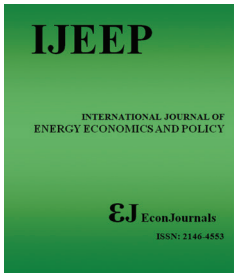

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Gamification in Energy Consumption: A Model for Consumers' Energy Saving

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ABSTRACT

In this study, the possibility of saving energy with gamification designed applications was investigated, literature studies on this subject were examined and a gamification-based approach was followed for energy saving. From this point of view, the aim of the study is to propose a gamification-based model to make energy saving easier, fun, enjoyable and beneficial. This study is exploratory qualitative research using systematic literature review, synthesis and induction methods. Within the scope of the study, the literature was first examined. The literature review focused on learning gamification-based designs that encourage energy consumption reduction. After that, a new model was developed based on the general principles of gamification, the characteristics of consumer behavior and the energy consumption target, which is the main subject of the study. As a result of the study, a gamification-based model is proposed for household consumers to reduce their energy consumption and save energy. This gamification-based model includes making energy savings easier and more beneficial for consumers, as well as making it more fun and enjoyable. After that, the proposed model was analyzed based on the studies in the literature and finally the potential of the proposed framework was discussed.

Keywords: Energy, Gamification, Energy Consumption, Energy Saving, Consumer Behavior
JEL Classifications: Q40, D11, E21

1. INTRODUCTION

To minimize the amount of energy used by buildings, several strategies have been put forward, including the adoption of building energy efficiency standards, encouraging building refurbishment, and applying applied ICT solutions for building automation. Economic incentives, feedback systems, and social norms are just a few of the measures that have been put out in recent years to persuade building inhabitants to save energy (Erell et al., 2018). The use of smart meters in the residential sector might potentially play a significant role in fulfilling the objectives of sustainability programs, according to the Third Energy Market package from the European Union. Residential consumers may not be prompted to utilize energy more sustainably by the standalone deployment of smart meters, nevertheless (AlSkaif et al., 2018).

Due to globalization, the scale of international commerce, and widespread internet usage, people are compelled to consume more. In this setting, the global importance of energy production and consumption is likewise rising (Huseynli, 2023). Nonetheless, when supply cannot keep up with demand, energy conservation is a primary priority for all governments. There are several research philosophies on the broad subject of energy conservation. Gamification, or the use of game simulations in mobile apps, may be quite beneficial. These mobile applications are more enjoyable for the user and help marketers get more accurate data. Gamification is crucial in apps that seek to gather data about users' behavior to increase user engagement and application retention (Toasa et al., 2017).

Gamification has recently become a method to boost residential customers' engagement in energy systems by focusing on the

many different motivations a client may have, such as economic and environmental motivations as well as social motivations like learning and giving to society (Seaborn and Fels, 2015; Geelen at al., 2012; Rai and Beck, 2017). As gaming's advantages as a tool for encouraging positive habits become more widely acknowledged, more goods and services that aren't typically connected with games are becoming "gamified" (Degirmenci and Breitner, 2023). According to Polyanska et al. (2022), gamification may help organizations in the energy industry manage employees more effectively (internal gamification).

Energy usage has been significantly influenced by human behavior and its drivers, although attempts to modify behavior have had various degrees of success (Abrahamse et al., 2005). The usage of usually non-renewable resources and high consumer prices result from excessive electrical energy use (Toasa et al., 2017). Reducing energy utilization is the primary goal of energy-efficient game development. While this is not the only positive impact of these games, it could be useful to sum up what is known about the energy savings they result in (Grossberg et al., 2015). The promotion of desirable real-world energy acts and the modification of player behavior may both be significantly influenced by gamification. According to Landers (2019), for gamification to be effective, certain psychological traits of workers or consumers must be addressed, and game features that will have an impact on these traits must be chosen.

Most existing initiatives, however, tend to be knowledge-intensive and don't appear to be sufficiently inspiring to encourage people to adopt energy-saving habits (Wee and Choong, 2019). Gamification, on the other hand, may result in a longer-term psychological commitment than other behavior modification strategies like nudging (Lieberoth et al., 2018). It is crucial in this situation to employ gamification and serious games as methods to engage, motivate, and educate people about energy use and associated issues. From this vantage point, an energy-saving strategy based on gamification is suggested in this research.

