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Short Paper

Sentiment Analysis of Student's Perspectives on the Integration of a Mobile Fitness Application in a Physical Education Course Using Machine Learning Techniques

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Abstract

Purpose – With the intention of encouraging physical exercise and overall well-being among university students, the usage of mobile fitness applications in higher education has received attention. Bulacan State University (BulSU)-Meneses Campus, an HEI situated in Bulakan, Bulacan, offers different programs that take Physical Activity Towards Health and Fitness (PATHFit) courses. Students taking PATH-Fit courses at BulSU-Meneses used a mobile fitness application in their classes.

Method – The study used qualitative sentiment analysis to determine the students' sentiments toward integrating a mobile fitness application into their PATHFit course. The Support Vector Machine (SVM) algorithm was utilized to analyze and predict the sentiments on the annotated data.

Results – On accomplishing paper-based forms, 191 out of 347 students tend to have more difficulty tracking and computing necessary fitness details, felt the hassle of accomplishing the forms rather than focusing more on exercising, and papers are easily misplaced or lost. With an accuracy of 91.34% and a class precision of 91.50% on the algorithm's predicted positive sentiments, 313 out of 347 students were more focused on their activities using a mobile fitness application.

Conclusion – In summary, the contrasting sentiments of students toward traditional, paper-based forms and the integration of a mobile fitness application show the power of technology in enhancing their experiences. As the landscape of fitness tracking continues to evolve, embracing technology is key to unlocking the potential of students in learning.

Recommendations – In this light, BulSU, its other campuses, and other HEIs should consider implementing and integrating the same and other related fitness applications to technologically advanced pedagogical approaches in the university.

Research Implications – Considering the results, this implies that students tend to accept the use of a fitness application integrated with their physical education course through their positive sentiments on using the application.

Keywords – fitness applications, higher education, machine learning, mobile applications, physical education, sentiment analysis

INTRODUCTION

Since the Coronavirus Disease 2019 (COVID-19) started, universities in the Philippines shifted to flexible learning (CMO No. 4, s. 2020, 2020). Philippine universities have implemented synchronous and asynchronous learning modalities to continue the delivery of education in higher education institutions. Several authors have studied the effects of this shift from traditional, in-person classes to online distance learning. Times Higher Education (2021) mentioned that it was a great time, if not the right, for the Philippines to review its digital learning revolution. Additionally, Dayagbil et al. (2021) studied how teaching and learning should continue amid the pandemic. Dela Rosa (2023b) also studied how learning management systems can be a solution to continue delivering quality education during and even after the pandemic. Universities should capacitate their faculty members, recalibrate curricula offerings to fit flexible learning and upgrade infrastructure to accommodate the needs of both teachers and students. However, Tarrayo et al. (2021) and Barrot et al. (2021) found results on the adverse effects of online learning that the students lost engagement for several reasons.

With the rise of online platforms being used to deliver education since the start of the pandemic, such as Google Workspace and Microsoft Office, other educational sectors

have tried to find solutions to providing education to students that need physical instructions, such as students taking physical education programs. Institutions rely on the existence of technology and maximize it to aid the needs of their students.

Bulacan State University (BulSU)-Meneses Campus is one of the external campuses of BulSU situated at Bulakan, Bulacan that offers multidisciplinary programs. One of its program offerings, the Bachelor in Physical Education (BPEd), tends to have difficulties in online learning since the course requires more physical, in-person learning for them to properly grasp the lesson or topic. Additionally, since online learning has less guidance on individual students than in-person learning, students tend to lose engagement in doing the activity at home. Moreover, spaces within the students' homes may not be suitable enough to deliver the activity needed to be accomplished as required by the course.

