Gamification on Senior Citizen's Information Technology Learning: The Mediator Role of Intrinsic Motivation

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Abstract. Gamification refers to the use of game elements in a non-game context so as to increase users' engagement and improve their experience. In recent years, gamification has been promoted by both practitioners and scholars as a superior alternative to traditional training methods in terms of improving students' learning process and performance. In this paper, we attempted to verify the effectiveness of gamified training in a unique context, i.e., to help senior users learn new information technology. We proposed a theoretical model to explain why gamification can positively affect senior users' learning experiences and outcomes. Through a laboratory experiment and a pilot study of 9 senior participants, we investigated whether or not gamification can really help improve senior people's learning process and performance. This paper not only extends gamification studies to the context of senior citizen education, its empirical results can also help practitioners design better gamified applications for senior users.

Keywords: Gamification · Senior citizens · Information technology learning

1 Introduction

Gamification refers to the use of game elements in a non-game context to increase users' engagement and improve their experience [1]. Gamification has emerged as a popular trend over the last years [2]. The idea of gamification has been used in industries, community, education, enterprise, environment, government, health, marketing, and social website[1].

Given the potential to increase engagement and enjoyment, practitioners and scholars have been touting gamification as a way to transform education and learning [2–4]. Gamified applications have been used to increase students' participant rate [5, 6] and improve students' learning quality in online learning platform [3, 4, 7]. Some scholars find that students perceive the gamified application as fun, enjoyable and useful [6, 8, 20], and have more positive attitude toward gamified learning methods than

[1] http://badgeville.com/wiki/gamification_examples.

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traditional ones [4, 7, 9]. However, some studies also find that gamified education is not as effective as non-gamified learning methods [2].

Based on the literature review, we find there are some limitations in the previous research as follows: First, few of previous researches discuss the mechanism of how gamification affecting learners' intrinsic motivation or performance. In their experiments, whether the application (or learning methods) is gamified or not is the independent variable. Intrinsic motivation and performance are the dependent variables. With comparison between gamified applications and traditional ones, they get the conclusion whether gamification is useful to increase intrinsic motivation and improve performance [2]. However, none of previous research argue why and how gamification can exert this kind of effect. We believe that this question is related to how to choose appropriate elements and design useful gamification application. But, there have been a lack of standards for design and implementation [10]. According to Gartner, by 2014, 80% of current gamified applications failed to meet business objectives primarily due to poor design [11]. Therefore, understanding the mechanism of how gamification elements working is very important for designing successful gamified application.

Second, most of previous research mainly focus on young people (e.g., undergraduate students), but do not prove that gamification is useful for other people with different age (e.g., senior citizens). Since the population is becoming ageing, scholars have paid increasingly more attention to the problems of senior citizen. One of the most important problems is the education and training for senior citizen to catch up with the high-speed development of society, especially the development of information technology [12]. But the traditional training methods are not effective for senior citizen to master the information technology. According to Activity Theory, participating in social activities can improve senior citizens' life satisfaction and enhance their life quality [13]. Therefore, we should discuss whether gamification can improve the quality of new technology-related education for senior citizen.

To sum up, in this paper, we plan to solve the following two questions. First, is gamification useful for senior citizen to learn new IT? Second, what is the mechanism of gamification affecting people's IT learning? This paper is organized as follow: in the second part, we discuss the related theories; in the third part, we propose the hypothesis and build the research model based on related theories; in the fourth part, we conduct a pilot test to answer the two research questions and prepare for the formal experiment; in the fifth part, we demonstrate the results of pilot test; in the sixth part, we discuss the theoretical contribution and practical implication; in the seventh part, we talk about the limitation and future works.

2 Theory

2.1 Gamification

Gamification refers to applying game elements into non-game context to improve users' experience and engagement [1]. The main goal of gamification is not to build a full-fledged game, but rather to apply some game elements to make the system more motivating and fun [9, 10]. According to Hamari, there are some difference between

gamification and game: (1) gamification commonly attempts to afford experiences reminiscent of games, rather than providing direct hedonic experiences; (2) gamification attempts to affect motivations (e.g., intrinsic motivation) rather than attitude and/or behavior directly; (3) gamification refers to adding "gamefulness" to existing systems rather than building a full-fledged new game [14, 15].