2. THEORETICAL BACKGROUND

2.1. Energy Consumption

During the oil shocks of the 1970s, studies of energy consumption behavior arose from a broad range of academic viewpoints (Stephenson et al., 2010). Yet, as Lutzenhiser (1993) notes, despite having a considerable impact on the effectiveness of technology-based efficiency increases, the human aspect in energy consumption analyses has been generally ignored. Due to the growing population and industrialisation of nations with abundant and equally distributed primary energy resources, global energy consumption is rising. Using more energy than is available globally and producing that energy has therefore become an issue for governments (Sarkhanov and Huseynli, 2022). Programs that promote lowering energy use are developing in this situation.

In order to encourage customers to decrease their energy usage, intervention options fall into one of two categories: structural interventions or psychological treatments (Gardner and Stern, 1996; Steg et al., 2018). Interventions with a structural focus aim to change the circumstances that lead to behavior. These prerequisites might be monetary restrictions, physical or technological alternatives, or legal restrictions. Psychological therapies seek to alter personal characteristics (such as knowledge, awareness, attitudes, norms, and values) (AlSkaif et al., 2018).

The majority of individuals utilize electricity. Concerns regarding supply issues, the depletion of energy supplies, and negative environmental effects have been expressed as a result of the fast increasing global energy consumption (Pérez-Lombard et al., 2008). It is assumed that because everyone uses energy, more energy is utilized in buildings because working people, non-working people, children, the elderly, and all other types of people spend more time at home. Heating and cooling systems, lighting, freezers, computers, and other equipment are the main energy consumers in business buildings (Conti et al., 2016). It is also mentioned that energy is still a finite resource, and that future energy efficiency and savings ideas, techniques, and solutions will still be required (Fraternali et al., 2018). The International Energy Agency (2016) identifies six elements—exterior characteristics, temperature, machinery and automation systems, operation and maintenance, internal environment quality, and passenger behavior and activities—that influence energy use in buildings.

If users have access to smart meters, the measurement data they give is often generic and does not provide any particular insight that might encourage participation and increase energy efficiency (AlSkaif et al., 2018). The way power is utilized and the creation of more energy-efficient gadgets may both be affected by using an app that employs gamification approaches. Energy efficiency, however, may not always be tied to the equipment in question. Focusing on customer behavior rather than equipment is crucial right now.

One of the most crucial measures in energy conservation is to actively involve and encourage customers to lower their energy use. Yet, such an intervention may fail if not paired with strategies that make behavioral change of customers robust. Consumer behavior change is "the act of modifying or changing conventional ways of thinking or acting," according to one definition (Wagner and Hollenbeck, 2020). Consumption preferences are thought to be influenced by individual-level characteristics, such as awareness, beliefs, values, attitudes, and knowledge.

Kotsopoulos et al. (2017) suggested a behavioral research model for workers' energy conservation at work. The empirical impacts of some serious play in altering knowledge, behavior, and attitude towards energy conservation have been beneficial (Fijnheer et al., 2016). User behavior is influenced by a variety of elements, including monetary considerations, moral principles, and everyday routines. Several studies demonstrate that consumers may alter their behavior once they become aware of the consequences of their actions (Frederiks et al., 2015; Simanaviciene et al., 2015). In addition, attempts to minimize energy consumption via technical advances should be addressed

as well as energy conservation through behavior modification (Delmas et al., 2013).

2.2. Gamification

The idea of gamification is relatively new in academia; it first appeared in the field of digital media in 2008 and gained popularity following that year (Deterding et al., 2011). According to several research, the concept of gamification is the incorporation of game features into non-game environments in order to enhance user engagement, involvement, and behavior (Zichermann and Cunningham, 2011; Ribeiro and Ventura, 2013). The gamification approach engages consumers and teaches them about behavior by using something fun, like games. It is a method that transforms a routine activity into a game where people compete and react to obstacles. Gamification is a fantastic technique to get customers to do things that they may otherwise find challenging, pointless, or stupid to undertake on their own (Law et al., 2011).