With such a gap in students' online learning, a fitness mobile application was integrated with their Physical Activities Toward Health and Fitness (PATHFit) 2 course. At the beginning of the course, students were asked to install Strava into their mobile phones, a fitness application that tracks the physical exercises of its users. Students used the application within the course duration as part of their syllabus (Vega et al., 2020). As Luo and He (2021) studied, sports applications highly promote the participation of students in class. Additionally, Agosto et al. (2020) mentioned in a systematic review that the most used applications in learning related to physical education are fitness applications. Lastly, Martin et al. (2015) studied that fitness applications motivate students to be involved in participating in classes.

That said, the study aims to analyze students' perspectives, thoughts, and feelings on using the Strava fitness mobile application as integrated with their PATHFit 2 course. Determining the students' sentiments toward the integration of a mobile fitness application presents the opinions and emotions of the students on such advancement in their learning (Aqlan et al., 2019). To deliver the sentiment analysis, the study utilized natural language processing (NLP) and machine learning (ML) techniques to determine the polarity and visualization of results (Cahapin et al., 2023; Santiago et al., 2023; Villavicencio et al., 2021). The Support Vector Machine (SVM) algorithm was the utilized ML technique to deliver the sentiment analysis as it performs well on sentiment classification (Han et al. 2020; Zainuddin & Selamat, 2014).

This study answered the following research questions explicitly: (1) What are the students' thoughts on accomplishing paper-based forms of fitness tracking? (2) What are the students' thoughts and feelings on the integration of mobile fitness applications in their PATHFit 2 course?

LITERATURE REVIEW

Mobile Fitness Applications in Learning

It has been demonstrated that mobile fitness applications increase users' levels of physical activity. People who utilized mobile fitness applications had a higher likelihood of participating in regular physical exercise than people who did not due to social norms (Wang & Collins, 2021; Yin et al., 2022). Users' motivation to exercise and progress toward their fitness objectives increased because of using mobile fitness applications (Hussian et al., 2023; Laranjo et al. 2015; Wei et al., 2021). According to a different study by Direito et al. (2014), smartphone fitness applications can be useful in encouraging physical activity among those with chronic health issues. The study discovered that people with chronic health issues who used mobile fitness applications engaged in more physical activity than people who did not.

Several studies also present the advantages and disadvantages of e-learning, specifically during the era of the COVID-19 pandemic. Classes during the pandemic were shifted to an online learning modality that presented challenges for students, showing technical, financial, and mental challenges throughout (Balahadia, 2022; Fabito et al., 2020; Narvaez et al., 2023). However, with the return to face-to-face learning modality, students can be guided properly on the utilization of technologically enhanced learning, such as the use of mobile fitness applications in physical education. As Yeoh et al. (2022) studied, those students from a public university showed intentions of using mobile fitness applications.

According to studies presented, using mobile applications in physical activity has significant impacts on its users. Congruently, utilizing such mobile fitness applications can be an aid to teaching and learning practices in physical fitness and activities.

Sentiment Analysis Using Machine Learning

Machine learning (ML), a subset of artificial intelligence (AI), is a technique that aims to provide computer programs (machines) that learn (Alpaydin, 2021; El Naqa & Murphy, 2015; Jordan & Mitchell, 2015). Machine learning aims to learn from past events to predict what could happen in the future (Mahesh, 2020; Zhou, 2021). Several studies have already used and utilized machine learning techniques to deliver sentiment analysis. Agarwal and Mittal (2015), Ahmad et al. (2017), Cahapin et al. (2023), Hasan et al. (2018), Jain and Dandannavar (2016), Neethu and Rajasree (2013), Santiago et al. (2023), and Villavicencio et al. (2021) have used machine learning techniques on their studies to deliver sentiment analysis. Historical data has been collected and gathered, undergone cleaning and testing, visualized, and interpreted the results.

This study aims to utilize the same technique, machine learning, in delivering a sentiment analysis approach to the student's thoughts and feelings on using fitness applications in one of their courses. The researchers aim to understand and visualize

students' sentiments on the integration of a mobile application if they are positive, negative, or neutral sentiment.

