them in real-time physiological data collection and analysis. **Methods**: This study involved a structured course format where students engaged in physical activities and recorded physiological data using standardized measurement tools and techniques. The course structure included instructional sessions on data science principles, data collection procedures, and statistical analysis. Students then applied their knowledge by undertaking a project that involved analyzing the collected data to address specific research questions or hypotheses related to physical health and performance. Each student presented their findings through a PowerPoint presentation, fostering peer review and collaborative learning. **Results:** Findings indicated that students successfully developed data science skills while gaining insights into the relationship between physical activity and physiological metrics. The projects revealed varied patterns and correlations, demonstrating the practical applicability of data science in health and fitness contexts. **Discussion/Conclusions**: The study highlights the effectiveness of integrating physical activity with data science education, enhancing both engagement and learning outcomes. The course equips students with technical skills while emphasizing the importance of holistic health data analysis.

**Keywords**: Interdisciplinary, Data Science, Physical Activity, Google Sheets, PowerPoint

**Cite this article as:** Cradit R, S. (2024). Wait a Minute? Uniting Physical Exercise and Data Science in Higher Learning. *International Journal of Higher Education Pedagogies*, *5*(4), 24-36. https://doi.org/10.33422/ijhep.v5i4.785

- Students enroll in an interdisciplinary data science and physical activity higher education course where they become a live data set. They were to record the activity performed and other parameters in the daily journal at the end of each day the class was held.
- Functional Movement Screening, traditional fitness testing, circumference measurements, urinalysis parameters, nutrition metrics using myplate.gov categories, hours of sleep, hydration, and physiological measurements (blood pressure, temperature, various heart rates) were included in the data collected. Data was recorded using three different Google Sheets, measurements, daily journal, and daily reflection.
- Students were given creative freedom in using statistical software, utilizing charts, graphs, figures, and plots to present their findings in a PowerPoint presentation to their peers.

## 1. Introduction

After an exhaustive search for any studies involving Data Science and Physical Activity courses turned up empty, I decided to do a research study on my special topics course which

marries these two disciplines. This study compared all graded worksheet assignments and assignments associated with the project-based assignment (hypothesis, individual slide with assigned components, group project slides, and oral presentations of assigned components for the group project). Students can enroll in this elective course by choosing one of two options. Option one has a General Education Program (GEP) / Health and Exercise Studies (HES) option, the second has an Interdisciplinary Programs (IP) option, or students enroll by choosing the Data Science course (DSC) option. The students are tasked with being a live data set by their participation in the physical activity and other parameters included in the data set which is recorded into three Google Forms which are connected to Google Sheets. The students fill out two of the Google Forms only on activity days. The class is taught two days a week for 50 minutes. On the third day of class, all baseline measurements are performed, and students are tasked with inputting their data into a third Google Form, which is also connected to a Google sheet. This is the students first interaction with Google forms. The students are anonymized on day two of the course before the measurements are taken by being given a number, which they are instructed not to share with their peers. This is their student identifier in the Google Form, which has a dropdown including each number in all three forms. At the end of the course, all gradebook data was anonymized (any identifying information was removed), placed into a separate data sheet (Google sheet or Excel document) then analyzed. This course has only been taught once but has recently completed the second time being taught but has not been included in this study.

Interdisciplinary courses are becoming more popular with higher education students, especially those that involve computer and data analytics. Research has proven that the more physically active we are, the better longevity we will have. A colleague of mine and I developed a special topics course that would marry physical activity and data science. This course involves the creation of a live data set to be analyzed in the final project, which requires student participation in all in-class and out-of-class activities. The students in this course are the data set, and the collection of the data in each class meeting is crucial to the data set being complete. This course is housed in the Data Science Academy department, and I co-teach this course with a colleague. Since this is a Data Science course, it is required that this course be project-based. No tests or quizzes, instead worksheets, Daily Google sheets (reflection and journal)- only on the days that the class meets, a tri-semester measurements Google form, and giving the students guidelines on which statistical analysis would be needed for their final project. In the final project, they were assigned a small subset of the data to analyze, and if they choose to they could analyze the whole class. The last two weeks the students were instructed on the statistics required in and designing their PowerPoint in groups of three. The groups were given specific parameters to analyze separately so they were not overwhelmed with the amount of data they collected.

