

# The Application of Anthropomorphic Gamification within Transitional Healthcare: A conceptual framework

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## Abstract

This paper proposes a framework for the application of anthropomorphic interfaces in gamification for transitional healthcare. The framework bridges the theories around anthropomorphic research, gamification research, transitional health research, with the views of 15 field experts and a survey of 33 users. Patients in transitional healthcare process requires additional tools to assist them in following the transitional process, particularly in learning and managing their health condition. A different design of anthropomorphic interface applied within gamification could help to motivate the patients in going through their transition process, and thus may result in a change of behaviour towards self-manage. The framework consists of four factors; elements of an anthropomorphic interface, game elements for gamification, motivational elements, and requirements for transitional healthcare. Through triangulation of the literature, experts and users, these four factors were considered to be important and relevant elements of the framework. This validated the framework for anthropomorphic interfaces in gamification for transitional healthcare applications.

**Keywords:** Anthropomorphic Interfaces, Gamification, Motivation, Transition Healthcare.

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## 1. Introduction

Human-like representation in gamified applications creates the impression of communicating with a real person in a virtual world. Generally, applying the human like representation with its qualities of being human into something that is not human is referred to as anthropomorphism (Złotowski, Strasser, & Bartneck, 2014). A gamified application or gamification is recognised as applying game elements or mechanics into non-gaming perspectives such as education and healthcare, while maintaining the playfulness environment (Deterding, Dixon, Khaled, & Nacke, 2011; Hamari, Koivisto, & Sarsa, 2014). Anthropomorphic interfaces implicitly perceived as an avatar or personalisation of a game element in gamification (Hamari *et al.*, 2014; Seaborn & Fels, 2015). Applying

anthropomorphic interface in gamified applications may offer a fun and exciting environment. This situation could indirectly motivate and encourage users to sustain their engagement (Mekler, Brühlmann, Opwis, & Tuch, 2013).

Being in control of one's own health is important, particularly for people who are in a transitional care situation. Transitional healthcare is a term in healthcare referring to a process in managing one's health condition, equip them with required knowledge to self-manage, then transfer them from hospital care to self-care (Marape, 2013). This process involved with people who live with long-term conditions such as people who have diabetics, cancer, renal transplant, and asthma. People in transition find it is difficult for them to sustain their engagement in the transition process (Field, 2014; Marape, 2013). The involvement of technology could offer a different outcome to the users' engagement. An experience like playing a game can result in a change in

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behaviour towards one's health routine (Baranowski, Buday, Thompson, & Baranowski, 2008). Offering a game-like tool for the transition process could possibly motivate the users to self-manage his/her own condition, and thus could sustain their engagement in the transition process (Wilson & McDonagh, 2014).

This research suggests a gamified application that offers motivational tools for transitional healthcare. For a game-like tool, there is little research on how gamification can be used for transitional care process. The objective of this research is to explore anthropomorphic interfaces in gamification, particularly on how it can be implemented in the transitional healthcare application and how it can act as a motivational tool for a sustainable engagement. There are three main areas we are looking at: 1) the anthropomorphic characteristics, 2) gamification, and 3) the transitional healthcare process. To conceptualize the interrelation of the subjects, this research aimed to answer:

*What is a suitable framework for the use of anthropomorphic interfaces in gamification for transitional healthcare application?*

This research shows how the framework was developed and confirmed. Factors that contribute to the achievability of the framework were identified and formed as a framework for anthropomorphic interfaces gamification that can help to increase patient motivation and sustain their engagement while going through the transfer process. A mixed-methods approach was applied, including 15 interviews with experts in HCI, gamification, and healthcare, and 33 questionnaire surveys to people who live with some medical conditions (such as diabetes, asthma, and kidney transplants). Based on the results of these studies, the proposed framework can then be confirmed.

The outline of this research is as follows: firstly, in Section 2 we begin by discussing the gamification of anthropomorphic interfaces and applied them to the transitional care process. Secondly, the construction of the framework is presented in Section 3, followed by a confirmation study in Section 4, in which we present the methodology used, including data collection processes, the participants involved in the study, and the procedures in conducting the study. In Section 5, the results and discussions from expert interviews and questionnaire surveys are summarized. In Section 6, we discuss the practical implications of the framework and limitation of the study. The conclusion of this research will be presented in the final section.

## 2. Research Background

The application of anthropomorphic interface in gamification for transitional healthcare is mainly aimed at motivating and engaging a patient with their transition healthcare process. This research first explores the relationships between anthropomorphism, gamification and transition healthcare, followed by an explanation as to how the gaps between them may be bridged (see Figure 1). Of particular concern, is determining the gamification of anthropomorphic interfaces for the transitional healthcare application for patients with certain conditions.

