Technology Support for Health-Promoting Lifestyle: Development and Testing

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ABSTRACT
In this study, we have described creating and deploying an online application designed to support university systems that promote healthy lifestyles. Based on the findings of small sample trials, several participants said they could easily access the program on their computer, tablet, or smartphone. Additionally, the participants stated that they extensively used the application's capabilities. Although participants' satisfaction ratings with the app were moderate, they expressed greater optimism over the program's overall potential for intervention. According to the results of our focus groups, users should receive further instruction on how to utilize the app to maximize their efficacy in subsequent research. The technical difficulties the research team encountered also emphasize how crucial it is to give appropriate time for large-scale trial studies. It is unclear whether eHealth interventions will contribute to the global physical activity pandemic in a timely and suitable manner, even though they have the potential to change particular participants' behavior. Physical exercise is a complicated behavior that can take place in a range of settings and be impacted by a number of environmental, social, and psychological elements. It is recommended that future studies investigate the potential of technology-based intervention strategies to identify the most effective approach for bolstering university health-promoting systems, with the ultimate goal of influencing global community behavior.

1. Introduction

It has been detected that globally, the population at every layer and level is becoming less physically active and more sedentary. Both behaviours are independently associated with health outcomes and are causes of death [1-3]. There has been a lot of research carried out, especially in the last two decades, there has been a rapid increase in evaluating and designing research related to
physical activity tests [4,5]. Several examples of the physical activity in education are shown in Table 1.

Table 1
Example reports on physical activity

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<td>1.</td>
<td>Boxing training technology based on the level of physical development of children</td>
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<td>2.</td>
<td>Development analysis research on physics education by mapping keywords using the VOSviewer application</td>
<td>Al Husaeni, D.N.</td>
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<td>The efficiency of the experimental methods of improving complex technical and tactical actions of boxers</td>
<td>Kurbanmuratovich</td>
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<td>4.</td>
<td>A critical success factors model for golf athletes' talent development in Malaysia and Indonesia</td>
<td>Suherman et al.</td>
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<td>Improving the effectiveness of the method of conducting physical education classes for students of grades 5-9 in hot climate</td>
<td>Ulaboevich</td>
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<td>7.</td>
<td>Technologies for selecting boxers and preparing them for competitions</td>
<td>Djurabevich</td>
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<td>8.</td>
<td>Bibliometric analysis of research development in sports science with vosviewer</td>
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<td>9.</td>
<td>The mechanism of development of professional and pedagogical creativity of future physical education teachers based on a competent approach</td>
<td>Hasanovna</td>
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<td>10.</td>
<td>Nutritional research mapping for endurance sports: A bibliometric analysis</td>
<td>Firdaus et al.</td>
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<td>11.</td>
<td>Development of the theoretical foundations of sports activity (sports business) in post-industrial conditions</td>
<td>Glushchenko</td>
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<td>Analysis of boxers' pulse oximeter and chronometry ability to perform during boxing</td>
<td>Kamraju et al.</td>
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<td>Yoga and weight management</td>
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<td>The impact of yoga on physical health</td>
<td>Kadhkim</td>
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<td>16.</td>
<td>Effect of weight exercise on the development of some components of special muscle strength and perform some artistic gymnastics skills</td>
<td>Obafemi et al.</td>
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<td>Effect of demonstration method on primary school pupils' academic achievement in physical and health education</td>
<td>Yaseen</td>
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<td>Rehabilitation program for surgical shoulder joint protrusion among team games players injured</td>
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<td>Effect of physical exercise on weight reduction of students</td>
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<td>Effectiveness of cooperative learning using multimedia in some physical abilities and basic skills for junior players in basketball</td>
<td>Vera, M.J.C., and Calixtro Jr, V.L.</td>
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This has become a supporting system for health institutions and organisations to produce evidence-based physical activity recommendations [29]. In various countries, public health guidelines recommend that adults do at least 150 to 300 minutes of moderate-intensity physical activity. The form of physical activity carried out can be muscle-strengthening activities carried out at least 2 times a week [29]. However, in reality, only a few people achieve this amount of physical activity each week, and evidence suggests that physical activity increases and meets recommendations only initially, but is not sustained and consistent over the long term [30-32].