### 1.1. Purpose

To create an interdisciplinary course that requires physical activity participation and recording results from the participation into a live data set incorporating data science with fitness. The data would be analyzed by the students and incorporated into a final project (PowerPoint presentation).

Subjects: Three males and three females registered for this elective course and completed the course.

## 2. Literature Review

The intersection of physical activity and data science presents a unique opportunity for enhancing educational outcomes in both fields. This literature review explores the existing body of research surrounding the design and implementation of courses that integrate these disciplines, focusing on pedagogical strategies, student engagement, assessment methods, and the benefits of interdisciplinary learning.

### 2.1. Pedagogical Approaches

Several studies emphasize the importance of innovative pedagogical frameworks in designing courses that effectively combine physical activity with data science. Ahshan (2021) advocates for active learning strategies that foster student engagement in remote and hybrid environments. This approach can be adapted to a physical activity and data science course by incorporating interactive technologies that allow students to track their physical activities and analyze data in real-time.

Moreover, Bolkan (2019) highlights the effectiveness of multimedia presentations in engaging students. Utilizing data visualization tools and gamified learning experiences can enhance students' understanding of both physical performance metrics and data analysis techniques. Integrating hands-on projects where students collect and analyze their physical activity data can create a more immersive learning experience.

### 2.2. Student Engagement

Engagement is a critical factor in the success of interdisciplinary courses. Al-Kahtani et al. (2022) found that student perspectives on blended learning environments emphasize the need for interactive and adaptive learning experiences. A physical activity and data science course can leverage this by incorporating technology and proceedures that collects data on physical performance, allowing students to engage actively with the material.

Research by Korobova and Starobin (2015) suggests that diverse engagement strategies are necessary to meet the varying needs of students. By including both physical activities with data science projects, educators can cater to different learning styles, making the course more inclusive and engaging. This interdisciplinary course has multiple assessment methods and no tests or quizzes per the requirements of the Data Science Academy where this course is housed.

The Student Outcomes Survey was utilized in this study. Using a validated peer-reviewed student satisfaction survey is critical for this study "Questions (numbered 1 to 6) correlate to the teaching block, those (numbered 7 to 11) correlating with the assessment block, and those (numbered 12 to 19) correlating with the generic skills and learning experience block of questions" (Fieger, 2012). The generic skills block of questions may be slightly modified or not included due to the nature of these being specifically for vocational education students. This information is important because most studies evaluating course content success exclude a student satisfaction survey.

Due to the limited time to teach activity and allow for students to obtain blood pressure and temperature measurements, the lecture component is brief and mostly covered in online PowerPoints which "helps instructors and students with technology to enable time, privacy,

and independent study" (Al-Kahtani, 2022). The students have the choice to either look at the PowerPoints or use other tools to complete their worksheets which is "suggested to increase intrinsic motivation by providing the learner a sense of control, thus promoting engagement and improving learning gains" (Feldman-Maggor et al., 2022).

### 2.3. Assessment Methods

Effective assessment strategies are crucial for evaluating student learning outcomes in an integrated curriculum. Moulton et al. (2017) discuss how different presentation mediums can affect comprehension and retention. In the context of a physical activity and data science course, assessment could include a combination of traditional tests, project-based assessments, and presentations that require students to analyze and present their data findings. Feldman-Maggor et al. (2022) indicate that offering optional assignments can lead to greater student success, suggesting that flexibility in assessments could be beneficial. Students might choose to analyze their physical activity data through various lenses—be it fitness, health trends, or even social comparisons—thereby personalizing their learning experience.

### 2.4. Benefits of Interdisciplinary Learning

Integrating physical activity with data science not only enriches the curriculum but also prepares students for real-world applications. The literature reveals that students benefit from developing skills in both areas. For instance, Bugarcic et al. (2014) highlight the importance of argumentation skills in presentations, which can be cultivated through projects that require students to defend their data analysis and physical activity insights.