METHODOLOGY

Demographic Profiles

Within the second semester of the academic year 2022-2023, students from the Meneses Campus of Bulacan State University (BulSU), specifically those under the program of Bachelor in Physical Education (BPEd) have been identified as the study's respondents. Table 1 presents the demographics of the student participants.

Table 1. Demographics of the Student Participants

Demographic	Frequency (n=347)	Percentage (%)
Age		
16-18	130	37.46%
19-21	204	58.79%
22-24	11	3.17%
25 and above	2	0.58%
Sex		
Male	217	62.54%
Female	128	36.89%
Prefer not to say	2	0.58%
Do you own a smartphone?		
Yes	343	98.85%
No	4	1.15%

As seen in Table 1, students are within the age bracket of 19-21 (204 out of 347) since they are 1st-year BPEd students and most of them are male (217 out of 347). Students were also asked if they own a smartphone since the study is focused on utilizing a fitness application. 343 out of 347 own a smartphone which led to the possibility of conducting and continuing the study.

Data Collection

This study utilized a survey questionnaire shared with the students in the middle of the second semester of the academic year 2022-2023. The questionnaire was created using Google Forms which consisted of questions about age, sex, and if they own a smartphone. Then, students were asked two open-ended questions: 1) "What are your thoughts on accomplishing paper-based forms of tracking your fitness?" and 2) "What are your thoughts and feelings on the integration of mobile fitness applications in your PATHFit 2 course?" The students were guided on how to answer the questions properly and correctly. The students were informed of the purpose of the data gathering through informed

consent. Students were also assured that their data would be treated with confidentiality. The survey questionnaire was open until after their midterm examinations.

Data Preparation and Preprocessing

With the conclusion of data collection using a Google form, the number of responses from the students was 347. Respondents were recommended to answer in English as these words will be processed for analysis. Then, the student responses underwent data preparation and preprocessing. The succeeding processes are implemented to the dataset for natural language processing (NLP). Figure 1 presents the data preparation and preprocessing of the student responses.

1. *Data Cleaning*. During this process, numbers and special characters are removed. Additionally, all letters are transformed into lowercase for easier analysis.
2. *Tokenization*. In this process, punctuation marks and white spaces are removed. Since this removes white spaces, texts or responses have been converted into individual words. A unigram tokenization was implemented to have a bag of words for processing.
3. *Stopwords Removal*. Stopwords are removed during this process such as common words like "the," "an," "a," "and," and the like.

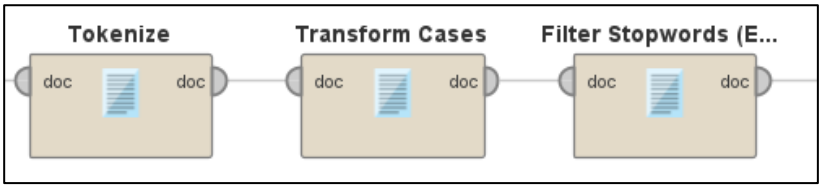

Figure 1. Data Cleaning Process and Preprocessing

After delivering the data cleaning process and preprocessing, a total of 2,985 words from 347 responses from the students were generated. Only the students' sentiments towards the integration of a mobile fitness application were prepared for training and testing of the algorithm. There are 741 unique words processed where the word "Strava" was mentioned 143 times, "use" was mentioned 85 times, and "activity" was mentioned 67 times.

Data Analysis

Text classification was utilized to perform sentiment analysis. On text classification, the polarity of the student responses was determined if they were positive or negative through polarity analysis. Positive polarity is assigned to statements or texts that show a positive emotional tone. The negative polarity is given if the statement has a negative emotional tone (Fersini, 2017). Upon data annotation, if the student's sentiment is a more positive emotional tone with a few negative statements, the positive polarity was given as annotation and vice versa.

