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A SURVEY RESEARCH ON THE USAGE AND THE INFLUENCEING FACTORS OF GAME-BASED LEARNING AMONG ELEMENTARY TEACHERS IN TAIWAN

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This study aims to learn the usage and influencing factors of game-based learning among elementary teachers in Taiwan. This research sorts out the factors of influencing behaviors proposed in the related literature, refers and sorts out the literature results, then divides the influencing factors into five directions of knowledge, motive, relevant training, incentive policy and resource to design the subjects of the questionnaire, which is expected to learn whether the factors influence the usage of game-based learning among elementary teachers. Finally, according to the research results, this study conducts analysis and discussion, induces the main research findings to make a conclusion, which is provided to propose the suggestions as references for teachers, policy makers and the future follow-up study.

Keywords: Game-based learning; behavioral engineering model; information integration teaching.

1. Research Background

In the last 20 years, the so-called G-generation is living in times of rapid development of science, advanced networking and a knowledge explosion (Prensky, 2007). In these times, students improve their competitiveness by learning in many ways. Taiwan's Ministry of Education promotes information technology at elementary and secondary schools with the purpose of breaking down traditional limitations of time and space, cultivating lifelong learning, and enabling students to use information technology (IT) to improve their learning and life skills. Teachers can use information technology to improve their teaching. Taking advantage of abundant information available through networks, teachers

as teaching strategists with enough computer literacy can effectively integrate technology into their teaching to improve its effectiveness. Teachers can help students to adapt to the information-based society, if they understand the characteristics and significance of the information society. Restated, teachers who lack computer literacy can neither use computer technology to improve teaching nor improve the abilities of students to use information technology ability. Therefore, the computer literacy of teachers on the front line of education, and their ability to use computer technology not only affect the success or failure of schooling, but also critically affect the practical application of information education policy. Nowadays, several action studies that employ teaching strategies that involve game-based learning compare the learning effectiveness of students who engage in game-based learning with that of those who receive traditional education. Most research results reveal that the students who undertake game-based learning have greater learning effectiveness and motivation (Garris, Ahlers, & Driskell, 2002).

Relevant results in the literature (Prensky, 2007; Ye & Song, 2004) reveal the effectiveness and importance of game-based learning in education, but most related studies treat the students as objects; compare the learning outcomes and satisfaction of the students who undertake game-based learning, and then discuss more broadly the use of information technology in this way. Few studies have treated elementary teachers as subjects to identify the factors that affect usage of game-based learning. This study treats elementary teachers as objects, and elicits the current usage the game-based learning using a questionnaire survey. It also refers to the relevant literature on behaviors associated with the use of information technology to identify the factors that affect the usage of game-based learning by elementary teachers with different backgrounds. This study also elucidates the relationship between the influencing factors and the usage of the game-based learning with reference to the relevant literature.

2. Literature Review

In the literature, game-based learning is defined as follows:

- Prensky (2007) defined game-based learning as the close combination of any educational content and computer games, as in any educational games that are played on a computer or online.
- Garris, Ahlers, and Driskell (2002) proposed that game-based learning involved games that integrate teaching content and game features. Games not only immerse but also ensure that students reach a particular learning target.
- The main purpose of game-based learning is to achieve a particular learning target. It can involve serious games in professional fields whose primary purposes are not recreation and entertainment. Such games in the fields of education, medical treatment, religion, politics and military and others (Ye & Song, 2004).

2.1. *Behavioral Engineering Model*

Lin (2006) gave questionnaires to, and interviewed to understand the current state of integrating technology in teaching and the factors that affect such integration. That work

Environment	Information ● Providing clear concept of teaching of technology integration ● Providing necessary educational training	Resources ● Team operation ● Way of solving problems ● Teaching material database ● Enough hardware	Incentives ● Proper incentive policy ● Planning of the course scheduling and teaching hours, which can be reduced by technology integration
Individual	Knowledge ● Knowledge of operating the software ● Knowledge of multimedia teaching design ● Knowledge of subject content or field integration	Capacity ● Enough professional competence ● Meet with the capacity or needs of technology integration	Motives ● Self-efficiency of the teaching with technology integration ● Value (interest, importance and utility) meet with own expectations

Figure 1. Behavioral Engineering Model.

was based on the Behavioral Engineering Model that was proposed by American psychologist Gilbert in 1978. It differs from the pyramid model that was proposed by Watkins and Wedman (2003) clearly distinguishing into environmental and individual: the former includes information, resources and incentive and the latter includes knowledge, capacity and motivation.