There are many game elements that have been applied into non-game contexts, such as badge, story, leaderboard, points and so on [1, 9, 14]. In this paper, only the elements of badge and story were used because: First, they are the two most important and frequently used elements in gamification [3, 16]; Second, gamification encompasses so many different game mechanisms in their applications that it is difficult to examine every possible gamification element in one study [2]; Third, we just study gamification in a short term application context. We want to test whether gamification is useful for training senior citizen to learn self-service machine in a short term class. However, points need a relative long term to accumulate. So, we do not use points in our study; Forth, leaderboard is a complicated element in gamification. Many researches about leaderboard have controversial results. For example, in Hanus's research, they find that the leaderboard results in more social comparison and then decreases intrinsic motivation, satisfaction, effort and feeling of empowerment. But in Dominguez and de-Marcos' researches [4, 7], they find the leaderboard can increase students' intrinsic motivation. Therefore, in this paper, we do not include leaderboard.

Badge. A typical gamification method is to use achievement badges. A badge is a graphical icon that appears to users after reaching an achievement or completing certain activities [5, 9, 16].

Actually, badges have no practical value for users. The motivation to pursue badges comes from the emotional reward of achieving challenging goals [9]. The fulfillment of goals gives people the feeling of competence. In psychology, need of competence is a human's basic psychological need [17]. People have the innate desire to fulfill the need of competence and make sure "I am doing very well".

Therefore, a good badge should be designed to offer players timely and informative feedback that they are doing very well and have enough ability to finish the activity [18]. Useful badges should have goal setting to offer challenge and instant feedback about people's ability and "how I am doing". For example, De-Marcos and Dominguez [4, 7] in their papers take badge as an achievement system that reward student immediately on successful task completion. When students obtain badges, they feel that they are performing very well in some way. Consequently, these authors find the achievement system can improve students' learning outcome of operational activities.

Story. A compelling story is important to engage players to participate in activities and achieve the goals [19]. Story elements have been applied in many gamified applications [14]. For example, Li, Grossman and Fitzmaurice in their gamified application design Apollo program as the backstory and they find that the GamiCAD (one example of gamified learning applications) is more enjoyable, fun and engaging [20]. Guin, Baker, Mechling and Ruylea apply a story into online surveys to test if gamification can improve participants' engagement [21]. Flatla and his colleague apply a story into calibration games and find it useful to make user feel more enjoyable than regular calibration procedure, without compromising the quality of the data [22].

In game, stories are used to attract and engage players in two ways: curiosity and situation. Stories in games act as plot hooks. Plot hooks are unanswered questions that keep readers guessing. The uncertainties derived from stories attract players to the question and make they feel compelled to answer [23]. The purposes of plot hooks are to arouse curiosity, create intrigue, and frame puzzles, which all lead the players to ask "what is going to happen next?" [23]. Actually, curiosity give the players the meaning of playing the game [24]. This kind of story is often used in story-driven game, such as Role Play Games (RPG).

In addition to curiosity, stories can provide situations where and when leaners can generalize, comprehend knowledge easily [25]; and use, apply knowledge to real-world problems and requirements [26]. In this way, educational and training games have much in common with problem-based learning or case-based learning [25]. Through stories, metaphor or analogies are given to aid learner in understanding knowledge and skill better [21]. In addition, according to Malone's theory, it is more instructional, when story is designed to indicate how skills might be used in the real-world setting [21]. In this way, story enhance and highlight the meaning of learning [27].

As for gamification in education and training, useful stories are often designed to arouse curiosity and offer realistic situation where knowledge and skills can be applied into. For example, Li uses Apollo Program as backstory where users are responsible for helping NASA build components of a spacecraft [20]. Through the story, users are curious about the learning process and can understand how the skill of Computer Aid Design (CAD) can be used in the real-world setting [6].