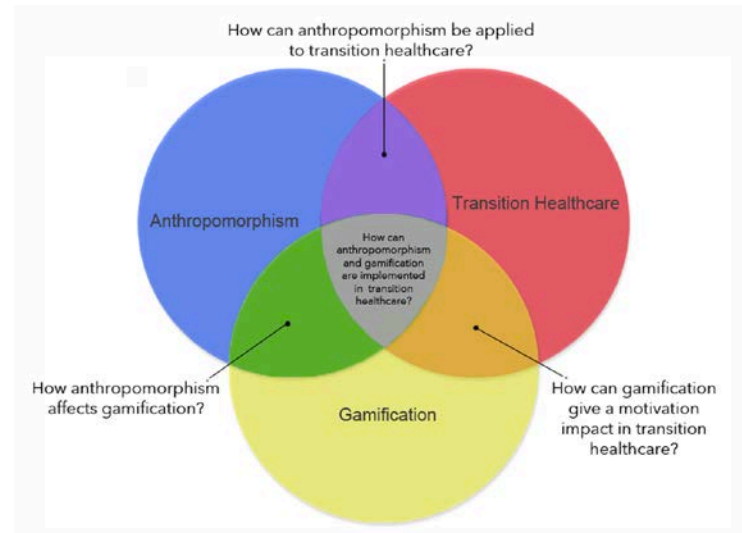


Figure 1 Triangulation maps

### 2.1. Anthropomorphic Interfaces Gamification

An anthropomorphic interface is a human-like representation which has human qualities applied to an object that is not human (Złotowski et al., 2014). In computer applications, this anthropomorphic interfaces were used in many form of designs. Based on previous conducted research, the utilisation of anthropomorphic interface could be perceived as an avatar (Mull, Jamie, Moon, & Lee, 2015) or an interface agent (Lisetti, Amini, Yasavur, & Rishe, 2013) in different degrees of anthropomorphic designs. According to previous research in examining the effectiveness of user interface, the anthropomorphic interface designs could be comprehend into real human representations (avatar), interface agents (mixes between human and animal representation), and hybrid characters (an abstract design, could be in any form) (Lortie & Guitton, 2011; Lugin, Latt, & Latoschik, 2015; Tsiourti, Joly, Ben Moussa, Wings-Kolgen, & Wac, 2014).

Applying the different degree of anthropomorphism in gamification could offers great possibilities for playful gameplay. A gamified application also known as gamification, with applied game elements and mechanics in a non-gaming setting or in the context of applications like

education, healthcare, or businesses. The implementation of game elements plays an important role to increase user motivation and sustain user engagement throughout their interaction (Hamari et al., 2014). As summarized by Hamari et al. (2014), Pedreira, García, Brisaboa, & Piattini (2015), and Seaborn & Fels (2014), the game elements that are usually applied in a gamified application are reward systems (points, badges, trophies), progression and rankings (leaderboards, status, levels), feedback, storyline or narrative, avatar/personalisation, and challenges. In this view, an anthropomorphic interface which recognised by an avatar, is part of the game elements used in a gamified application.

In a gamified application, an avatar is customised when certain tasks or levels have been achieved by the player; these achievements will unlock other avatar designs that enable players to change their avatar in the game (see e.g: Barata, Gama, Fonseca, Gonçalves, & Jorge, 2013; Kuramoto, Ishibashi, Yamamoto, & Tsujino, 2013; Otake, Sumita, Oka, Shinozawa, Uetake, & Sakurai, 2014). As mention earlier, an anthropomorphic interface design also exist other avatar, which are interface agents and hybrid characters. However, little exploration has been made on how these designs are applied in gamification. As of avatar, in previous studies (see Barata et al. (2013); Kuramoto et al. (2013); Otake et al. (2014)), the strategies of avatar customisations were associated with the collection of points and level of achievement in the game. According to Hamari et al. (2014) and Nicholson (2012), gamification where most of the game elements are based on points may restrict the progression in gameplay. It is because, gamification will only be viewed through the manipulation of points. Point systems allied to avatar development and manipulation could improve a user's motivation and engagement with the gamified application, rather than just the award of points after reaching a certain level. This interaction in personality development could be helpful.

When considering encouragement and sustained user interaction, the anthropomorphic interface has to appeal to the user. The anthropomorphic design should be emphasized with the elements of presence and responses. Previous works related to the elements of presence on the anthropomorphic interfaces include the element of gender, ethnicity, facial attractiveness (Angeli & Khan, 2007; Forlizzi, Zimmerman, Mancuso, & Kwak, 2007; Qiu & Benbasat, 2010), and age (Yoo, Peña, & Drumwright, 2015). Meanwhile, previous works such as Cowell & Stanney (2005) Gong (2008) and Zlotowski, Strasser, & Bartneck (2014) considered the eye contact, facial expression, posture, voice, emotion, and intelligence as the element of responses. These characteristics

of anthropomorphism are suggestions that should be incorporated in gamification.