Gamification has lately attracted a lot of attention as a strategy for changing attitudes and behavior (Ro et al., 2017). The basic objective of gamification is to improve user engagement by using game-like elements like leaderboards, achievements, or virtual currency that give users a sense of actual ownership and purpose when engaging with activities (Groh, 2012). Wherever a game or competitive item is pushed, gamification is applied. According to Figol et al. (2021), gamification is employed to manage the behavior of certain demographic groups.

Serious games are described as "any sort of interactive computer-based game software produced by one or more players for use on any platform and with the purpose to be more than amusement" (Ritterfeld et al., 2009). The simplest definition of gamification is "the use of game features in non-game situations to improve user experience and user engagement" (Deterding et al., 2011).

Virtual recreations of real-world activities that might instruct players and influence behavior are referred to as serious games (Orland et al., 2014). The usage of gamification and serious games both aim to change human behavior (or attitudes and cognitions) via the use of intrinsically compelling elements found in well-made digital games.

Gamification elements are one of the most crucial factors utilized in gamification design. Points, badges, and leaderboards are examples of gamification components that encourage user participation. The use of incentives and penalties, two common gamification components, has been shown to be successful in encouraging users to engage in desired behavior (Fang et al., 2019; Gamma et al., 2021). In gamified solutions, points, badges, and leaderboards serve as the currency of confidence and social capital. Points are obvious, immediate rewards for players' activities, and they are often the main driving force behind those acts. Scores provide players the ability to assess their achievement, compare it to that of other players, display their accomplishments to others, and track their progress toward their objectives (Grossberg et al., 2015). The emphasis of a growing body of study on gamification design and assessment has been on various gamification components, such as leaderboards and badges (Enríquez et al., 2019; Hamari, 2017).

Internet-based and mobile apps both leverage gamification. While they make it easier to do certain everyday chores like paying for services, playing games, and checking the weather, mobile applications are becoming more and more prevalent in people's daily lives. Yet, there are several elements that might be more often taken into account while developing mobile apps in order to analyze user behavior (Toasa et al., 2017).

2.3. Gamification in Energy Consumption

Energy efficiency, self-consumption, and demand response are the main topics of gamification-based energy applications (AlSkaif et al., 2018). Nonetheless, various gamification-based apps, games, or programs connected to energy usage have been created. Games like "Cool Choices," "WeSpire," "Ecoinomy," "Energy Chickens," and "Carbon4Square" are examples of energy efficiency games used in the workplace. These games include both solitary and cooperative game options, as well as monetary prizes (Grossberg et al., 2015).

According to Zhao et al. (2017), only 42% of energy efficiency is directly attributed to technology advancements in building systems. This implies that behavior flexibility has a significant influence on energy savings. In a study by Kiatruangkrai et al. (2017), schools were urged to promote energy-saving behavior among their students after the Thai Government announced it was reducing energy consumption for all government institutions, including public schools, due to the issue of insufficient energy supply causing Thailand's energy insecurity problem. The efficiency of a gamification technique that offers.

A mobile application for iOS was created by Toasa et al. (2017) that enables users to track their energy usage behavior. The deployment of gamification techniques to assess behavior and the inclusion of suggestions to enhance users' energy behavior are the application's primary objectives. The user may explore and choose from the different categories after downloading the app, as well as provide answers. The answers to these inquiries, which are offered by energy specialists, are utilized to ascertain the user's behavior. The user then regularly gets mobile application tips or notifications on how to reduce energy use at home when the questions are answered (Toasa et al., 2017). Through an Internet of Things (IoT)-enabled gamified mobile application that offers workers individualized energy-saving guidance ideas for adopting energy savings and more, Kotsopoulos et al. (2018) developed a comprehensive picture of user profiles and preferences.

AlSkaif et al. (2018) suggested an interdisciplinary framework that creates a behavioral model to identify important energy-related behavioral modification needs required to engage residential consumers in energy practices. Casals et al. (2020) analyzed the findings of the EU-funded EnerGAware research project, in which a novel serious game (a game created for objectives other than amusement) was created to lower energy use and carbon

emissions by altering the energy efficiency behavior of social housing residents.