Corell et al. (2018) discuss how competitive learning tools enhance motivation and performance. A course that combines physical challenges with data analysis competitions could motivate students to excel in both disciplines, fostering a dynamic learning environment. The integration of physical activity and data science in educational settings offers promising avenues for enhancing student engagement and learning outcomes. By employing innovative pedagogical strategies, diverse assessment methods, and fostering interdisciplinary connections, educators can create a rich learning environment that prepares students for the complexities of modern health and technology landscapes. Future research should focus on the long-term impacts of such courses on student skills and career readiness, as well as the best practices for implementation and curriculum development.

Educators today, after the COVID-19 pandemic, have changed educational delivery, recognizing that learners overwhelmingly prefer and expect some aspects of electronic presentation software to be used in their courses (Bolkan, 2019; Hill et al., 2012). Learners identify that electronic software presentations aid in attentiveness and individual comprehension of information (Apperson et al., 2008; Hill et al., 2012) if there is a verbal component to PowerPoints. It has been noted that many instructors add salacious details to the voiceover PowerPoints which have no bearing on the PowerPoint content (Sperring, 2023), however, our PowerPoints have no voiceover element. Due to limited class time, the online PowerPoint emphasizes the important aspects that the wellness worksheet assignments cover. This aspect of the course is required to meet the GEP HES characteristic of this course.

## 3. Methods

Students register for an elective course under the data science special topics' that has the Health and Exercise Studies General Education Program requirement. This is a 16-week course that is taught for 50 minutes twice a week. Before any data is collected or reported, the students are given a random number, picked by a free number wheel that I found using Google, that chooses a number, once a number is used, it disappears from the wheel. This keeps the student's identity anonymous, and students are instructed not to reveal their number. The students are tasked with recording and submitting their daily results in a Google form, which starts with a pull-down of their student identifier. They are asked to record their meals using the MyPlate.Gov category that best matches how they ate (Rookie through Allstar), or none if they didn't eat anything. Their water intake in ounces, sleep in hours and minutes, as well as the quality of their sleep according to the student (Good, Moderate, or Restless), the type of exercise that was performed in class, the resting heart rate and Blood Pressure (both given on the same wrist cuff device), body temperature (forehead thermometer), Peak heart rate (taken 15-20 minutes into the routine), recovery heart rate (taken after the cool down and stretching), as quickly after class as the student can (urinating on) a urinalysis strip analysis, and finally a stress rating 1-5 based on how the student ranks their overall stress level for the day. Students are also invited to complete a daily reflection if they wish, where they can explain any irregular numbers during the workout, their stress rating, or any additional comments they decide to include. Before the activity begins, baseline measurements are taken, including Functional Movement Screenings (Shoulder Mobility, Deep Squat, Straight Leg, and Push-ups), circumference measurements (using a standard tape measure, and using their hands to find the midpoint of the area to be measured), and two fitness tests (timed plank and wall sit). After the sixth workout, the students get a midpoint measurement as well as after the twelfth workout. This gives the students three reference points, the most crucial measurements are the baseline and final ones.

After the activity sessions conclude, students work in a traditional classroom setting individually, and were divided into groups of three. One person in each group was responsible for the exercise performed, meals consumed (up to six) using myplate.gov grouping, water intake in ounces, sleep in hours and minutes, and stress rating (1-5). The second person was charged with analyzing twelve components including heart rates (resting, peak, and recovery), body temperature, blood pressure, and seven urinalysis strip measurements. The third person analyzed the six Functional Movement Screening assessments, the two traditional fitness tests, and the four circumference measurements. Students were given one day of instruction on what statistics to include, a presentation rubric, and other helpful materials to design their PowerPoint. The students worked for two weeks analyzing and interpreting the data, working on PowerPoint or Google slides, and working on their storytelling of the data each student analyzed. The students, while in their assigned groups, presented their findings to their peers. In addition to their grouped data analyzation and storytelling, they were tasked to design one slide representing their individual results compared to the whole class, which was not required in the group presentations, but was required for assignment completion.

Students were asked to provide the following statistical measures in their PowerPoints: Mean, Median, Mode, Range and Standard Deviation, however if they chose to include more they could do so. Since this was the first time most of these students were tasked with using

statistics, the lecture before the students began working on the analyzation and storytelling these statistics were described, defined, explained and communicated. Students were given the creative freedom to use Google Sheets, Excel or other statistical software of choice. Students were given creative freedom on how they wanted to portray the data (scatter plots, bar graphs, tables, etc.).