## 2.2. The Use of Anthropomorphs Gamification for Transitional Healthcare Application

A transitional healthcare could be understood as a transferring process of one's health care from hospital care to self-care (Marape, 2013). This could be for a diabetic patient who wants to be transferred from hospital care to self-manage. During the transfer process, patients are required to acquire knowledge about their condition, so that they can adapt it into their lifestyle, thus, enable them to self-manage. The patient could learn about timing for medication, right food consumption, resting arrangements, safe activities, or to know how to get the right help. However, in a transfer process, many of the patients did not manage to get through the process towards the end, as they might be dropped off and left the process confused and distressed (Field, 2014). Research by Marape (2013) and Sawicki et al. (2011) indicated that poor management and implementation in following the process has resulted in low survival outcomes by those in the transition process. To maintain the patient's motivation while in the transition process and to support the process itself, an additional tool is required (Kralik, Visentin, & Van Loon, 2006; Marape, 2013). An involvement of technology, games in particular, could increase user motivation and improve user engagement throughout the process (Wilson & McDonagh, 2014). Therefore, a further suggestion is made to implement anthropomorphic gamification for the transitional health process.

Anthropomorphic interfaces and gamification have been applied independently in various aspects of healthcare settings. As an example, research by Van Vugt, Konijn, Hoorn, & Veldhuis (2009) utilised an avatar as an advisor for a weight management application. From Van Vugt et al.'s study, they found that an advisor with a dissimilar appearance to the user was perceived negatively by the user, and an advisor with a similar weight appearance to the user was perceived as positive by a strong emotional connection. The study suggested that the advisor presentation should be designed to be in line with the user's weight loss for a better result. Another example of avatars in healthcare application is a research study by Schmeil & Suggs (2014). They studied different characteristics of anthropomorphism to personalize patients' health conditions. This includes body shape, posture and skin texture. In the application, the patient needs to update their information regularly, so that the patient would know his/her health condition based on the anthropomorphic appearance. The result from Schmeil & Suggs's studied

shows that, there was a significant positive change seen in the user's motivation to improve health behaviour when the users can view, model, and personified their own future health. Thus, in healthcare, both of the studies show that the applications of anthropomorphic interfaces were used to visualize the user's condition virtually.

In gamification, gamifying users' representations is usually incorporated with other game elements, such as points and levels. For example, by collecting points, a user can trade their points for other avatar accessories and by completing a level, users can upgrade their avatar appearance to a more powerful avatar. For gamification, game elements implemented in healthcare applications are involved with points, badges, and leaderboards (PBL). One example is the Strava app, which is used to monitor, record, and summarize players' activities for running, and cycling. Players collect points while exercising, get badges on achievement, and share their achievements with friends (through the leaderboard). However, as gamification grows, many pieces of research of gamification in healthcare (such as Hall, Glanz, Caton, & Weinhardt, 2013; King, Greaves, Exeter, & Darzi, 2013; Wilson & McDonagh, 2014) focus more about conceptualizing the gamification application. More empirical testing should be conducted to evaluate the effectiveness of using a gamified application.

Considering a gamification application for transitional healthcare, one recent study conducted by Wilson & McDonagh (2014) had proposed a conceptual gamification model to motivate the patient to go through their transition process. In their model, a few game elements were proposed, including points, trophies, badges, leaderboards and levels. This gamified model mainly uses points and a reward system as the main components in promoting gamification for user motivation and engagement. However, as argued by Hamari et al. (2014) and Mekler et al. (2013), too many extrinsic element like points and rewards may undermine the intrinsic elements. A balanced use of points and rewards or different implementation of other game elements should be considered as well. Moreover, Wilson's gamification model was specifically for transition care checklists rather than a gamified application on how a patient could learn and adapt their condition through the transfer process. Thus, exploring a suitable gamification application might suggest different outcomes for the transfer process as well as patients' commitment for self-manage. However, to understand the use of anthropomorphs in gamification and their effects on motivation, motivational theory analysis would suggest whether the users' intrinsic and/or extrinsic motivation is actually facilitated or undermined.

### 2.3. Motivational Theory related to the effects of Gamification

Anthropomorphic interfaces through avatars within gamification affects motivation and this could lead to changes in behaviour (Kuramoto et al., 2013; Otake et al., 2014). It is anticipated that when people are motivated, it will make them want to follow the given instruction or change their habit according to the situation. Thus, a similar situation is expected to happen in the transitional healthcare where by playing games, patient's engagement to learn about themselves can be improved (Wilson & McDonagh, 2014). As proposed by Deterding (2012) and Hamari et al. (2014), the implementation of game elements should be considered in tandem with the motivational aspects. Looking into specific motivation theories will help to understand the effect of game elements on motivation.

A motivational theory that has considerable applications in gamification (see Kim & Lee (2015); Proske, Roscoe, & McNamara (2014)) is the ARCS (Attention, Relevance, Confidence, Satisfaction) model of motivation, introduced by Keller, (1987). The ARCS motivation model emphasised the factors that influence the way people approach learning. The concern could be whether a person's learning interest is increased or decreased, or whether a person's attention can be sustained throughout learning activities. As in the transitional healthcare process, patients are required to acquire knowledge related to their condition which will support them for self-care. Therefore, gauging patient's learning motivation using ARCS motivational model is considered appropriate.