3. RESEARCH METHODOLOGY

3.1. Purpose

Reducing energy consumption and saving energy are among the leading energy issues all over the world. Various applications and models have been prepared in order to save energy for consumers. In this study, the possibility of saving energy with gamification designed applications was investigated, literature studies on this subject were examined and a gamification-based approach was followed for energy saving. From this point of view, the aim of the study is to propose a gamification-based model to make energy saving easier, fun, enjoyable and beneficial.

3.2. Research Design

Leveraging the effectiveness of gamification in motivating energy-saving behavior may lead to advances in this regard. This study is exploratory qualitative research using systematic literature review, synthesis, and induction methods. In this direction, first, the literature on energy saving was searched, the applications made in this field were examined, energy consumption was examined within the scope of consumer behavior and the general framework was determined. Then, based on the principles of gamification and considering the motives of consumers' energy consumption, a model has been proposed.

Every household's activity and consumption have been impacted by the COVID-19 epidemic in the majority of nations. The pandemic caused substantial harm to several industries, including energy, transportation, manufacturing, and home development (Qarnain et al., 2021). Many studies are being conducted in areas linked to lowering the rising consumption. This research offers a paradigm for residential customers' energy savings.

Based on broad ideas of human behavior, studies have been done that examine people's attitudes and actions regarding pro-environmental and energy usage in companies. Of these theories, the Theory of Planned Behavior is the one that is most frequently used (Figure 1). The Theory of Planned Behavior (TPB) is often used to describe energy-saving and ecologically responsible behavior (Ajzen, 1991; Ajzen and Fishbein, 1977). According to this view, people behave rationally and weigh all available information while making judgments.

When the literature is evaluated in general, it becomes clear that research efforts concentrating on household energy consumption behavior may be divided into three major groups, incorporating various views (Arawomo, 2017; Da Silva and Cerqueira, 2017; Zhou and Yang, 2016):

1. Economic behavior oriented
2. Technological behavior oriented
3. Psychological behavior oriented.

According to all of these, in this research, the Theory of Planned Behavior has been approved as the primary theory to influence the energy consumption behavior of consumers. Because altering customer behavior via the use of psychological principles may also result in energy savings. In this research, a model that is based on gamification has been developed to describe the factors that determine the adoption of energy-efficient technology. These factors are based on individual behavior theories.