Grading was completed using the following components: ten worksheet answers and completion (these reflected their review and comprehension of the wellness and fitness PowerPoints that are reflective of the Health and Exercise Studies (HES) General Education Program (GEP)); completion of 80% of the daily journal, daily reflection, and measurements Google Sheets entries; hypothesis statement, individual component of the group PowerPoint, and their individual oral presentation of the PowerPoint group presentation.

## 4. Results

### 4.1. Heart Rates

The students all had recovery heart rate scores indicating that they became more fit throughout the sixteen activity sessions (Table 1). The HIIT (High-Intensity Interval Training) exercise showed the most significant improvement in mean scores for recovery heart rate. The Recovery Heart rate for the HIIT activity was in the recovery range aimed for by the instructor, which was between 100-103. Most students either improved or maintained their performance in the measurements from baseline to final. Most of these listed activities were taught twice, the TRX were taught once using different supplementary exercises, which compose a total of seven activities.

Table 1.
*Mean Recovery Heart Rate Scores*

| Exercise Type | Pre-Workout Hr | Max Hr | Recovery Hr |
|---|---|---|---|
| Circuit Training | 76 | 138 | 113 |
| ***High-Intensity Interval Training*** | ***81*** | ***137*** | ***102*** |
| Pilates | 79 | 97 | 90 |
| Step Aerobics | 83 | 142 | 111 |
| Trx Resistance | 87 | 148 | 119 |
| Trx Cardio | 77 | 160 | 117 |
| Yoga | 79 | 106 | 85 |

### 4.2. Functional Movement Screening

The Functional Movement Screening (FMS) scores aided in the students learning a new method of assessment which none of them had encountered prior to this course. The students were eager to learn this new method of assessment and performed the tests to the best of their ability. None of the students performed the push up to the highest score of three, however many students received a three on the other assessments. Zero is the lowest score (if the movement elicits pain, the assessment is to be terminated and a score of zero is given). A one is scored when there is limited movement, too much movement and the participant can't execute the movement properly. A two is scored when the participant doesn't quite execute the movement to an optimal level. A three is given when optimal movement is achieved by the participant. All students' scores (Table 2) are provided for the FMS testing. The improvement that most of the students made in these assessments warrants us using these in

future fitness classes that may only currently be using traditional fitness testing. The implementation of this testing assessment gives the students an opportunity to be assessed on their mobility and if there are mobility limitations, these scores will be lower. Most of the students attained higher FMS scores in the middle and some in the final assessment, while some maintained their scores throughout or did worse. All students agreed the pushup was the most difficult portion of the FMS assessments.

Table 2.
*FMS Scores*

| Measurement | Student # | Straight Leg R | Straight Leg L | Deep Squat | Shoulder Mobility R | Shoulder Mobility L | Push Up |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 3 | 2 | 2 | 3 | 3 | 2 |
| 2 | | 3 | 3 | 3 | 3 | 3 | 2 |
| 3 | | 3 | 3 | 3 | 3 | 3 | 2 |
| 1 | 2 | 3 | 3 | 2 | 3 | 2 | 2 |
| 2 | | 3 | 3 | 3 | 3 | 2 | 2 |
| 3 | | 3 | 3 | 3 | 3 | 3 | 2 |
| 1 | 4 | 2 | 2 | 3 | 3 | 3 | 1 |
| 2 | | 2 | 3 | 3 | 3 | 3 | 2 |
| 3 | | 2 | 2 | 3 | 3 | 3 | 2 |
| 1 | 5 | 2 | 2 | 2 | 1 | 1 | 2 |
| 2 | | 2 | 2 | 2 | 3 | 3 | 1 |
| 3 | | 2 | 2 | 1 | 3 | 3 | 1 |
| 1 | 7 | 2 | 2 | 2 | 1 | 2 | 1 |
| 2 | | 2 | 2 | 2 | 2 | 2 | 2 |
| 3 | | 2 | 2 | 3 | 3 | 2 | 2 |
| 1 | 8 | 3 | 3 | 2 | 3 | 3 | 2 |
| 2 | | 3 | 3 | 2 | 3 | 3 | 2 |
| 3 | | 3 | 3 | 2 | 3 | 3 | 2 |

One student had a shoulder injury that they had not properly rehabilitated, their measurements remained unchanged for the shoulder mobility FMS measurement (Figure 1). This student did report they experienced an improvement in their flexibility, as stated verbally to the instructor who was measuring the shoulder mobility assessment, from their baseline measurements.