In the ARCS model, there are four main elements to indicate a person's level of motivation in a learning environment. These are attention (A) (a process of gaining and attract person's attention), relevance (R) (relating prior knowledge or experiences with present learning activities), confidence (C) (gaining and building a person's self-confidence, particularly towards believing how they can achieve something with some effort), and satisfaction (S) (people's satisfaction when their effort and what they have learned were matched with the intended outcome). To date, very few studies have been conducted on how anthropomorphic gamification can affect patient engagement and motivate them to learn about their condition throughout the transitional process.

Based on our arguments, there is a lack of a theoretical viewpoint in research that relates to a gamification application of anthropomorphic interfaces in providing a motivational tool to support the transitional healthcare process. Suggesting a framework as one reference point for

the application would contribute to the current research area and may also help the designers and developers to conceptualize the idea and then, help them to build the application.

This research will propose a suitable framework for motivational anthropomorphic gamification in transitional healthcare. To develop the framework, we would like to identify the important factors that might contribute to the framework. Further exploration with experts in the field and people who had experiences with transitional healthcare process were conducted.

### 3. Research Methodology

Our aim was to determine the important factors contributed in the application of anthropomorphic interfaces in gamification for transitional healthcare. A mixed-methods research was adopted because by looking from various perspectives that relate to the research, personal experiences, and the practical approach, it will help us to understand the scenario of the research and thus, confirming the framework. The mixed method adopted was that of triangulation. We triangulated the research from previous works with the data collected from expert interviews (qualitative) and a survey of people who live with certain health conditions such as diabetes, kidney transplants, and asthma (quantitative). We applied a sequential procedure, by conducting the interviews (Study I) followed with a close-ended questionnaire survey (Study II). By conducting them sequentially, it allowed the

exploration of concepts from experts' opinions and then find statistical support for the findings. Figure 2 illustrates the overview of the research process.

#### 3.1 Study I: Expert Interviews

A total of fifteen experts were interviewed. The experts were selected based on their interest, related publications, previous experience and current involvement within the research area. There were eleven academics and researchers who were the experts in the field of human-computer interaction, interactive design, persuasion, gamification, serious games, and healthcare. Apart from them, there are two healthcare consultants who have interests in game and interactive applications, one researcher who was involved in researching a healthcare software application, and one PhD student whose PhD is about games and health. As information obtain from the 15 interviews have reach saturation level, no additional interviews were needed.

The interviews were conducted individually, either face-to-face or using a Skype call based on the expert's location, time-zone, and availability. Each expert was invited by email. Once they were decided to participate, a date, time, and place/Skype call were arranged. A semi-structured interview was used to collect the data. Table 2 listed all the questions. All interviews were audio recorded with consent. Generally, the interviews took about 30 minutes to one hour. There was no personal information collected.

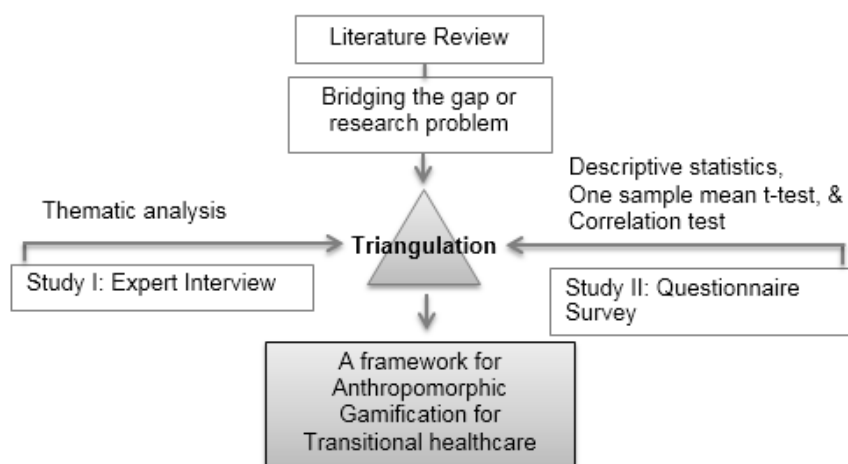


Figure 2 the overview of the research process

The participant was assured that all data would be kept confidential. All the interviews were transcribed manually and analysed using the NVIVO application. The analysis process was conducted according to the thematic analysis

technique. Abductive approach were applied in determining the themes for the framework, whereby themes were defined in advance based on the factors proposed in the framework and throughout transcribing and

reading, the themes that defined were added to, merged, and/or reduced.

### 3.2. Study II: Questionnaire Survey

The questionnaire surveys were completely answered by 33 participants. They were above 18 years old with an average age over 30 years old (N=15). Twenty of them were female (61%) and thirteen were male (39%). These participants were the people who may have experience with the transition process or people who are living with certain health conditions such as diabetes, asthma, or kidney transplantation.