2.2 Intrinsic Motivation

Intrinsic Motivation refers to the doing of an activity for its inherent satisfaction and pleasure derived from participation rather than for some separable consequences [28]. Intrinsic motivation is the inherent tendency to seek out novelty and challenge, to extend and to exercise one's capacities, to explore, and to learn. According to Cognitive Evaluation Theory, people's intrinsic motivation can be enhanced by the satisfaction of competence need and autonomy need [17].

Competence. Competence refers to people's capacity for effective interactions with environment in producing desired outcomes and preventing undesired events [17, 29]. According to Deci and Ryan's point of view [17], intrinsically motivated activities involve seeking and conquering optimal challenges. Optimal challenges include elements that are slightly discrepant from, and can be assimilated into, one's existing and organized knowledge or skill structures [17]. And these perceived challenge can stretch out but do not overmatch existing skills [30]. Some psychologists argue the feeling of competence is derived from the match between people's ability and activities' challenge [30, 31]. When people have high competence, they will more concentrate on the activity itself [30], then have more intrinsic motivation [28]. Otherwise they will have less intrinsic motivation with more tension and pressure [17].

Autonomy. Psychologists are most apt to take intrinsic motivation as self-determined [17, 28]. Deci and Ryan [17] use autonomy to refer to the feeling of engaging in activities out of one's own choosing, without external or internal controlling [17, 28].

People engage in an activity just for the satisfactions and pleasure that they can experience, not for external reward or internal pressure [17]. External controlling events, such as reward, punishment, deadline, surveillance, competition and others-administered evaluation, make people finish activity not for activity itself but rather to obtain separate outcomes [17]. Internal controlling is derived from internalized norms, rewards and punishments and is represented as "I should to do" or "I have to do". People like to explore the curious and valuable activities [17]. So, making the activity more curious and valuable can increase people's autonomy. Consequence of Intrinsic Motivation.

Intrinsic motivation can influence people' affect, cognition and behavior [28]. Affective consequences include interest, positive emotions, satisfaction and reduction of anxiety [28]. Intrinsically motivated people will feel more positive emotions, such as interest and pleasure, and less negative emotions, such as anxiety [17]. Cognitive consequence include concentration, attention, good memory, conceptual learning, cognitive flexibility and creative thinking [17, 28]. In some experiments, researchers have proved that intrinsically motivated students learn best, most effectively and most lastingly [27]. Behavioral consequences include persistence at the task, good behavioral intentions and performance [28]. In this paper, we focus on the practical operation of information technology for senior citizens. So, we just examine the effect of gamification on their affective consequence (e.g., technology anxiety) and behavioral consequence (e.g., learning performance).

3 Research Model and Hypotheses Development

The research model is summarized in Fig. 1.

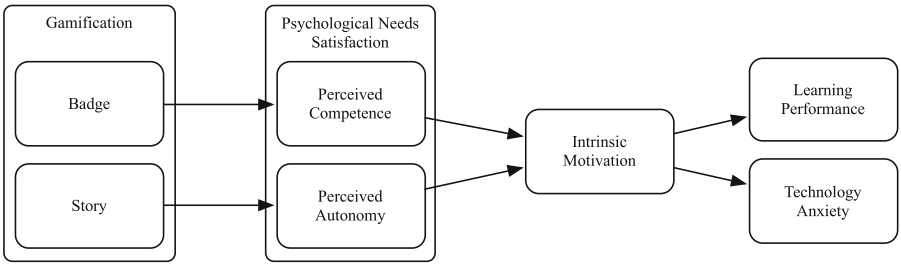

Fig. 1. Research model

3.1 Badge and Perceived Competence

In this paper, perceived competence refers to senior citizens' perception of their competence to produce desired outcome in the learning context [17, 29]. A badge is a graphical icon that appears to the user after reaching an achievement or completing certain activities [5, 9, 16]. Badges can provide information about learners' behavior and performance, which can reflect their competence and then enhance their intrinsic motivation [17]. In gamification field, useful badges should act as goal setting and instant feedback