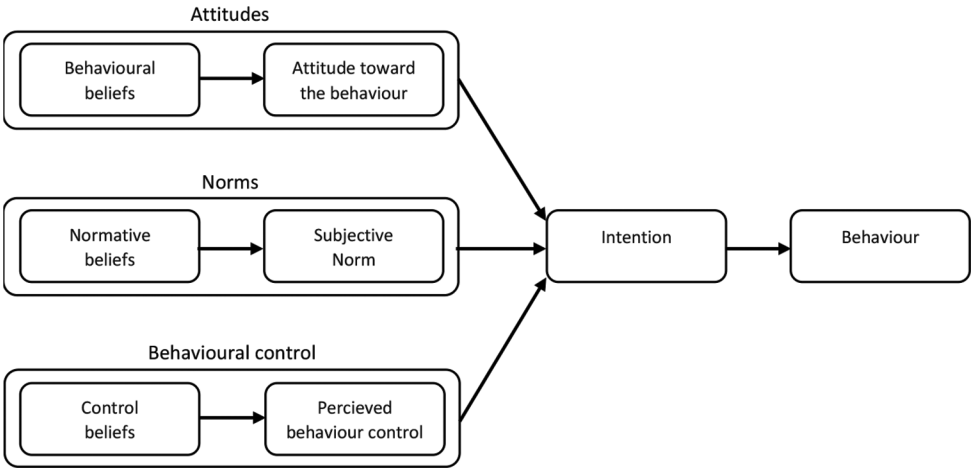
4. A GAMIFICATION-BASED MODEL PROPOSAL TO REDUCE ENERGY CONSUMPTION

People are more likely to be willing to save money when they have a visual representation of the quantity of energy they consume and its worth in terms of money. Nevertheless, giving visual feedback on energy usage is not sufficient to ensure that consumption reductions will be accomplished on its own, since the success of this strategy is heavily dependent on the engagement of end users (Hargreaves et al., 2013). In this setting, the feedback that consumers get on their screens, which offers precise tips or recommendations for cutting their energy use, has been well investigated (Emeakaroha et al. 2014; Joachain and Klopfert, 2014). Even though many programs for energy consumption provide a variety of capabilities, the information may in some circumstances be shown to the user instantly (direct feedback), while in other instances, the information may be processed before it is presented to the end user (indirect feedback).

Apps that include gamification aspects, such as offering feedback or allowing users to earn points for a behavior, are often evaluated more favorably by users than programs that attempt to modify behavior by only presenting information (Rai and Beck, 2017). In this context, incentives are used to promote desirable actions in gamified systems, whereas penalties have the objective of discouraging bad behaviors (Diefenbach and Mussig, 2019).

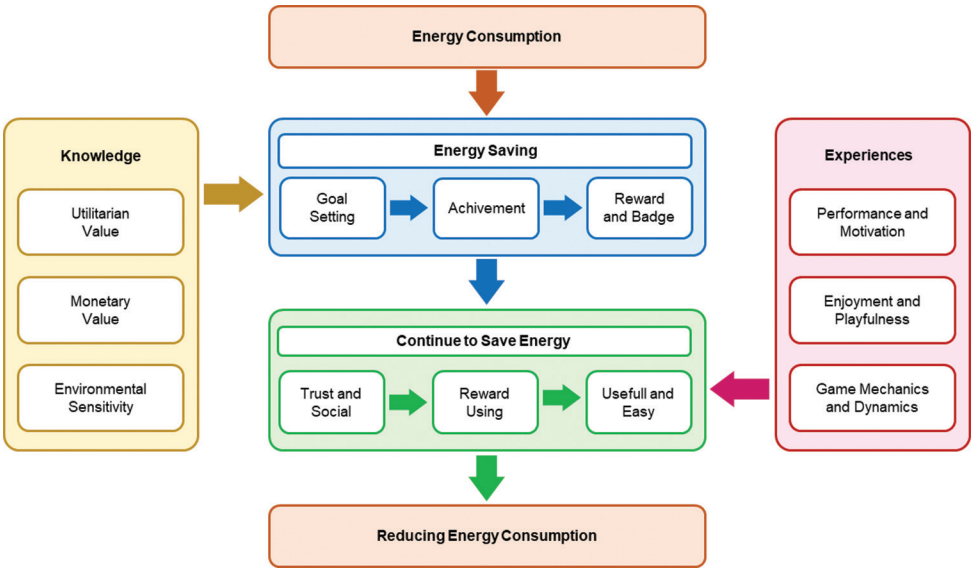
The gamification-based energy saving model has been proposed for consumers to reduce their energy use (Figure 2). Theoretically, it is assumed that consumers have no intention of making changes in their behavior. The first thing a person needs to consider making a change is to be aware of a behavior. The information process must be continuous to help the consumer change his behavior (in this case, any action to reduce energy savings). If these operations are done using a game-designed application, it means a gamified application. It is known from studies in the literature that such applications and platforms should be easy to use. However, the most important component of this model is that the user enjoys the game-designed application, that this application is fun, that he can share his own results with others, that he receives badges and points among users according to his own results. Finally, it is when the consumer makes certain changes in his energy consumption behavior. If the consumer takes steps towards energy consumption with this gamified application tool, if these steps reduce energy consumption, if the consumer uses this application easily, enjoys it, and most importantly, if he finds this application useful, he will continue to use it. The focus of this phase is to motivate the consumer to continue the changes. Currently, enriching the design by making use of gamification elements comes to the fore. The main goal of this process is to make the user experience unique to the consumer.