Based on data in several developed countries such as the United States and England, physical activity that meets recommendations is only followed by 1% to 16% of adults, which includes activities to strengthen muscles [33,34], and reduce the risk of falls, fractures and osteoporosis [35].
Of great concern is the fact that adults spend approximately 60% to 70% of their waking hours engaged in sedentary activities alone [36]. Meanwhile, several research results state that for inactive adults, high sedentary activity is associated with an increased risk of developing non-communicable diseases (e.g., type 2 diabetes) and may be the main cause of death [37]. Overall, this shows the need for more innovative interventions to encourage people to undertake and regularly engage in physical activity and reduce sedentary activities.

To increase the level of physical activity involved in the university population, effective interventions with a wide reach are needed. Considering that interventions via mobile health (mHealth) can be used everywhere by involving many people, and the delivery costs are relatively cheap and can be carried out at a convenient time and place [38]. Therefore, these tools can be used to promote physical activity interventions in university populations [39]. Furthermore, interventions through mHealth can integrate key health behavior change strategies, including self-monitoring, goal setting, prompts or motivation, and feedback on behaviors that are effective in increasing participation in physical activity [40]. There is a large body of systematic evidence supporting the use of mHealth as an intervention to promote health behavior change [38,41,42], although trials with long-term follow-up (e.g., > 6 months) should be conducted [43,44]. Reports on physical activities have been increased as shown by bibliometric analysis, especially related to technology support (see Figure 1). Bibliometric analysis is one of the effective methods for understanding research trend in many subject areas (see Table 2). Detailed information on how to use bibliometric analysis is explained elsewhere [45]. This research aims to determine the level of knowledge of teachers in vocational education regarding OER and the extent to which teachers have integrated OER in the implementation of learning.

![Fig. 1. Scopus database results for technology in physical activity, taken in May 2024](image1.png)

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<td>Phytochemical profile and biological activities of ethylacetate extract of peanut (Arachis hypogaea L.)</td>
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<td>stems: In-vitro and in-silico studies with bibliometric analysis</td>
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<td>Prototype of greenhouse effect for improving problem-solving skills in science, technology, engineering, and mathematics (STEM)-education for sustainable development (ESD): Literature review, bibliometric, and experiment.</td>
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<td>Nandiyanto, Asep Bayu Dani, Risti Ragadhita, and Muhammad Aziz.</td>
<td>Involving particle technology in computational fluid dynamics research: A bibliometric analysis.</td>
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This research aims to describe a systematic, theory-based process (using IM) to develop a smartphone-based physical activity application linked to an individual physical activity tracking system that can ultimately increase participation and individual physical activity levels.

2. Theoretical Framework

Physical inactivity has been described as a global pandemic [84] and occurs almost worldwide. The latest data estimates show that around 80% of young people experience physical inactivity internationally, and do not meet the physical activity guidelines recommended by WHO, namely 60 minutes of moderate to vigorous physical activity (MVPA) each. Research results state that adolescent boys are usually more active than girls [85-88], but have significantly higher levels of screen time [89], making them vulnerable to unhealthy weight gain and social and emotional well-being. Schools and Educational institutions such as colleges are identified as ideal settings for physical activity, as well as the promotion and prevention of obesity, because they have access to the majority of adolescents, adequate facilities, and qualified personnel to achieve these outcomes. Based on research results from previous research, the novelty in this research is the use of "snack app" principles and theory which intervenes in physical activity as an activity that is carried out for a short duration but is carried out as often as possible, so that cumulatively it can meet WHO physical activity recommendations, and can even exceed the limits. Apart from that, in this research, the application that was built was able to track its users' physical activity and provide feedback and suggestions regarding strategies for achieving the users' physical activity targets.