The Support Vector Machine algorithm was utilized to train and test the dataset retrieved from the data cleaning and preprocessing of student responses. The Support Vector Machine (SVM) algorithm is a machine learning algorithm popularly used for classification and regression analysis as it separates data points into different classes (Chang & Lin, 2011). This algorithm was utilized as it performs well on sentiment classification (Han et al. 2020; Zainuddin & Selamat, 2014). To implement the algorithm, the RapidMiner Studio was used. The annotated data was loaded into the studio, underwent data cleaning and preprocessing, then the SVM algorithm was performed.

A word cloud was used to visualize student responses. Several studies have used the word cloud as a visualization tool to present words according to their frequency within the dataset (Cahapin et al., 2023; Dela Rosa, 2023a; Villavicencio et al., 2021). In word clouds, the higher the frequency, the bigger the word in the cloud to visualize that the word appeared more in the dataset than of the other existing words.

RESULTS

RQ1. What are the students' thoughts on accomplishing paper-based forms of fitness tracking?

To highlight the students' sentiments on the integration of a fitness application in their PATHFit 2 course, students were asked regarding their thoughts on one of the usual practices on the said course, accomplishing paper-based forms on tracking their fitness. Using these paper-based forms, students will write down all their computed and calculated fitness measures. Figure 2 presents the polarity distribution of the students' thoughts on accomplishing paper-based forms when tracking their fitness.

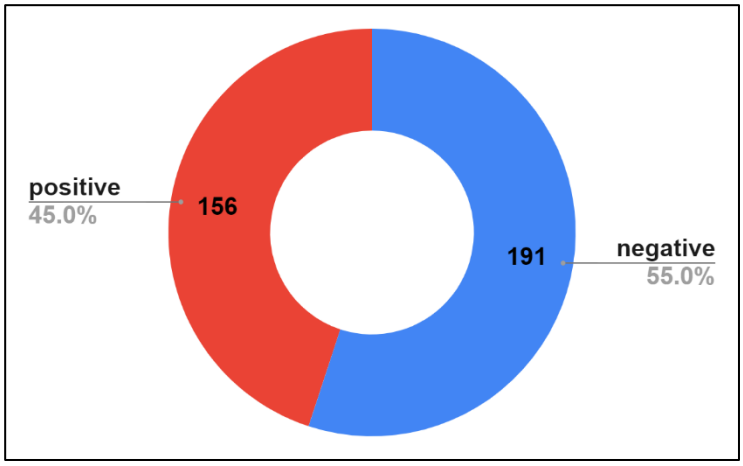

Figure 2. The Polarity of Student Responses to Their Thoughts on Accomplishing Paper-based Forms on Tracking Their Fitness

As seen in Figure 2, students' thoughts are almost equal when accomplishing paper-based forms when tracking their fitness. 156 out of 347 students had a positive outlook on

using paper-based forms. However, most of the students (191 out of 347) have negative thoughts about tracking their fitness by accomplishing paper-based forms.

RQ2. What are the students' thoughts and feelings on the integration of mobile fitness applications in their PATHFit 2 course?

Figure 3 presents the polarity of the students' sentiments regarding the integration of a mobile fitness application in their PATHFit 2 course. If students' sentiments are geared towards the acceptance of the integration of the fitness application, positive polarity is assigned. Negative polarity was assigned to students' sentiments that disagree or found difficulty in the integration of the fitness application. As seen in Figure 3, students tend to have a more positive outlook (313 out of 347) on the integration of a fitness application in their PATHFit 2 course. However, there are still students who have encountered difficulties (34 out of 347) in using the fitness application due to some constraints.