The questionnaire was a self-administered survey. The survey was distributed online by two methods. The first method was through a forum, which is the UK diabetes forum and the UK kidney patient group forum. A research request was posted to the forum’s admin for approval. Once approved, the link to the questionnaire was made available to the other people who are active in the forum. The second method was through the network of a friend. The participants were identified early in the process to ensure they were 18 years and above, and are living with certain health conditions. They were contacted personally by the researcher via email. Once the participants were agreed, they were given an online questionnaire link to be answered.

The questions in the survey were designed based on two things, one is the query item for each of the factor and second is the additional query arising from the interview session. Therefore, there are three sections in the questionnaire asking about 1) transition experiences, years of involvement in transition, and the tools that have been used, 2) experiences in playing games, type of games played, and character preferences in games, and 3) perception of self-presentation in games particularly about the characteristics and behaviours of the character. The survey was statistically analysed using the IBM SPSS tool. We employed descriptive statistics and a t-test as the method of analyses, to understand the data distribution and its relationships.

Table 2: Interview Questions

Specific to Games	<ul style="list-style-type: none"> <li>▪ What do you think of rewards system in games?</li> <li>▪ How useful do you find the emergence of gamification in a healthcare application?</li> <li>▪ In what ways do you think gamification can improve user’s motivation?</li> </ul>
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Specific to Anthropomorphism	<ul style="list-style-type: none"> <li>▪ What theory of motivation do you think may support the implementation of gamification?</li> <li>▪ What do you think the effect of implementing an anthropomorphic interface into healthcare application?</li> <li>▪ What do you think of designing anthropomorphic interface with a specific appearance and behaviour of human characteristic?</li> </ul>
Specific to Game & Health Transition	<ul style="list-style-type: none"> <li>▪ Can you explain about the transition health care?</li> <li>▪ What sort of games do you think are suitable for Transitioning Care process?</li> <li>▪ What do you think of having character like avatar, implemented in a game for the transitioning care?</li> </ul>

## 4. Findings and Results

Based on the proposed framework, each factor was explored and confirmed their impact in the framework. We present the results based on the expert interviews first (5.1), followed by the questionnaire survey (5.2).

### 4.1. Findings from Expert Interviews

The thematic analysis processes are followed by the steps outlined by Braun & Clarke (2006). The steps are; i) familiarising with the transcribed data, ii) creating the codes, iii) look for a suitable themes, iv) go through the themes, v) refining the themes, and vi) write the report. Through the steps, there were eight themes that emerged from the findings, which are anthropomorphic characteristics, the degree of anthropomorphism, gamification, transition health, gamification in healthcare and transition, anthropomorphic gamification for motivation, and the theory of motivation. All the experts’ opinions from the interview are summarized together as the following themes;

#### Anthropomorphic Characteristics

The anthropomorphic interface requires human behaviour and appearance embedded in its design. The experts pointed out that the anthropomorphic interface should be able to express emotions, communicate naturally, shows body gestures, and impersonate the user’s appearance through the selection of gender, body shapes, different

hairstyle and skin colour. The experts also emphasized that emotion should be projected through facial expressions. A game/application that provides personalization to anthropomorphic interface is expected to have an effect on user interaction.

### **The Degree of Anthropomorphism**

Throughout the interviews, the experts refer to anthropomorphism as an avatar in a game. Among the types of character in a game, ten of the experts mentioned about a character that is more human-like such as the Sims and Tomb Raider. Six of the experts talked about a character that is a mix between human and animal, like Thrall and Air Penguin. The expert also pointed out a character that is less human-like and appears more like an object or an animal, like Con Man and Paperclip. Experts implicitly said that an agent such as anthropomorphic interface should be provided with standard accessibility features. The feature is not solely for disabled people because the features also can help to facilitate users with mobility limitations. Users who are in a transition process might be sensitive and vulnerable, but they are not necessarily disabled.

### **Gamification**

The experts claim that utilisation of game elements in a non-gaming context makes gamification useful for the learning process in a healthcare application. The experts also pointed out that the reward systems such as points, badges, and trophies, are perceived as attractive elements, which help to improve the users' engagement. Other than the reward systems, leaderboard, levels, points, progress, ranking, status, and storyline are among the game elements being utilised in gamification.

### **Transitional Healthcare**

The experts describe the transitional care as a period of time for a person to adapt himself/herself to their health condition. The transition could be in the form of transferring from one form of care to another form of care, or from one health condition to an improved condition. During the transfer period, a person will be able to learn the things to make their condition stable and manageable. Thus, the person can live independently and be accountable to himself/herself. Currently, transitional care is applied to patients who live with a long-term condition, which involves children aged between 10 to 18 years old. When considering gamification for transitional care, the experts believed that the types of games and characters that should be implemented have to be animated, funky, and not too realistic.

### **Gamification in healthcare and transition**

The involvement of technology in healthcare settings, such as m-health applications and games, could help to support the patients, practitioners, or the system itself. The experts believed the gamification may increase the patients' motivation and engagement with the health system. The experts also felt that gamification would be an advantage for the patient with respect to the transitional care process. However, experts contend that the application should be designed to provide a balance between fulfilling its purpose and the excitement of a gamified application.