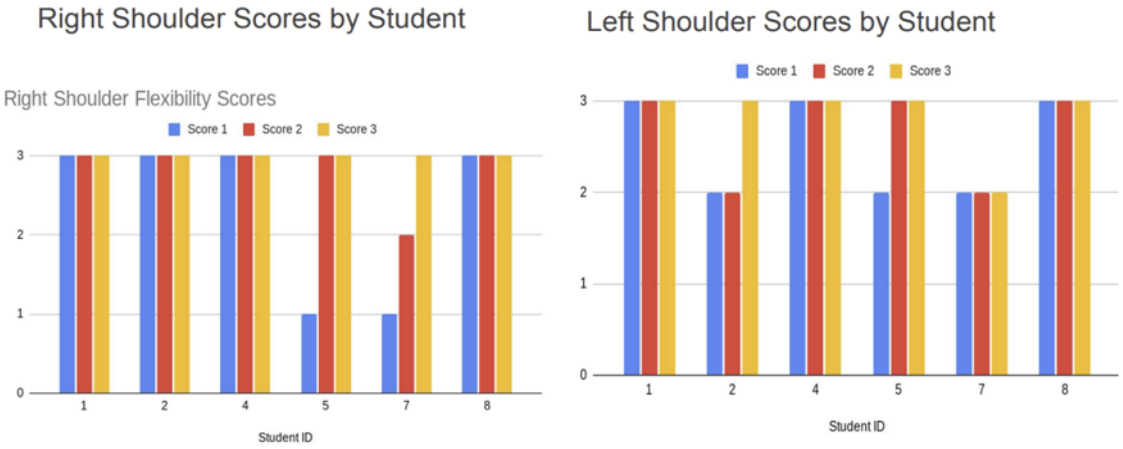


*Figure 1.* FMS Shoulder Mobility Scores

The FMS scores remained consistent with one exception. Student number five had a decrease in their deep squat and push-up FMS scores from their baseline to their final measurement yet maintained the baseline during the mid-semester measurements for the deep squat (Figure 2), their score at the mid-measurement in the push-up also declined (Table 2). No rationale was provided in the daily reflection for the decrease in the mid-semester measurement of the push-up. The decreased score in the deep squat could be due to what they wore to the final measurement class, a business pantsuit, which hindered their mobility, as stated in their daily reflection.

Statistics-

- Average:≈2.09
- Median:2
- Mode:2
- Range:2
- Standard Deviation:≈0.53
- Variance:≈0.28
- Average Change in Student Scores

between first and last response: 0.5

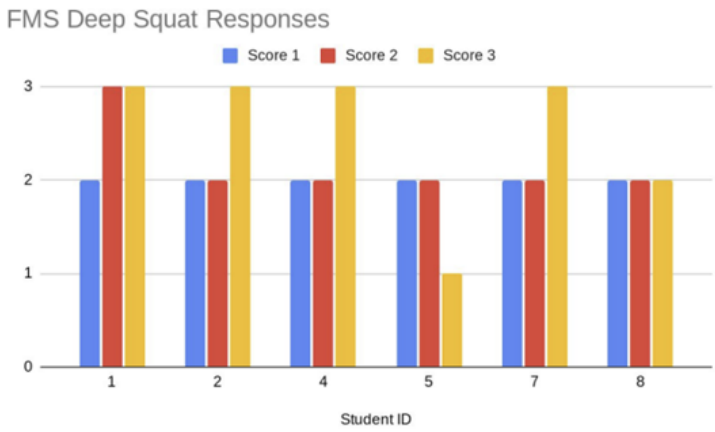


*Figure 2.* FMS Deep Squat Results

### 4.3. Traditional Fitness Testing

The Wall Sit (Figure 3) measurements also demonstrate that the students maintained or improved from measurement one to three or two to three. This result allows an assumption that what you are wearing does not affect how long one can hold a wall sit. This result also recognizes a question; if the student was wearing proper attire, would the score result in a longer time?