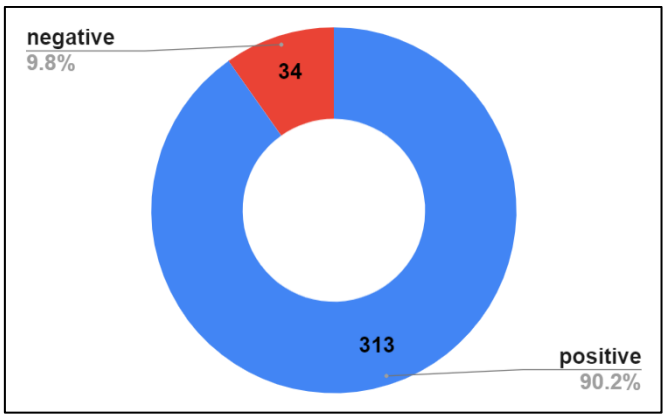

Figure 3. The Polarity of Student Responses to Their Sentiments on the Integration of a Fitness Application in the PATHFit 2 Course

Upon training and testing the dataset using the SVM algorithm, the results performed an accuracy of 91.34%. This shows that using the SVM algorithm on students' sentiment analysis resulted in an accurate prediction if the sentiments are positive or negative. To understand the results from the SVM algorithm, a confusion matrix is presented in Table 2. A confusion matrix is a performance evaluation tool used to assess the accuracy of a machine learning algorithm's predictions (Provost & Fawcett, 2013). It presents the actual positive, predicted positive, actual negative, and predicted negative rates of a model's predictions in a tabular format (Jeppesen et al., 2019).

Table 2. Confusion Matrix on the Integration of a Fitness Application in PATHFit 2 Course

Label	Actual Positive	Actual Negative	Class Precision
Predicted Positive	**312**	29	91.50%
Predicted Negative	1	**5**	83.33%
Class Recall	99.68%	14.71%	

As seen in Table 2, from the 313 actual positive sentiments, 312 sentiments have been predicted by the SVM algorithm as positive as well. This shows that the annotated dataset is precise and accurate. Five out of 34 actual negative sentiments were predicted as negative. This shows that the annotated dataset may have considered several sentiments that are partially positive that have been annotated as negative. Highlighting the precision of the SVM algorithm, the predicted positive has a class precision of 91.50%, which shows that the predicted positive sentiments are precisely annotated from the actual sentiments.

To visually present the students' sentiments, a word cloud was presented in Figure 4. The word cloud contains the clustered positive and negative sentiments of the students.

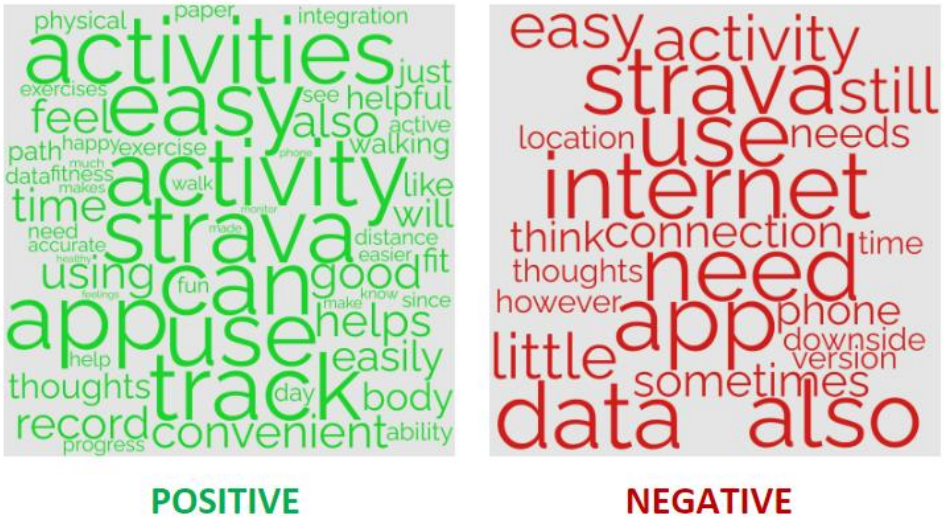

Figure 4. Word Clouds of Students' Sentiments (Positive and Negative)

DISCUSSION

On accomplishing paper-based forms for tracking their fitness, several students have agreed that using paper-based forms is more accessible and does not require any technology. One of the students said, "[Paper-based forms] are not complicated to use that the [fitness application] technology." Another said, "Paper-based forms of tracking our fitness [are] good because all of us have access to it even without an internet connection."