Many studies have been carried out to develop, improve, and even evaluate health promotion through physical activity [90,91]. This is one way to motivate and support organizations or individuals to carry out movements while promoting a healthy and active lifestyle throughout life which will ultimately have implications for health [91,92]. This research makes a significant contribution to public health, particularly in managing and changing health behavior. This research provides insight and reinforcement that the world of education has a high contribution in carrying out this healthy living movement, because the world of education is a strategic place to facilitate health promotion and effectively help improve the level of public health. Health promotion activities in educational environments at universities are supported by WHO. Health-promoting universities are WHO-supported projects that are studied based on conceptual, field experience and action frameworks. During the year 2000, the entire fabric of community life and social activities in cities, schools, workplaces and home environments, should provide greater opportunities for improving health (WHO Europe Copenhagen, 1998). Schools are identified as ideal settings for physical activity and health promotion, due to the effectiveness of school-based interventions in increasing physical activity and preventing obesity [93, 94]. In comparison, evidence on the effectiveness of school-based interventions targeting adolescents finds that school-based interventions are twice as successful as interventions targeting adolescents in regular social settings [93, 95, 96]. The challenges of achieving health behavior change have prompted the exploration of new and exciting intervention strategies. The stages of behavior change consist of five stages, namely pre-contemplation, contemplation, preparation, action and maintenance [97]. The stages of behavior change can be seen in Figure 2.
Guidelines for healthy and active living have been developed in several countries which aim to provide recommendations for physical activity according to WHO recommendations, namely with moderate to high intensity with a duration of between 150-300 minutes and with a frequency of at least 2 times a week. This recommendation is given in the context of preventive and curative efforts to overcome health problems due to lack of movement or non-communicable diseases. Several research results state that adults who are sedentary and do not carry out physical activity as recommended are at higher risk of developing non-communicable diseases (for example type 2 diabetes and heart disease) and may be the main cause of death [98]. Globally, innovative, interesting and effective movements are needed quickly to help people have high motivation to live a physically active, regular and sustainable life. Activities and movements for health promotion focus on participants' involvement in continuous physical activity, with moderate to heavy intensity, carried out for a short duration but carried out continuously and sustainably. Some activities that may be done with a low to moderate level of difficulty include walking, squatting and standing, standing while teaching or doing work, or climbing stairs. Health promotion and an active lifestyle can be a source of reference for preventive and curative measures against non-communicable diseases such as obesity, high blood pressure, heart disease, and so on. Educational settings, especially universities have access to the majority of adolescents, adequate facilities, and qualified personnel to achieve effective outcomes [99]. For a number of years, the usage of IT in healthcare has increased dramatically [100]. However, utilization within health promotion is just beginning to emerge, as seen by the very modest percentage of research papers included in the reviewed publication series [101]. Despite the fact that the Internet may contain a wealth of material that promotes health, relatively little research has been done on the subject. It should be mentioned that there haven't been many critical researches on the usage of technology [102].

2. Methodology

This study developed an application that was part of a larger study to test the effectiveness of the application in increasing physical activity throughout the day in adults [16]. The app works by self-monitoring, providing feedback on the activity completed, offering users a method for setting goals, and creating an action plan to complete their physical activity each day. This application development framework consists of 6 work plan stages, these stages are ways of working that are
often applied to guide the development of interventions aimed at changing health behavior. The first four stages of this application development process include (1) Needs for Assessment specifying intervention outcomes and objectives, (3) designing the intervention and applying theory, and (4) refining intervention development. Meanwhile, the last 2 steps for Application Development (adoption, implementation, and evaluation plan) The flow diagram for this research is as follows Figure 3. The flowchart for developing this web-based application is as follows Figure 4.