Figure 1: Theory of planned behavior



Source: Ajzen (1991)

Figure 2: Gamification-based energy saving model



Source: Author

According to Toasa et al. (2017), the goals of the integrated gamification approach are as follows:

- Determine how the user behaves in relation to energy usage
- Encourage people to be aware of proper electrical energy use
- Contribute to lowering energy costs and raising energy efficiency by sharing best practice guidance and rewarding user cooperation
- Let the user to act in each way and show that they are interested in answering the questions.

To urge people to save energy, there are several applications. In recent years, gamification has been included to these programs. A new field of study in energy conservation is gamification. However, there is a dearth of scientific proof that gamification has a positive impact on energy (Casals et al., 2020).

While it has not been put to as many tests as Ajzen's (1991) theory, the Theory of Interpersonal Behavior (TIB) is quite close to it. To explain actions that might be the product of familiarity and repetition rather than consciously deliberate action, this theory contains a "habit" component (Figure 1).

According to Ajzen (1985), behavioral intention is a group of factors that influence each person's conduct and signify the person's desire or attempt to carry out the action. A product that is required in everyday living is energy in general and electricity. Whether you like it or not, every home must have it and utilize it. ESB is the practice of turning off when not necessary, using high-efficiency electricity, and spending money on energy-saving technologies (Zaidan et al., 2021). It is controversial whether the "Subjective Norm" concept has a stronger impact on intents and behaviors than attitudes in organizational contexts (Papagiannakis and Lioukas, 2012; Dixon et al., 2015; Tetlow et al., 2015).

Both individual home users and the government have a strong interest in lowering their overall energy usage. The setting of a

goal for the reduction of energy consumption, the accomplishment of these aims, and the receipt of a reward because of the accomplishment of these targets all play a significant role. At this juncture, it is essential to raise the level of knowledge and consciousness among customers. It is hypothesized that this information will have a greater impact on people's overall energy use to the extent that it is both practical and connected in some way to monetary value. One might make the case that environmental consciousness also has an effect now. It is one of the most crucial stages for people who want to conserve energy under the strain of these factors to trust the system, to utilize the incentives that are offered by this system, and to spread it in their social circles. This is because trusting the system is one of the most critical processes. At this point, the system needs to be helpful in addition to being simple to use. Since this phase is connected to the continuing of customers' efforts to save energy, it is also vital to inspire them. This motive must be constructed such that it satisfies the performance requirement while also making the request more fun and interesting. At this point, though, components that will improve the user experience should be included by using the dynamics and mechanics that are associated with gamification.

Gamification experience has an essential position in ongoing energy consumption. If knowledge and awareness play a key part in the transition from energy consumption to energy conservation, then gamification experience plays an important role in that transition. If we are successful in designing and putting this whole system into action, then we will be able to bring about the measurable decrease in the amount of energy that we use, which is the last element.

Gardner and Stern (2008) also hypothesized that individuals have erroneous beliefs on the efficacy of their acts. For instance, "turning off the lights when you leave the room" is often advocated as a technique to conserve energy, but it only saves a marginal amount of energy (Kempton et al., 1985). Gardner and Stern (2008) did not examine people's perceptions of the behaviors on their shortlists; however, other research indicates that the public has a poor understanding of the mechanisms associated with climate change and energy consumption associated with what is known. This is even though Gardner and Stern (2008) did not examine people's perceptions of the behaviors on their shortlists (Sterman and Sweeney, 2007; Bostrom et al., 1994).

5. DISCUSSION AND CONCLUSION

The viability of a gamified solution is contingent on its capacity to incentivize individuals to carry out activities that, in their natural state, would be boring. What behavioral science has discovered about the most effective strategies to motivate people may be used in a number of different settings, including well-structured challenges, accomplishment levels, triggers, team building, feedback, incentives, and recognition (Grossberg et al., 2015).

The currently available games are either centered on working together or competing against one another. These games also have dialogue, avatars, and other elements. It is built on a sequence of stories, such as Games have been established in home settings, public buildings, and workplaces, and they target various users, including members of the family, workers, young people, and students at universities (Pasini et al., 2017).