Lin (2006) used the Behavioral Engineering Model that was proposed by Gilbert to identify the factors that influence the usage of information technology by teachers, the results were as Figure 1 shows.

The literature on the use of information technology and the factors that affect it identify the nature of the available information technology as important in determining its use by teachers. This factor is followed by relevant training and incentive policies (Lin, 2006). Even in schools that have enough software and hardware resources, if their use is not properly planned, the consequent inconvenience for teachers will directly affect their willingness to use them (Gifford, 2004).

The attitude of administrative personnel toward integrating information technology in teaching, the incentives in place, whether related studies have been performed and whether teachers are provided with professional training to improve their IT integration, are all factors that affect the intention of teachers to use information technology (Wu, 2006). A more comprehensive incentive policy corresponds to a stronger intention of the teachers to integrate IT. In 2010, Chang indicated that a supportive attitude of administrative personnel were important factors in increasing the intention of teachers to integrate information technology in teaching.

Teachers' professional knowledge and internal motivations strongly affect the integration of technology into teaching (Fuller, 2000; Gifford, 2004; Whitehead, 2002). In 2004, Gifford studied the factors that limit the use of information technology by K12 teachers. The results of a questionnaire result indicated that the factors that influence the

usage of educational technology by teachers included the personal views of teachers on the integration of educational technology in the class, whether the teachers gained positive feedback on the integration, whether the software and hardware were effective for the teachers' purposes, incentive policies and the teachers' basic skills.

According to the above analyses, the factors that most strongly influence the usage of game-based teaching are personal background, knowledge, motivation and environment. Therefore, in this study, personal background is treated as a dependent variable, and the other factors are influencing variables. The usage of game-based learning by teachers varies with various background variables. Accordingly, this investigation examines the variation in use by teachers with their gender, educational background, subject at college, teaching seniority, hours spent online weekly and of participation, or otherwise, in studies on game-based learning.

The literature shows that the provision of a school of enough software and hardware improves teachers' intentions to use information technology, and that the support of the school's administration is positively correlated with the usage of information technology. However, the integration of IT into teaching also benefits from the establishment of an incentive policy and the undertaking of relevant studies. Therefore, this study discusses the relationships between available resources, incentive policies and relevant training and the usage of game-based learning among teachers. Moreover, the literature reveals that the teachers' personal knowledge of IT is positively relegated to their use of information technology, and in terms of whether use the information technology; confidence in their ability to use information technology is also important.

2.2. *Personal background factors that influence usage of game-based learning*

2.2.1. *Gender*

According to the literature, males are more pro-active than females in using game-based learning. They also score better in familiarity with information technology, relevant knowledge, ability to use it and general perception of it (Pern, 2010).

2.2.2. *Educational background*

The literature indicates that teachers with higher levels of educational attainment have more positive attitudes toward the usage of information technology (Ting, 1996).

2.2.3. *Subject studied at university*

Cheng (1994) gave questionnaires to university students and found that the attitudes of students toward learning using computers vary with subject. Wei (2000) found that teaching students in the fields of information technology and the pure sciences have greater computer literacy of the teachers than those in fields of Chinese.

2.2.4. *Teaching seniority*

The literature reveals that the motivation to undertake advanced study using information networks varies with teaching seniority (Lin, 2006). Teaching seniority is a personal background factor that significantly affects attitudes of elementary teachers.

2.2.5. *Weekly hours online*

Relevant research with various objectives has found that the number of hours spent online hours every week significantly affects overall attitudes toward computers and computer literacy. More hours of computer use weekly correlate with more positive attitudes toward computers and higher computer literacy (Wei, 2000).

2.2.6. *Previous participation in game-based learning*

Cai (2006) found that hours spent studying on computers or in networks affect the intentions of teachers to participate in e-learning.

3. Research Method

3.1. *Research framework*

The framework of this study concludes the correlation variable to discuss the attitude of the elementary teachers toward the game-based learning, whether the difference exists in the factors influencing the usage, and whether the influencing factors is related to the use situation of the game-based learning. Including the independent variable as the basic background variable, the dependent variable as the influencing factor of the behavioral expression of game-based learning, and the situation of usage of the game-based learning among the elementary teachers.