Average Time≈63.85 seconds

Median Time=65 seconds

Range of Times:100 seconds

Variance≈437.53

Standard Deviation:20.92

Average Change≈16.83 seconds

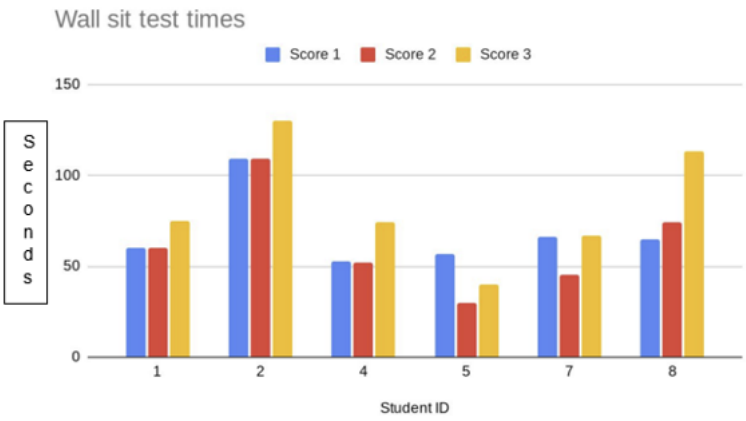


*Figure 3.* Wall Sit Test Times

In contrast, the Plank measurements (Figure 4) fluctuated from doing worse, maintaining, or improving. This could be for many reasons, as the last measurements were taken during Greek week, and after Homecoming weekend, which lack of sleep and poor nutrition could

have affected these results. There were no significant p-values or t-test scores when comparing project scores or measurements.

Average:≈87.33 seconds

Median:83 seconds

Range:127 seconds

Standard Deviation≈24.26

Average change in Time from first to last responses:

≈ negative 25.8 seconds

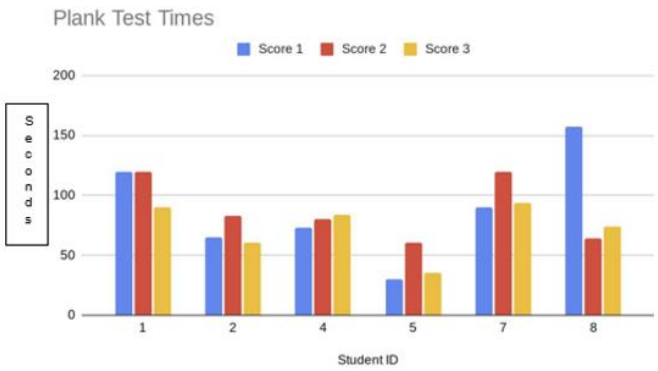


*Figure 4.* Plank Test Times

Only those students who completed all three measurements were included in the data set. Students 3, 6 and 9 dropped the course prior to the final measurements being taken, which is why those numbers are missing from the tables and figures. Figure 3 exposes that every student improved from measurement two, however, student five decreased from measurement one to measurement three, and student number seven maintained their initial measurement time during the final measurement.

The overall student scores were in the A to B grade ranges and most students were dressed appropriately (as described in a rubric and syllabus given to the students on day one of the course and placed in the Learning Management System, Moodle for their reference). The students adequately described, analyzed, and presented the data set to their peers. Some students added categories that were not a part of the dropdown menu which confused many students and the instructors which made some data interpretation inaccurate. If the students had looked at and followed the course outline (also supplied on the first day of class and located in Moodle for their reference) these mistakes should have never been made. The students were given creative freedom to use whatever analysis, charts, graphs, figures, etc., they felt would help present their particular parameters to the class in their PowerPoint. The students also had to present their individual data to the instructor and compare their data to the whole class data set in an additional slide.