related to people's ability and "how I am doing". Essentially, goal setting offers people challenge and instant feedback provides information whether their ability and challenge are matched to complete the challenge. If they are matched, obtaining badges is like an encouragement that senior citizens can master the ability of modern IT. Even though they are not matched, people need immediate feedback to judge whether their skills can match with perceived challenges (i.e., proximal goals). Even though they are not doing very well (do not get badge), senior citizens can learn from the timely feedback where the problem is, and then make plan about next stage [17]. Therefore, in gamified context with badges, people are more like to perceive competence. Hence, we propose:

Hypothesis 1 (H1): Participants in the with-badge group have higher perceived competence than those in the no-badge group.

3.2 Story and Perceived Autonomy

In this paper, perceived autonomy refers to senior citizens' feeling of engaging in learning out of their own choosing [17, 28].

Stories, in gamification, usually engage learners by providing a curious situation. As for gamified educational application, story can make senior citizens more curious about what will happen in the next [23, 25]. Then they will behave more actively and spontaneously [17, 23, 25], because curiosity is the basic propensity in human function [17].

Story can also provide a practical situation where and when a senior citizen is able to generalize, comprehend knowledge easily [25]. Furthermore, they can learn how to use and apply the IT to real-world problems and requirements [26] by themselves. So, it is more likely for them to understand the value and importance of learning IT, and learn more actively. Then motivation is internalized and autonomy is increased [17]. Hence, we propose:

Hypothesis 2 (H2): Participants in the with-story group have higher perceived autonomy than those in the no-story group.

3.3 Perceived Competence and Intrinsic Motivation

In this paper, intrinsic motivation refers to the extent of which senior citizens want to study and do exercise, because of the pleasure, enjoyment and satisfaction derived from the study and exercising themselves [17].

Learning new technology-related skill and knowledge itself is able to be intrinsically motivated for senior citizens, because the desire to explore, discover, understand, and know new knowledge is intrinsic to people's nature and is a potentially central motivator of the educational process [17]. Moreover, learning new technology itself is a challenging activity for senior citizens, because of the physical degeneration and social pressure.

According to Cognitive Evaluation Theory, only when people have high competence, they can have enough confidence and focus on the learning activity itself motivation [17]. Then they can have more intrinsic motivation [17]. The need for competence is one of the basic need of human. When it is unsatisfied, it will get human's attention to the gap, so people can not focus on the learning activity itself [17]. Moreover, low

competence always accompanies with stress and anxiety, which will result in lower intrinsic motivation [17]. Hence, we propose:

Hypothesis 3 (H3): Perceived competence is positively associated with intrinsic motivation;

3.4 Perceived Autonomy and Intrinsic Motivation

When senior citizens are self-determined or high autonomous to learn modern IT, they have choice and opportunity to be fully involved within learning itself and treat learning activity as something they want to do for the learning's sake [17]. Therefore, a greater opportunity for self-determination frees people to be more intrinsically motivated [17].

When senior citizens perceive their autonomy to be threatened with external controlling events (e.g., peer pressure, "my friends are learning this, maybe I should do this, too) or internal controlling events (e.g., pursuing reputation and under the control of internalized norms), they experience the escaping of controlled and unfree [17]. At such time, they consider that doing the activity is for extrinsic factors rather than the activity itself. They regard their behavior or activity as an instrument to obtain what they want (e.g., reward, reputation, avoidance of punishment) or avoid what they dislike, and their attention are redirected away from the activity itself [17].

In gamification design, more and more designers are aware of the importance of autonomy. One of Cheong's recommendations for gamified design is that participation should be voluntary: "if the participants are forced to undertake the activity, it takes away from its gameful nature" [3]. Hence, we propose:

Hypothesis 4 (H4): Perceived autonomy is positively associated with intrinsic motivation;

3.5 Intrinsic Motivation and Learning Performance

In this paper, completion time of exercise is used to measure senior citizens' learning performance. Completion time of exercise can provide an indicator of how well people learned self-service machine during the training [20].