3.2. *Participants*

This study takes the elementary teachers in the New Taipei City in Taiwan, and school as sampling unit, and the objects include the group leaders, supervisors, formal teachers and agent teachers in establishment, but without the guards and workmates. The total amount of the samples is 813.

3.3. *Research procedure*

Totally 813 questionnaires were issued by mail in 2012, and 587 questionnaires were returned after two months with the return rate of 72%. Except the 12 invalid questionnaires which were incomplete filling and with same answers, there were 575 effective questionnaires, in which, there are 175 males (30.4%), and 400 females (69.6%).

3.4. *Instruments*

This study conducts the investigation by questionnaires, and the first section aims to learn what the factors influence the teachers' intention to use the game-based learning, and the relationships of the influencing factors and the usage situation. In the aspect of influencing factors of use intentions, totally 27 questions in five aspects of "knowledge", "motive", "related training", "resource" and "incentive policy" are worked out by sorting out the related literatures and referring the questionnaire of influencing factors of usage of technology which was based on the elementary seeded teachers and issued by Lin (2006). The second section is the use situation and personal basic information, and aims to learn the relationships of the personal basic information, use situation and influencing factors. In which, in the aspect of use situation: the testers are requested to fill that whether they used or used successfully, integrating subjects and integration periodicity; in the aspect of personal basic information: there are 11 questions, the testers are requested to fill their gender, educational background, college, teaching seniority, online hours for teaching needs every week, and whether they participated in the related studies of game-based learning.

Based on the analysis results of literature, in order to further confirm the adequacy of the questionnaire questions and establish the validity of the content, after working out the first draft of the questionnaires, this study asks three scholars and experts who have educational background, information background and experience of game-based learning to propose their views on the accuracy, adequacy and fluency of expression, and check the questionnaire questions and mark "adequacy", "adequacy after modifying" and "inadequacy", then propose their revisions for each questionnaire question to assist the researcher in verification of the scales; and the related revisions are taken as important references for screening the pro-test questionnaire questions and amending the semantic. The Cronbach's α of each aspect are in order: knowledge is 0.78, motive is 0.69, related training is 0.74, resource is 0.77 and the incentive policy is 0.78.

4. Results and Discussion

4.1. *Background information and the usage of game-based learning among teachers*

The background variables data were counted up as Table 1 and Table 2 shown.

Table 1. Background information of teachers.

Basic information	Item content	Number	Percentage
Gender	Male	175	30.4%
	Female	400	69.6%
	Total	575	100%
Education background	College	8	1.4%
	University	388	67.5%
	Master	175	30.4%
	Doctor	4	0.7%
	Total	575	100%
Teaching seniority	1-5 years	102	17.7%
	6-10 years	139	24.2%
	11-15 years	171	29.7%
	More than16 years	163	28.3%
	Total	575	100%
College	Sports of Normal college	144	25.0%
	Liberal arts colleges	98	17.0%
	College of Management	15	2.6%
	College of Science	35	6.1%
	Business college	29	5.0%
	College of Education	125	21.7%
	Others	129	22.4%
	Total	575	100%
Online hours for teaching needs every week	0 hour	7	1.2%
	1-10 hours	427	73.7%
	11-20 hours	97	16.9%
	More than 21 hours	47	8.2%
	Total	575	100%
Participate in the related study about integrating the game-based learning to teaching	Yes	157	27.3%
	No	418	72.7%
	Total	575	100%

The research results show that over half participants used the game-based learning in class and the teachers who used mostly realize they can successfully use it in class. In terms of integrated subjects and the related studies on the game-based learning integration teaching, most studies integrated the game-based learning into subject classes (Fan, 2010), however, this questionnaire results show that the integration of the game-based learning has tended to multiple, and the reason is evolved to link with the factors of whether the integration experience is successful, that should be that the e-books provided by the booksellers were widely used by elementary teachers; more integration periodicity are once a week to use the game-based learning in class, that indicates the frequency of the elementary teaches to use it.

Table 2. The usage of game-based learning among teachers.