The students were in the normal ranges for college aged students in the following metrics meals consumed, water intake, sleep time and minutes, body temperature, and had typical urinalysis ratings. The students typically had higher than normal blood pressure ratings and resting heart rates due to them walking across campus, some even running or biking to class. The students initially had higher resting and recovery heart rates; however these measurements did decrease by the last four workouts compared to the first four workouts. Circumference measurements changed minimally, most students seeing slight increases in muscle size, and stress rates were inconsistent due to the rigors of college life, which was typical in the peer reviewed sources that the students had to discuss when discussing the data results in the oral PowerPoint presentation.

## 5. Conclusions

Figure 4 is the most perplexing of the fitness tests. The plank time decreased for all but two students. The initial or second measured times were the best scores, which is the most interesting scores to observe. There could be many explanations, such as the students were up late watching the basketball game the night before, the students had many tests or assignments due in other courses, or the students just gave up and contributed minimal effort on this test because it was the final test of the measurements. No daily reflections gave any insight into these results.

Creating a course that combines physical activity and data science is a daunting task but is a valuable experience for the students and the instructors. Students who would not have otherwise taken a data science course are introduced to the field of data science and discover that they use data science every day. Integrating physical activity from Health and Exercise Studies with data science has been a rewarding interdisciplinary experience. Many students complained that the outside-of-class time activities take more than three hours to complete, so making this a two-credit hour class has been a request from all the students as stated in their class evaluations. Unfortunately, this course can't be a two-credit hour course, as one of the stipulations of the Data Science Academy is that all courses must be one credit hour.

The integration of physical activity and data science in educational curricula represents a compelling approach to enhance student engagement and learning outcomes. This literature review highlights several key themes that underscore the potential of such interdisciplinary courses:

1. **Innovative Pedagogy**: Employing active learning strategies, multimedia tools, and technology can create immersive learning experiences. Allowing students to engage with real-time data collection and analysis, educators can foster a deeper understanding of both physical activity and data science concepts.
2. **Diverse Engagement Strategies**: Recognizing the varied learning styles and preferences of students is crucial. Blended learning environments and hands-on projects can cater to these differences, making the course more inclusive and motivating for a broader range of students.
3. **Variable Assessment Methods**: Implementing a mix of assessment types—such as project-based evaluations, presentations, and worksheets can accommodate diverse student needs and promote a sense of ownership over their learning. This variability can lead to improved learning outcomes and greater student satisfaction.
4. **Real-World Applications**: By combining physical activity with data science, students gain valuable skills that are applicable in various contexts, from health and fitness to technology and data analysis. This interdisciplinary approach not only prepares students for future careers but also equips them with critical thinking and analytical skills.

The integration of physical activity and data science in education holds significant potential for enhancing student learning experiences. Continued exploration of effective teaching methods, assessment strategies, and real-world applications will be essential for maximizing the benefits of such interdisciplinary courses. Creating this type of course is a huge undertaking for the instructors, however the reward of observing how much the students have learned and will take with them outweigh the effort to create the course.

This course allows students to see results-based data and perform physical activity simultaneously. The results of the fitness testing were interesting and did not adequately depict the work that the students appeared to put into the activity portions of the live data set. The students seemed intrigued to be part of a live data set but didn't put the information to use until the conclusion of the final measurements. Many students commented in their evaluations that "they wish they had worked more with data science", not realizing that they were using data science on a daily basis. Data collection is a huge aspect of data science, however the students thought that only data analysis is what data science is all about. The students realized they could continue their version to track individual progress similarly once the course ends.

The limitations of this course include only having six of nine students completing the course. Students lack adequate rest time before performing their blood pressure and resting heart rate metrics, due to these measurements having to be completed before any exercise. This class is only 50 minutes long and there are a lot of metrics to be completed in this short time frame. Future classes will be evaluated to make changes to improve each iteration of this course. Future research should focus on evaluating the long-term impacts of these programs on student skills, engagement, and career readiness, as well as identifying best practices for curriculum design and implementation.

**Acknowledgements**

The student figures 1-4 are reproduced from Michael LaPata's final project, and he has given written permission to reproduce. All students signed a consent form which was approved by the university IRB prior to any data collection and analysis.

**Conflict of Interest**

There is no conflict of interest.

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