**Step 1 Needs Assessment**
- Scoping review of the literature
- Establish planning group
- Stakeholder improvement and PPI
- View of the public

**Step 2 Program Objective**
- State of the outcome
- Specify the performance objectives
- Specify the determinants of behavior
- Define the behavior change technique
- Define how these change techniques will be implemented into the app

**Step 3 Theory Based Intervention methods and practical applications**
- Define the underlying theory and the process of change

**Step 4 Intervention Development Apps**
- Operationalize strategies into plans-Design and Develop the Apps
- User Testing

**Step 5 Adoption and Implementation of Plan**

**Step 6 Evaluation Plan**

*Fig. 3. Diagram for this research*
2.1 Participants

Participants are used as objects to conduct small sample trials to detect the main function of this application. Participants involved in this small sample trial were the academic community of the Indonesian Education University consisting of lecturers, students, and university staff totaling 100 people.

2.2. Instruments

The evaluation process for this research product also used The Adaptation of ATLAS Evaluation Questionnaire to test items on the type of app/website usage and the frequency of use as well as
their behavioral intentions. Apart from that, the evaluation process was also carried out qualitatively through focus group discussions between researchers and expert judges from relevant fields.

3. Results and Discussion

3.1 Website Design

Website design is carried out in several stages, from needs assessment, Specification of Outcomes, Performance Objectives, Change Techniques, Theory-Based Intervention Methods and Practical Applications, Development of Application, Adoption and Implementation Plan, and Evaluation Plan. The entire process can be seen in the following explanation:

3.1.1 Stage 1 needs assessment

In stage 1, several activities need to be carried out as an initial step in application development as follows:

(i) Overview literature
   Reviews relevant literature on behaviour change theories and techniques related to physical activity promotion, as well as Interventions [103]. This helps guide the content that will be built such as strategies and techniques, application implementation, and participant engagement [104].

(ii) Planning Group
   Create a working group of people who will build the application. This planning group consists of people who have expertise relevant to creating the application. This planning group consists of 8 members with various scientific backgrounds, namely IT experts, physical activity experts, medical experts, psychology experts, nutrition experts, and members as supporting systems [105].

(iii) Stakeholder and patient public involvement
   This stage was carried out by surveying the community to find out their responses and perceptions regarding the initial development of the intervention using the application. It is planned that 100 community members will be surveyed regarding the application concept and use of digital technology as a behaviour change mechanism. Some of the information that will be explored is regarding the importance of embracing digital technology to enable people to live a healthier lifestyle. Apart from that, the concept that needs to be ensured is that there are sufficient opportunities for community members to do this. Including also input from the community which makes it possible to add features to the application that will be developed [106].

(iv) View of the public
   At this stage, analyze and determine the community's views obtained based on the results of previous surveys.

3.1.2 Stage 2 specification of outcomes, performance objectives, and change techniques

The second step is the development of specific health features that align behavior in the application with the Behavior Change Technique (BCT). Based on information from the findings from stage 1 (needs assessment), then identify 3 main performance objectives for developing this application. This also includes the goals the individual wants to achieve to complete the application features [107].
3.1.3 Stage 3: Theory-based intervention methods and practical applications

A key principle in the development of this application was to encourage users to learn from their experiences through engagement in self-regulatory activities (e.g., self-monitoring, feedback, and goal setting), in line with control theory and self-regulation theory; building intrinsic motivation; And promotes autonomy (also consistent with self-determination theory). An important goal of the app is to promote the formation of active daily living habits in line with the habit formation model to maximize the potential of app use and physical activity [108].

3.1.4 Stage 4: Development of application

At this stage, the application that will be used for intervention begins to be developed and created. The application development consists of the following components:

(i) Application and Physical Activity Tracking
This feature was created so that users can self-monitor their goals and receive feedback. This feature provides decisions about how physical activity should be measured and how the user is progressing. One way to achieve this is to use device-based physical activity measurements (e.g., accelerometers, fitness trackers, and smartwatches) that can continuously record physical activity [109].

(ii) Mobile App Development
This application will be in the form of a mobile app consisting of 5 features, namely Dashboard, Status, Goals, Resources, and notifications. An image of the mobile app development interface design can be seen in Figure 5.