Intrinsically motivated senior citizens will have more concentration on learning [17, 30]. Under this condition, they are better to think creatively, grasp the meaning of learning materials, and have more flexible cognition [17]. Intrinsic motivation is the natural wellspring of education and achievement. And it can result in high-quality learning and creativity.

When students are intrinsically motivated to learn, they learn better, more effectively and more lastingly [27]. Parker and Lepper, in their experiment, find intrinsically motivated students have greater outcomes of learning programming language [27]. Vansteenkiste et al. find, under the autonomy-supportive context, students who are driven by intrinsic goal have better learning outcome [32]. Hence, we propose:

Hypothesis 5 (H5): Intrinsic motivation is positively associated with learning performance;

3.6 Intrinsic Motivation and Technology Anxiety

Technology anxiety refers to the fear and/or apprehension people feel when considering use or actually using general technology tools [33]. It is characterized as an affection response [34]. Technology anxiety is one of the most important factors in preventing senior citizens from learning modern IT [35].

According to Self-Determination Theory, intrinsically motivated people do something because it is inherently interesting or enjoyable. Then positive emotions will be the consequence of intrinsic motivation [28]. The feeling of positive emotions is the reward for intrinsic motivation [17, 28]. With more intrinsic motivation, the senior citizens will have more positive mood. Therefore, intrinsically motivated learners are less likely to have specific technology anxiety after learning process. Hence, we propose:
Hypothesis 6 (6): Intrinsic motivation is negatively associated with technology anxiety.

4 Research Method

In the above sections, we discuss the mechanism of gamification theoretically. Next, we did a pilot test to analyze the model, which lay a foundation for future empirical experiment. In our pilot test, we recruit 9 senior citizens (>60-year-old) to join an activity to learn how to use Ticket Vending Machine (TVM). In China, the adoption of TVM is very low for senior citizens. And none of the 9 selected senior citizens knew how to use this machine and had never tried it by themselves before.

In Beijing, China, subway is one of the most widely accepted public transportation ways. In 2008, Ticket Vending Machine (TVM) was first fully used in Beijing subway system. The goal of TVM is to reduce the waiting time wasted to buy ticket in artificial ticket office. However, senior citizens still prefer to buy ticket in the artificial ticket office. They are used to interacting with people, but not with machine. And with the negative news about the malfunction of TVM, it is hard for senior citizens to learn how to use this kind of machine. Therefore, we chose TVM as our experiment scenario. We designed a learning activity to teach senior citizens how to use the TVM and used gamification methods to gamify the process.

4.1 Participants

We recruited 9 senior citizens (>60-year-old), who lived in the community close to our university in Beijing, China. Firstly, we randomly invited 25 senior citizens to join a learning activity, which hosted by the university. Secondly, we deleted 10 people who knew how to use TVM, and 5 people who were not available in our experiment time. Thirdly, we deleted 1 people whose health condition was not good enough to join the learning activity. Finally, we recruited 9 senior citizens who were above 60-year-old.

We classified them into four groups: Badge group, Story group, Badge+Story group and control Group (i.e. not gamified group). The specific information of classification can be seen in Table 1.

Table 1. Demographic information.

	Badge	Story	Badge+Story	Control group
Gender				
Male	0	0	1	0
Female	2	2	2	2
Age				
60–64	0	0	1	0
65–69	1	1	1	0
70–74	1	0	0	0
75–79	0	1	1	1
80+	0	0	0	1
Education				
Elementary school	0	1	0	0
Middle school	1	0	1	0
High school	1	1	0	0
Undergraduate	0	0	2	2
Living condition				
Only with spouse	1	1	1	1
With spouse and children	1	0	2	1
Only with children	0	1	0	0
Income (one year)				
30000–50000	2	2	2	0
50000–100000	0	0	1	2

4.2 Procedure

We developed a Learning System to teach senior citizen how to use Ticket Vending Machine (TVM). In the system there were three parts: (1) video-watching part, watching video to learn what is TVM and how to use it; (2) practice part, practicing on our Learning System. There were three practice sessions. In the first practice session, they bought 1 ticket, but did not change the line; in the second practices session, they bought 2 tickets, but did not change the line; in the third practices session, they bought 2 tickets, but changed the line; (3) test part, doing a test at last. In the practice part, we gamify the system by badge and story.