The majority of gamification research has concentrated on analyzing the visual cues that indicate gamification. In the field of gamification study, fundamental aspects like image and sound, which are the fundamental constituents of every gamification element (Landers, 2019), have not been examined to an adequate degree (Degirmenci and Breitner, 2023). But, it is essential for customers to add features to gamification elements that will be tailored to conserve energy. These elements should include things like images and sounds. Since it motivates users to establish savings objectives in order to gain virtual prizes like badges and medals, gamification has become a popular way to behavior modification for resource efficiency initiatives as a motivator. This is one reason why gamification has become so popular (Fraternali et al., 2018).

As compared to other approaches to changing people's behaviors, games and gamified activities have a lot of potential as a tool to encourage more environmentally friendly behaviors (Lieberoth et al., 2018). Customers' awareness and understanding of the significance of self-consumption may be increased by the use of an app that is based on gamification, which can also provide consumers incentives and self-control to boost their involvement. Information presentation is a basic but effective game design feature that may have consumers' awareness and understanding about their energy consumption and production, as stated by AlSkaif et al. (2018). This can be accomplished by having customers play a game that incorporates this aspect.

Casals et al. Even though some aspects of the game did not work as intended, as noted by (2020), the game increased awareness and engagement of social housing tenants on certain energy saving behaviors, which resulted in an average savings of 3.46% in electricity and an average savings of 7.48% in gas. This was the result of the game. To inspire, engage, and educate people about energy usage and associated problems, gamification-based techniques have emerged as a new focal area in recent years (Johnson et al., 2017; Pasini et al., 2017; AlSkaif et al., 2018; Boomsma et al., 2018; Csoknyai et al., 2019; Casals et al., 2020).

It is anticipated that the majority of gamified apps will not be successful in meeting corporate objectives, and the primary reason for this will be bad design (Burke, 2013). Both Senbel et al. (2014) and Gustafsson et al. (2009) stress the usefulness of competitiveness and social sharing as a strategy to inspire individuals to participate. In addition, Senbel et al. (2014) discovered that although points and awards function as an effective initial motivator, other game aspects prove to be more beneficial over the engagement phase. Gamification has the potential to play a significant part in influencing players' energy habits and encouraging real-world energy behaviors that are desirable.

Because of the research, a model that is based on gamification is offered for home customers to utilize to cut down on the amount of energy they use and save more energy. The goal of this concept,

which is based on gamification, is to make reducing energy use less difficult and more advantageous for customers, as well as more entertaining and exciting. Gamification experience has an essential position in ongoing energy consumption. If knowledge and awareness play a key part in the transition from energy consumption to energy conservation, then gamification experience plays an important role in that transition. When the planning and execution of this complete system are done well, it will be feasible to achieve a discernible cut in the amount of energy that is used, which is the last element.

The research has limitations. First of all, the research that has been done and the model proposed are literature-driven, thought-provoking. It is true that every step is based on studies in the literature. However, the proposed model has not been tested in practice or as a pilot. This is one of the common limitations in design-oriented studies. In order to motivate individuals to have more energy awareness and to transform this knowledge into action, there is a need to determine the effectiveness of applied games, and in this direction, both gamification-designed applications and empirical research are needed. The biggest limitation of the study is that the designed model is not applied in real life. This constraint can shed light on future studies and guide the implementation of the model and the evaluation of its outputs. Based on different studies and applied models in the literature, it is possible to say that the proposed model may be applicable.

Due to the resurgence of energy consumption and the danger of depletion of traditional energy sources, states are turning to renewable energy. Today, states are competing for the discovery of renewable energy by breaking away from the traditional method. Many countries are now meeting domestic energy demand by taking advantage of the blessings of renewable energy (Huseynli, 2022). Most energy behavior studies to date have focused on home environments (Lopes et al., 2012; Greaves et al., 2013; Boomsma et al., 2016). Energy consumption behaviors in households often deviate from established theories of economic decision making (Zhou and Yang, 2016). In this study, a gamification-based model is proposed for household consumers to reduce their energy consumption and save energy. This gamification-based model includes making energy savings easier and more beneficial for consumers, as well as making it more fun and enjoyable.

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