Items	Item content	Number	Percentage
Using the game-based learning in class or not	Yes	364	63.3%
	No	211	36.7%
	Total	575	100%
Is it successful for integrating experience	Yes	341	93.7%
	No	23	6.3%
	Total	364	100%
The subject which is integrated with game-based learning	Mathematics	117	32.1%
	Chinese	95	26.1%
	English	60	16.5%
	Other	55	15.1%
	Nature	37	10.2%
	Total	364	100%
Interactive periodicity	At least once a week	113	31.0%
	At least once a month	109	29.9%
	At least once a term	82	22.5%
	Others	35	9.6%
	At least once a day	25	6.9%
	Total	364	100%
The influencing factors of whether integrated or the integrative experience is successful?	Teaching material database	196	34.1%
	Computer capacity	137	23.8%
	Enough hardware in school	84	14.6%
	Interest	59	10.3%
	Time allocation is Proper	27	4.7%
	The teaching material is reusable	19	3.3%
	Discussing and making with team	18	3.1%
	With related background of education major	18	3.1%
	With favor for own development	7	1.2%
	Someone helps	7	1.2%
	Encouragement and support of school	3	0.5%
	Support of parents	0	0%
	Total	575	100%

4.2. *Analysis of the usage of game-based learning among teachers with different background*

Table 3. Current situation of different personal background variables in the usage of the game-based learning.

		1		2		3					4				
		Yes	No	Yes	No	National language	Mathematics	English	Optional subjects	Others	Every day	Every week	Every month	Term	Others
Gender	Male	105	70	998	77	29	36	3	15	22	4	32	37	21	11
	Female	259	141	2243	116	66	81	57	22	33	21	81	72	61	24
	Total	364	211	3341	223	95	117	60	37	55	25	113	109	82	35
Educational background	College	3	5	32	21	0	1	0	0	2	0	1	1	0	1
	University	238	150	2221	117	65	74	37	24	38	18	75	71	50	24
	Master	120	55	1115	55	30	41	22	12	15	6	35	37	32	10
	Doctor	3	1	33	00	0	1	1	1	0	1	2	0	0	0
	Total	364	211	3341	223	95	117	60	37	55	25	113	109	82	35
The category of college	Normal College	85	59	882	33	26	30	10	13	6	5	30	30	13	7
	Arts	61	37	553	88	12	11	22	5	11	3	14	15	23	6
	Management	13	2	113	00	3	6	2	0	2	0	5	5	2	1
	Science	23	12	223	00	5	13	0	4	1	2	8	5	6	2
	Business	18	11	118	00	5	6	4	0	3	2	4	7	5	0
	Education	93	32	888	55	26	30	12	7	18	6	29	29	20	9
	Others	71	58	664	77	18	21	10	8	14	7	23	18	13	10
	Total	364	211	3341	223	95	117	60	37	55	25	113	109	82	35
Teaching seniority	1-5	71	31	666	55	14	16	30	4	7	5	17	26	20	3
	6-10	89	50	882	77	26	29	16	6	12	4	28	28	22	7
	11-15	114	57	1109	55	24	46	10	18	16	7	39	35	22	11
	More than 16	90	73	884	66	31	26	4	9	20	9	29	20	18	14
	Total	364	211	3341	223	95	117	60	37	55	25	113	109	82	35
Different online hours for teaching needs every week	0 hour	2	5	22	00	0	1	0	0	1	0	0	0	0	2
	1-10	266	158	2250	116	76	84	42	27	37	17	83	78	67	21
	11-20	61	36	554	77	15	19	14	6	7	6	16	19	13	7
	More than 21	35	12	335	00	4	13	4	4	10	2	14	12	2	5
	Total	364	211	3341	223	95	117	60	37	55	25	113	109	82	35
Research experience	Yes	133	24	129	4	43	46	20	10	14	11	42	38	29	13
	No	231	187	212	19	52	71	40	27	41	14	71	71	53	22
	Total	364	211	341	23	95	117	60	37	55	25	113	109	82	35

1. Whether used the game-based learning in class; 2. Whether the integration is successful; 3. Which subject has been integrated; 4. Integration period

4.2.1. *Gender*

The analysis results by Chi-Square indicates that the elementary teachers with different gender have less difference in each level of use situation ($p > 0.05$). That is to say, the elementary teachers will not be affected by different gender in the use situation of game-based learning. The result is not agreed with the findings in the studies of Pern (2010). The related results indicated that the elementary teachers with different gender have differences in the network attitude, network literacy and the attitude of accepting the creative things.