In the badge group, after every session of practices part, if subjects successfully finished the practices, they could get a Little Red Flower (Badge). The Little Red Flower meant that senior citizens successfully finished the practice. If they performed better than in the last session, they could obtain two Red Little Flowers. Before the practice part, all subjects in Badge group and Badge+Story group were informed the Little Red Flower and how they could them.

In the story group, we provided a story background. In this story, one subject's old friend would come to visit them. And she/he wanted to visit Beijing. So, the subject decided to show the friend around Beijing by subway, because the subway was more convenient and the traffic in Beijing was not good. First, subject would take the subway

to train station to pick her/his friend up. Second, they took the subway to The Imperial Palace from train station. Third, they took the subway from the Imperial Palace to The Lama Temple.

In the test part, all subjects took the same examination. After learning process, subject filled up the questionnaire and got the interview. Through the questionnaire, their perception and other psychological state were measured. And through the interview, their opinions about the gamified training method were recorded.

4.3 Measurement

We adapted scales of Intrinsic Motivation, Perceived Autonomy, and Perceived Competence from Ryan and Deci's Intrinsic Motivation Inventory[2]. Six items were used to measure Intrinsic Motivation. Four items were used to measure Perceived Autonomy. Five items were used to measure Perceived Competence. Items of measuring Technology Anxiety were adapted from Meuter and McInerney [33, 36]. Five items were used to measure Technology Anxiety. The time that subjects use in final test refers to subjects' learning performance (See Appendix A).

5 Results

5.1 Descriptive Statistics and Correlation Analysis

Table 2 shows the mean values of constructs. It can be seen from Table 2 that subjects in Badge+Story group have best learning performance (they spent least time in final test). Subjects in Story group have better learning performance than those in Control group and Badge group. Subjects in Badge group have the worse learning performance.

Table 2. Analysis results.

	Badge	Story	Badge+Story	Control	Total
Perceived competence	6.2	5.5	6.7	7	6.4
Perceived autonomy	6.3	5	5.5	5.5	5.6
Intrinsic motivation	7	6.6	7	7	6.9
Technology anxiety	1.8	2.2	1.2	2	1.7
Learning performance	44218	33631.5	22272.3	34352.5	32357.9

Note: Learning performance was measured by the time subjects took to finish their final test.

[2] http://www.selfdeterminationtheory.org/intrinsic-motivation-inventory/.

As for perceived competence, subjects in Control group feel the most competent; those in Story group are the least competent. As for perceived autonomy, subjects in Badge group have the highest autonomy; those in Story group have the lowest. As for intrinsic motivation, subjects in Badge group, Badge+Story group and Control are equally intrinsic motivated; those in Story group have the least intrinsic motivation. As for technology anxiety, subjects in Badge+Story group have the least anxiety; those in Story group feel the most anxious.

Although the sample is too small, we can see the trend that subjects in gamification group have better learning performance and lower technology anxiety.

We also did the correlation analysis. In Table 3, it can be seen that perceived competence and perceived autonomy are positively related with intrinsic motivation. Intrinsic motivation are negatively related technology anxiety and learning performance, which means the higher subjects' intrinsic motivation, the better their learning performance is and the lower their technology anxiety is. The results of correlation analysis are consistent with our theoretical model. They demonstrate the relationships of perceived competence-intrinsic motivation, perceived autonomy-intrinsic motivation, intrinsic motivation-technology anxiety and intrinsic motivation-learning performance in some way.

Table 3. Correlation analysis.