### **Anthropomorphism and gamification for motivation**

Anthropomorphic gamification may affect the way users interact with the application and may encourage the users' to sustain their engagement. In the experts' views, the users will develop a kind of connection with the anthropomorphic interface when they imagined their real selves in a virtual environment. The experts also emphasized that the applications are not supposed to motivate users as the motivation should come from themselves; instead the application is there to increase the users' motivation or maintain the users' engagement throughout their interaction with the application.

### **The theory of motivation**

Experts contended that the motivational effect should be confirmed in line with a theory of motivation. Basically, the experts pointed out two motivation theories; the self-actualization in Maslow's theory, and the Self-Determination Theory. These theories could explain the relationship of intrinsic and extrinsic elements in affecting the level of users' motivation. However, the experts argue that any use of theory should be based on the type of information the particular research would like to assess.

## **4.2. Survey Results**

The data obtained in the survey was concerned with supporting our arguments from the interview. Through the questionnaire, we sought to investigate;

- i. The anthropomorphic interface, game elements, and transition
  - a. The degrees of anthropomorphic interface most preferred by the users based on the games they are playing and their choice of characters in the game,
  - b. The importance of game elements in a game,
  - c. The age range and problems when the participants were in the transition period,
- ii. Motivational effects and the characteristics of anthropomorphic interface
  - a. The characteristics of anthropomorphic interface and

- b. The relationship between anthropomorphic elements and the human behaviour.

### Analyses data of Anthropomorphism, Game element, Transition Process

Several degrees of anthropomorphic interfaces in games were summarised based on the most played games in the market<sup>†</sup>. Based on the list of characters and the frequencies of the characters selected by the participants, the 2D non-figurative character and 2D human-animal character were the most selected characters, with 17 participants choosing them. These characters were in line with the type of games that most of participants were playing (Angry Birds: 11.9% and Candy Crush: 15.9%). The participants chose the characters mostly because they were comfortable when interacting with the characters.

More than third-quarter of the participants (78.8%) select the element of points as the reward that grabs their attention the most when playing a game. Based on 5-point Likert-scale (ranging from 1 = Strongly Disagree to 5 = Strongly Agree), the mean average of leaderboard items in sharing and showing status publicly was 3.9 (SD = .95), sharing and showing score publicly was 3.9 (SD = .92), and sharing and showing progress publicly was 4.0 (SD = .88), which were each perceived as acceptable. It is because, all the score were closely to 5.0 (Strongly Agree).

From the participants' responses about their age range in the transitional process, 39.4% were between 15 to 25 years, 33.3% were between 20 to 30 years, and 27.3% indicated that they were not sure about the age range since they have never been hospitalized. However, we found that the age range may be different subject to the time a person was diagnosed with their conditions. The period of time also depended on the problems a person might experience during the transition process. The problems most participants faced in transition process were confusion (31.9%) and lack of information (29.8%). This might be because of there is no official or proper transition process the participant had experienced before.

### Analyses of the characteristics of anthropomorphism

Table 3 presents the mean and standard deviation for each items of the anthropomorphic characteristics. All variables were measured using a 5-point Likert-scale (ranging from 1 = Strongly Disagree to 5 = Strongly Agree, and 1 = Not Important to 5 = Very Important). Based on the Mean and SD scored, one item was not agreed - the age of

anthropomorphic interfaces and one item was not quite certain – the body position (half body or full body) of the anthropomorphic interface. Overall reliability for these 10 items is 0.75. The results imply that the factors are internally consistent.

Table 3: Items with mean and standard deviation (df = 32)

Item	M	SD
Provide gender selection	4.3	.59
Anthropomorphic interface is around the same age as I am	2.6	1.2
Provide a variety of skin colour	4.3	.59
Provide body shape customisation	4.1	.78
Portray facial expression	4.9	.33
Have an eye contact	4.1	.69
Show body motion	4.1	.71
Display body position	3.5	.91
Mimic human dialogue	4.6	.56
Offer praise or pleasurable feedbacks	4.7	.45

A correlation analysis was conducted to assess the relationship between Anthropomorphic Elements and the perception of Human Behaviour (Intelligence and Reliable) that anthropomorphic interfaces may exhibit during the interactions. The results in Table 4 shows that there is a moderate correlation exist between the Anthropomorphic Elements and Intelligence aspect of Human Behaviour ( $r = .43, p < .05$ ), and the Anthropomorphic Elements with Reliable aspect of Human Behaviour ( $r = .40, p < .05$ ). Thus, this result indicated that the anthropomorphic characteristics have an acceptable criteria of human behaviour.