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![Mobile app development interface design](image-url)

**Fig. 5.** Mobile app development interface design
3.1.5 Stage 5 Adoption and Implementation Plan

At this stage, an intervention will be carried out as an application trial on a small-scale sample. Pre-test-post-test group design will be applied in this intervention, which aims to test the effectiveness of the application. Ethical approval and informed consent will be given to participants before carrying out the intervention. The participants consisted of 50 Indonesian Education University students. Participants will download the application and carry out interventions according to the guidelines for 16 sessions [110].

3.1.6 Stage 6 Evaluation Plan

At this stage, the data collection process is carried out using the User Version of the Mobile Application Rating Scale, The Adaptation of ATLAS Evaluation Questionnaire to test items on the type of app/website usage and the frequency of use as well as their behavioral intentions. Apart from that, the evaluation process was also carried out qualitatively through focus group discussions between researchers and expert judges from relevant fields [111].

3.2 Research Results based on the Use of Website-Based Applications

The results of research based on the use of website-based applications found that participants in this study did not depend on ownership of Smartphones, in other words, the use of applications can also be accessed easily on tablet devices or computers [112].

However, 58% of participants reportedly had access to a smartphone or tablet device. The research results also reported that the majority of participants, namely 69%, reported that they found it easy to access the functions and use of the application to carry out their activities and goals, 22% reported difficulty accessing the application, and 9% did not access the application and did not carry out activities at all. The research results show that technology use has become widespread, not only limited to smartphones but also more widely using other devices such as tablets or laptops [113-117].

3.3 The Research Results are Based on the Satisfaction and Behavioral Interventions Website

Based on data analysis regarding Website satisfaction and Behavioral Interventions, 82% of participants agreed that the website-based application was fun to use. After using the application, it was also reported that participants had a desire to limit recreational screen time (X = 4.25 +/- 1.59), limit consumption of sweet drinks (X = 5.25 +/- 1.82), actively participate in regular MVPA (X = 4.32 +/- 0.97), and muscle reinforcement activity (X = 4.01 +/- 0.83). Based on this data, it can be seen that the level of completion of the physical activity program adapted to the application carried out by participants is in the high category [118].

3.4 Focus Group Discussion (FGD) Results

Based on the results of focus group discussions between the research team and various relevant and competent expert judges, it is known that thematic analysis revealed in The various themes that emerged regarding participants' general impact on the impact of the application program being developed contained several sub-themes represents changes in behavior, knowledge, and attitudes related to school, eating patterns, and perceived physical activity have participated directly as a result
of involvement in the web-based application usage program [117,118]. Testing of the website-based health promotion application shows that the application is ready to be used by various groups. The website’s student health promotion application makes it easy for users to access the health information system and multiple recommendations given to users [119,120]. The creation of this promotional application has also been based on several previous studies regarding health and quality of life [121-125].

4. Conclusions

In this research, we have explained the development and implementation of a web-based application aimed at Supporting a System for Health-Promoting Lifestyle in Universities. Results of small sample trials on several participants reported having easy access to the application via smartphone, tablet, or computer. Participants also reported that they used and were heavily involved with the features contained in the application. Participants reported moderate levels of satisfaction with the app but were more positive about the possibility of intervening with the app in general. Findings from our focus groups suggest that additional training on how to use the app is needed for users to increase effectiveness in future studies. Additionally, the technical glitches experienced by the research team highlight the importance of allowing sufficient time to conduct studies through large sample trials. Although eHealth interventions have behavioral promise changes among certain participants, it is unlikely that they will make a rapid and appropriate contribution to the global physical activity pandemic. Physical activity is complex behavior that can occur in a variety of environments and influenced by various psychological, social, and environmental factors. mental factors. Future research is encouraged to explore the utility of technology-based intervention strategy to determine the right strategy for supporting systems in the framework of health-promoting in the universities whose ultimate goal is changing community behavior globally.

References


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