		COM	AU	IM	TA	LP
COM	Pearson correlation	1	.000	.630	–.491	–.165
	Sig. (2-tailed)		1.00	.069	.180	.671
AU	Pearson correlation	.000	1	.624	–.205	.136
	Sig. (2-tailed)	1.000		.073	.596	.728
IM	Pearson correlation	.630	.624	1	–.674*	–.086
	Sig. (2-tailed)	.069	.073		.047	.825
TA	Pearson correlation	–.491	–.205	–.674*	1	.081
	Sig. (2-tailed)	.180	.596	.047		.835
LP	Pearson correlation	–.165	.136	–.086	.081	1
	Sig. (2-tailed)	.671	.728	.825	.835	

Note: COM: perceived competence; AU: perceived autonomy; IM: intrinsic motivation; TA: technology anxiety; LP: learning performance. *Correlation is significant at the 0.05 level (2-tailed); The number of sample is 9.

Although the correlation analysis demonstrates the relationships among perceived competence, perceived autonomy, intrinsic motivation, technology anxiety and learning performance, questionnaire data cannot support our expectation. It is because that the small samples result in the insignificant difference among different groups. So, we did another interviews with all subjects to find out what were their opinions about the gamified learning method.

5.2 Interview Results

In the interviews, we used the open questions and asked all subjects to talk about their opinions about the Badge and/or Story. We wanted to find out whether the subjects in

Badge group believed the badge could make them more competent; the subjects in Story group believed that story could make them more autonomous.

Badge and Perceived Competence. Badge, in the gamified learning context, "has not practical meaning" (S10). But, it provides challenge and reflects learners' ability, which helps people feel competent about the activity. In badge group, subjects said that "the badge encourages me and I feel I am capable to finish the exercise" (S1). "I have been off school for a long time. Without this kind of encouragement (of my ability), I do not think I can come back" (S6). And "obtaining a badge after better performance is a good encouragement" (S4), and "it makes me feel confident" (S10).

Story and Perceived Autonomy. In our theory, story has two functions to impact learners' behavior. First, story makes the learning process more curious. Just as one subject (S8) said "the story makes the learning activity more attractive. I want to know what is the next". Second, story can also provide a situation where and when a leaner is able to generalize, comprehend knowledge easily [25] and learn how to use, apply knowledge to real-world problems and requirements [26]. Just like one subject (S6) said "the story makes the learning process more real and can help me understand when and in what situation I can use the TVM". And this design makes them believe "the knowledge is useful in the future" (S10).

In the interviews, most of subject believed that the badge and story can make them more competent and autonomous. And the gamified design can make the learning process more interesting.

6 Discussion

Gamification has become and will become more important in company management, education, marketing and other social application [19]. In this paper, authors discuss the application of gamification in education field, especially for senior citizen's education. As the technology becomes increasingly ubiquitous and common in our daily, how to educate senior citizens to use them is becoming more import social and academic problem [12]. Therefore, authors try to analyze the effect of gamification on senior citizens' learning of information technology (e.g., Ticket Vending Machine).

6.1 Theoretical Contributions

In this paper, we focus on the senior citizens and try to examine the effect of gamified learning method on their learning. Although there are not enough sample in the pilot test, we find in the gamification group, senior citizens have less anxiety and better performance after the gamified learning. They believe that the badge and story make the learning more enjoyable and interesting. In some way, the gamified learning process can help senior citizen master the modern IT better.

In this paper, we try to discuss the mechanism of gamification, through the lens of Motivation Theory [17]. Previous studies pay more attention to the effectiveness test of gamification for younger people, but do not provide the mechanism. Therefore, we attempted to fill this the gap.

Based on the Motivation Theory [17], we believe that the intrinsic motivation is an important factor in influencing people's learning performance and technology anxiety. One of the most important functions of gamification is to offer senior citizens the similar feeling of playing game, without converting learning into a full-edge game [1]. In game, players' intrinsic motivation - doing an activity for its inherent satisfaction and pleasure rather than for some separable consequence [28] - play import role in explaining players' engagement. And in education field, scholars find that high intrinsic motivation of students is related with their high performance [17]. Therefore, we treat intrinsic motivation as the mediator between gamified design and learning results (e.g., performance, anxiety).