Table 4: Correlations Anthropomorphic Elements and Human Behaviour (HB)

Item	Anthropomorphs Elements	HB Intelligence	HB Reliable
Anthropomorphs Elements	-	.43*	.40*
HB Intelligence		-	.48**
HB Reliable			-

\*\* Significant at  $p < .01$ , \* significant at  $p < .05$

## 5. Discussion

Following the results we obtained from the interviews and surveys, a discussion to construct the framework will then be made. In constructing the framework, our argument was to find out what are the important factors influencing the application of anthropomorphic gamification for

<sup>†</sup> <http://www.pcgamer.com/best-pc-games/>

transitional healthcare. This can be achieved by triangulating the interview findings and survey results with the previous related research. Following the discussion, the framework of this research is presented.

### 5.1. A key factor of importance with the use of anthropomorphs in gamification

The use of anthropomorphic interfaces in gamification is generally designed as a personal identifier or utilised as part of a reward system. Considering a different manipulation of anthropomorphic gamification should be taken into account as well. At the same time, the characteristics of anthropomorphism also play important roles in influencing people engagement. Adopting a set of anthropomorphic characteristics into anthropomorphic interface will make a character livelier than one without it. An interactive and playful application could help to motivate and sustain patient involvement in the transitional care process.

In the literature, we have analysed the degrees of anthropomorphic interfaces and how these interfaces can be applied within gamification. The experts' views referred to the same degrees of anthropomorphic interfaces as in the literature, and these degree of human representations were also supported by the surveys. However, the surveys informed that the degree of human could be extended into five type of human representations. They are a real human, human cartoon, human animal character, hybrid characters, and a non-figurative character.

In previous studies by Kuramoto, Ishibashi, Yamamoto, & Tsujino (2013) and Otake, Sumita, Oka, Shinozawa, Uetake, & Sakurai (2014), the avatar (which is part of the anthropomorphic interface) was utilised as a representation of the player, which also offers personalisation. This representation and personalisation were similar to the obtained results; the results also advocate that particular characters were selected because the users were comfortable when interacting with them.

Other important factors include the emphasis of the anthropomorphic characteristics. From the results, characters that exhibit human behaviour may improve interaction. This supports our framework and at the same consolidates the previous arguments on facilitating a character that is responsive through trustworthiness (Cowell & Stanney, 2005), intelligence (Pereira, Prada, & Paiva, 2014), and convincing through the character's presence (Gong, 2008; Złotowski et al., 2014). Additionally, being accessible makes the character more widely applicable. When considering gamification, the

results indicated that the game elements such as reward systems, leaderboards, and levels are important to encourage the users' engagement. However, a careful design of the reward systems should be considered as too many rewards may undermine the gamification effects (Nicholson, 2012).

We outlined the following factors to determine the application of anthropomorphic gamification; i) the anthropomorphic interface designs: the type and purpose, ii) the anthropomorphic characteristics: response, presence, accessibility, and iii) the game elements: rewards system, leaderboard, levels.

### 5.2. The important of identified factors in 5.1, in determining the users' engagement in the transitional healthcare

We further determined how the anthropomorphic gamification could help to understand the users' engagement in transitional healthcare. In the research carried out, there was little mention of motivation theory applied to gamification interaction in health. In the transition care, the main concerned is to motivate patient to learn about their condition so that it could support them to self-manage. As a result, the ARCS model of motivation as explained in Hung, Lee, Chao, & Chen (2011) was considered suitable to look into the effect on users' motivation in learning.

Another important factor should include the transitional healthcare itself. In order for the users to feel connected with the transitional application, we argued that the anthropomorphic gamification should reflect the user's condition (state of health and behaviour) and how the anthropomorphic gamification may help in transitioning the user's condition. The results indicated that a transitional application requires self-management functions, such as medication, appointments, and treatment, which reflect on how well the users are aware about their condition.

### 5.3. Confirming the framework

Considering the results and the discussion points, the framework for anthropomorphic interfaces (A), gamification (G) and the transitional healthcare (T) called TAG is suggested.

Triangulating the three perspectives of the literature review, the experts' views, and the patients' agreement, resulted in four factors in the framework. They are; 1) a

comprehensive anthropomorphic interface includes the anthropomorphic design (degree of anthropomorphism), the design purpose, the element of responses, the element of presence, and the accessibility options, 2) the application of game elements in gamification, 3) motivational relations outlined which theory of motivation could be used to measure the motivation effects in gamification, and 4) the requirement of transfer process. All the factors and elements for the framework are summarised in Table 6.

Table 6: Factors and elements in the framework

No.	Factor	Element
F1.	Anthropomorphic Elements	Anthropomorphic Interface design (avatar, human cartoon, interface agent, hybrid character, and abstract character) Design Purpose, Responses (eye contacts, facial expressions & emotion, gestures, flattering effects, voice instructions, and intelligence) Presence, (gender, skin colours, and body shapes) Accessibility
F2.	Game Elements	Reward system (points, badges, trophies) Leader board (progress, status, ranking) Levels
F3.	Motivation theory	Attention Relevance Confidence Satisfaction
F4.	Transitional Healthcare	Stage of transition, Health condition, Self-Management

The factors of the proposed framework are illustrated in figure 3. The framework is presented in the design of puzzle. The puzzle is meant to symbolize that each research gaps or problem statements for the application of anthropomorphic interfaces in gamification for transitional healthcare has to be resolved as a whole. Each pieces of the puzzle representing one factor. These factors have to be arranged, combined, and built into a single reference

framework for the application of anthropomorphic interfaces gamification in transitional healthcare.