On the contrary, the majority of the students have negative thoughts about accomplishing paper-based forms as they tend to easily be lost and need to be redone which causes the hassle of accomplishing them and even the risk of data privacy is present, as one of the students said, "Paper-based forms are a hassle to bring because you might lose it, so you have to do it again. Also, using it can be risky if lost because there is some private information available on the forms." Moreover, accomplishing paper-based forms may not result in an accurate computation of fitness and can easily be manipulated, as

some of the students mentioned, "Boring, time-consuming, and easy to manipulate the result," and "Answering paper-based forms of tracking my fitness is not accurate and sometimes I forgot to write on the paper."

With overwhelming positive sentiments from the students, the integration of a fitness application in their PATHFit 2 course can be seen as successful. Students tend to find using the mobile fitness application easier, specifically in tracking their fitness without the hassle of using paper-based forms. Students are even overwhelmed with using the application in their PATHFit 2 course and find it as a modern approach to their learning. Some students mentioned, "Strava's integration on PATHFit 2 is quite new and a modern approach. It allows students to track their activity using their specific sensors, which are accurate," "It's wonderful that PATHFit has it since it's motivating to see your work or exercise offered by your instructor, and it's also nice to see how many kilometers you've traveled. In fact, I don't even know that there is such an app," and "It is good to have Strava in our subject because it helps us to be more active and it also helps us to do exercise at least 3x a week. And it records the distance that we have made." Some students also believed that by using the fitness application, their results are more accurate and reliable. Some of the students have mentioned, "Using Strava in PATHFit 2 I find it easier and more accurate than using paper and measuring myself. It is easy to use because I always carry my phone, while papers that I need to carefully bring to not be crumpled or what" and "I thought that would be great to use Strava for PATHFit 2 because it helps to avoid cheating on exercises or activities."

However, a few of the students still find difficulty in the integration of the fitness application in their PATHFit 2 course. Most of the students' sentiments were regarding the use of the internet when using the application to record their data. Several of the students' sentiments are "It is expensive since it [needs] mobile data to use," "The downside is it's not convenient since we need data connection while doing [an] activity," "If you don't have [an] internet connection, you cannot save your record," and "I feel a little bit sad because Strava can't use without data or [Wi-Fi] but at the same time I enjoy the app."

CONCLUSIONS AND RECOMMENDATIONS

Considering the study's results, it has been concluded that students have more negative thoughts about accomplishing paper-based forms when tracking their fitness due to a higher chance of losing or misplacing the form, it is time-consuming to answer, and results may not be accurate and easy to manipulate. On the contrary, students have a greater positive sentiment on the integration of a fitness application in their PATHFit 2 course as it helped them to track their fitness in a modern way with accurate results and gave them more motivation in finishing their exercises and activities.

With the findings of the study, the following are the recommendations: (1) Consider involving a larger sample size to have a more accurate sentiment analysis of students' thoughts and feelings on the integration of a fitness application; (2) Introduce additional

fitness applications suitable for the learning of the students in other PATHFit courses as well; and (3) Implement the practice across all programs taking PATHFit courses to enhance pedagogical approaches in physical education.

RESEARCH IMPLICATIONS

As the study presented the results, students had a highly positive sentiment about using a fitness application integrated with their PATHFit 2 course. This result shows that utilizing technology in physical education enhances the experiences of the students in maximizing available technology for their learning. Additionally, with a highly positive sentiment, the utilization of suitable fitness applications on other PATHFit courses may be integrated to technologically enhance student experiences in learning.

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DECLARATIONS

Conflict of Interest

The author declares no conflict of interest.

Informed Consent

All participants of the study were informed of the purpose and data to be collected upon answering the survey questionnaire. The identity of the respondents was not obtained during the data gathering.

Ethics Approval

The BulSU Research Management Office and Research Ethics Committee accepted and approved the conduct of the study.

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