Many previous studies also use intrinsic motivation as the bridge between gamified design and learning results [2, 9, 37]. However, not every paper finds the significantly positive relationship between gamified design and intrinsic motivation. So, there may be some factors unfounded between design and intrinsic motivation.

In order to answer the question, we introduce the antecedent factors of intrinsic motivation- perceived competence and perceived autonomy [17]. Perceived competence refers to the people's capacity for effective interactions with the environment in producing desired outcomes and preventing undesired event [17, 29]. Perceived autonomy refers to the feeling of engaging in activities out of one's own choosing, without external or internal controlling [17, 28].

By correlation analysis, we find the significant correlation among perceived competence-intrinsic motivation, perceived autonomy-intrinsic motivation, intrinsic motivation-technology anxiety, and intrinsic motivation-learning performance. Through the interviews, we also find that badge can increase senior citizens' perceived competence, and story can increase their perceived autonomy.

6.2 Practical Implication

In this paper, we find that successful badge design should increase learners' intrinsic motivation through their perceived competence. However, in extant research, many badges are so improperly designed that many researchers find that badge in gamified activities has negative influence on learners' intrinsic motivation and quality of learning [2]. For example, Hanus and Fox [2] argue that the badge system shift students' motivations of learning from intrinsic (i.e., because they want to learn) to extrinsic (i.e., because they want to earn a reward). In their experiment, their badges are designed to ask students to do something that is irrelevant to students' learning performance, such as badge "Go Forth and Multiply". This badge requires student "Go, physically, to the library and find a resource that you cannot find otherwise that could help with a class paper or project, make a copy of it, and bring it into class". Even though students get this badge, they will not feel competent about learning.

In this paper, we also find that successful story design should increase learners' intrinsic motivation through their perceived autonomy. If the story is intriguing and can provide the virtual or real situation where learners can apply the knowledge, it is a proper design to make learners feel that they participate in the learning activity for their own sake. So, just providing an unrelated story as the back-group of the learning process is hard to increase senior citizens' learning performance.

7 Limitations and Future Works

There are some limitations in this paper. First, due to the limitation of sample in the pilot test, the results cannot be concrete enough. In this paper, we just recruit 9 senior citizens to do a pilot test. And the pilot test just shows some superficial results or evidence of the model. We should conduct a concrete empirical experiment to test the model in the future. Second, in order to analyze the different effect of gamification on senior citizen and young people, we should recruit both valid samples of senior citizens and young people to test the model. In out pilot test, we just tried to test the effectiveness of the model for senior citizens. In the future, we should do the test for the young people and explore the difference between them.

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Appendix A

Construct	Items	Source
Perceived competence	I think I am pretty good at learning ticket vending machine	Intrinsic Motivation Inventory (IMI)
	After learning ticket vending machine for a while, I felt pretty competent	
	I am satisfied with my performance at this learning	
	I am pretty skilled at using ticket vending machine	
	This was an activity that I couldn't do very well	
Perceived autonomy	While I was learning ticket vending machine, I felt like it was not my own choice to learn (R)	Intrinsic Motivation Inventory (IMI)
	While I was learning ticket vending machine, I felt like I really wanted to	
	While I was learning ticket vending machine, I felt like I had to (R)	
	While I was learning ticket vending machine, I felt like I was active	
Intrinsic motivation	I enjoyed learning ticket vending machine very much	Intrinsic Motivation Inventory (IMI)
	Learning ticket vending machine was fun to do	
	I thought learning ticket vending machine was boring (R)	
	Learning ticket vending machine did not hold my attention at all (R)	
	I would describe learning ticket vending machine as very interesting	
	I thought learning ticket vending machine was quite enjoyable	
Technology anxiety	I am confident I can learn technology-related skills (R)	[33, 36]
	I have difficulty understanding most technological matters	
	Reading a technology manual makes me anxious.	
	I am not comfortable to Learn technology terminology	
	Taking a class about the use of technology make me anxious	

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