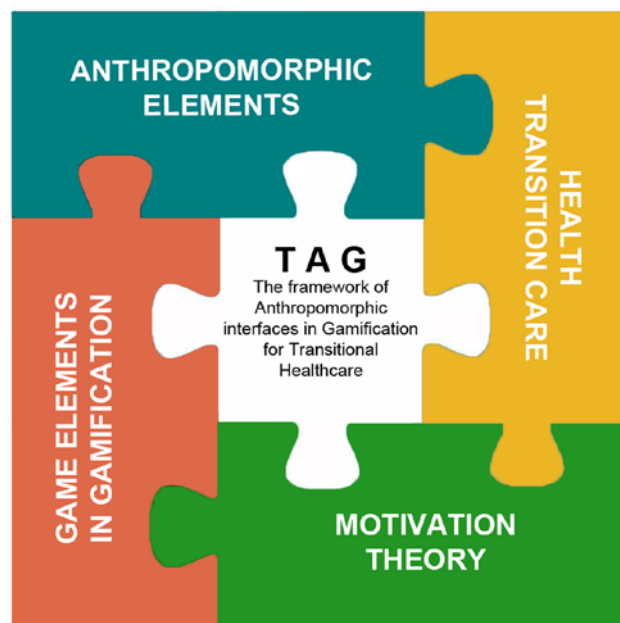


Figure 3 the TAG framework

## 6. Applicability of the framework

The framework presents a potential development of knowledge that consolidates the research in anthropomorphic interfaces for human-computer interaction, gamification for motivation, and transitional healthcare. As the framework incorporates these three dimensions, it could have several implications. First, the framework can serve as a reference for developers to design and create an anthropomorphic gamification application for healthcare. Second, the gamified application also can be used to understand how motivation is provided to the user. Third, the structure, method, and outcome of this study helps in providing a concept for researchers to use in developing and confirming a framework. Finally, the framework may be useful in examining anthropomorphic gamification, as a tool for a change in the users' behaviour and routines concerning their transition process.

From the research, it is clear that the factors and elements are important in using an anthropomorphic interface for patients. It is also anticipated that different degree of anthropomorphic interface based on Figure 3, could have slightly different impacts on user interaction. Thus, however needs to be tested and corroborated. Although the framework specifically looks at anthropomorphic gamification for transition, it is also

possible that the framework may be applicable in other contexts of healthcare beyond transition, or other digital games. In healthcare, playing games may help the users (patients) to divert their pain (Baranowski et al., 2008). In the actual gameplay, anthropomorphic interfaces may be important as they help to create a relationship between the user and the character for a better interaction (Banks & Bowman, 2016; Benyon & Mival, 2013).

## 6.1. Limitations

Although the framework offers a possibility to enhance the users' interactions, the main objective is not to replace the existing tools for transition, but instead offer an additional insight to help the users go through the process, which might result in a better outcome for the transition. It is important in a research study to have a diverse sample of participants to inform the framework. However, as a transition process is specific to a person who lives with a long-term condition (such as diabetes, asthma, or cancer), and the transfer process varies depending on the time their condition is diagnosed and the transition process they might have experienced. Also, when analysing the result from Study I, the findings were subject to the researcher's interpretation. Nonetheless, the research carried out indicates that there is some value in developing a framework such as the one shown above, where anthropomorphs are utilised in gamified applications for transitional healthcare. The key to this is to see how the user engagement is affected and what the longer-term consequences are.

## 7. Conclusion

When a person live with certain health conditions, the confidence and engagement towards his/her health plans are often not very strong. Anthropomorphic gamification could help provide greater interactions with transitional healthcare applications. With this in mind, as a first step, a conceptual framework was designed to understand a possible way of providing better interactions. In this view, different forms of anthropomorphism, a structure for gamification, and transitional concepts are suggested for the framework.

The direction of this study was to develop and confirm the proposed framework. It was designed in accordance with existing practices and users' requirements in consideration for use in a real setting. By triangulating the literature review, experts' views, and users' surveys, the framework was formed of the following factors; anthropomorphic elements, game elements, motivation

theory, and transitional healthcare. All the factors and elements of the framework have been agreed upon, thus confirming its significance in the context of this study. Thus, this paper has contributed to a better understanding of the use of anthropomorphic gamification for health by providing a framework that helps the developers or designers to develop a gamified application to motivate a person with health conditions to better manage their transition to good health. Also, the research approach applied in this paper, a triangulation mixed method research in HCI, gamification, and healthcare, contributed to the way a research being conducted in which, could be applied within a different context of study.

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