4.2.2. *Educational background*

The analysis result by Chi-Square indicates that the elementary teachers with different educational background have less difference in each levels of use situation ($p > 0.05$). That is to say, the elementary teachers will not be affected by different educational background in the use situation of game-based learning. The result is not agreed with the findings in the studies of Ting (1996) and Pern (2010). The reason of this research result may be that the educational background of the filling objects are university, thus it can't perform significant difference in background variables, and might have different research results with research time points and regionalism.

4.2.3. *The category of college*

The analysis result by Chi-Square indicates that the differences of the teachers who studied at different colleges and subjects are significant in two aspects of whether have used the game-based learning (Chi-Square = 15.23, $p < 0.05$) and which subject have been integrated in the game-based learning (Chi-Square = 47.08, $p < 0.03$). By comparison of the standardized residuals, in terms of whether have used the game-based learning, the teachers who studied at the education college are significantly lower than who studied at other colleges in usage of the game-based learning. Moreover, in terms of the subjects which have been integrated with game-based learning, the teachers who studied at Arts College are significantly higher than who studied at other colleges. This result is agreed with the studies of Wei (2000) and Cheng (1994). Thus the subjects studied at university do affect the attitude of the elementary teachers toward the usage of the game-based learning.

4.2.4. *Teaching seniority*

The analysis result by Chi-Square indicates that the elementary teachers with different teaching seniority have less difference in each level of use situation ($p > 0.05$). That is to say, the elementary teachers will not be affected by different teaching seniority in the use situation of game-based learning. The result is not agreed with the findings in the study of Lin (2006). The reason might be that the cognitive degree of the elementary teachers is generically equal in the game-based learning, so that the teaching seniority plays less difference in the usage of the game-based learning among the elementary teachers.

4.2.5. *Online hours for teaching needs every week*

The analysis result by Chi-Square indicates that the elementary teachers with different online hours for teaching needs every week have less difference in each level of use situation ($p > 0.05$). That is to say, the elementary teachers will not be affected by different online hours for teaching needs every week in the use situation of game-based learning. The result is not agreed with the findings in the studies of Guo (2000). The elementary teachers might search related teaching resource online due to the teaching needs, however, during the investigation of influencing factors, it can be learned that most teaching resources of using the game-based learning are the teaching CDs used by the booksellers to match the textbooks, that is conjectured by the researcher to be the reason of less difference of the teachers in the use situation of the game-based and the online hours.

4.2.6. *Whether have participated in the related studies on game-based learning*

The analysis result by Chi-Square indicates that whether have participated in related studies on game-based learning, which plays significant difference in whether have used the game-based learning (Chi-Square = 42.61*, $p < 0.05$) and whether the integration is successful (Chi-Square = 3.88*, $p < 0.05$) in the use situation. By the standardized residuals, in terms of whether have used the game-based leaning, the usage of game-based learning among the teachers who have participated in the related studies are significant higher than that among who did not participated in. Moreover, in terms of whether the integration is successful, the successful integration of the teachers who have participated in the related studies is significantly higher than that of who did not participate in. This result is same as the finding in the study of Cai (2006), thus it is conducive to improve the teachers' intention to participate, and reduce the difficulties in use by participating in related studies.

4.3. *Analysis of the influencing factors of different personal background and integration*

The following are the analysis of the influencing factors of usage and integration of game-based learning of the teachers with different personal background, such as gender, teaching seniority, college, education background, online hours for teaching needs every week, and participated in or not participated in the related studies of game-based learning.

4.3.1. *Gender*

According to the data in Table 4, gender has no significant difference in the aspects of knowledge and motive of the personal influencing factors. That is different from the results in literature of that the male is more pro-active than female, as well as in the aspect of familiarity, knowledge-ability and general perception on IT, male is better than female (Pern, 2010).

4.3.2. *Educational background*

The results of the one-way ANOVA analysis (see Table 5) indicate that the significant differences are shown in knowledge ($F = 4.46$, $p < 0.05$) and resource ($F = 3.89$, $p < 0.05$) in the factors of influencing the usage of the game-based learning among the elementary teachers with different educational background. By comparison, in the aspect of knowledge, the teachers with educational background of master are higher than who with educational background of university; in the aspect of resource, the elementary teachers with educational background of university and master are significantly higher than who with educational background of college.

Table 4. Table of t-test of the whole and levels of influencing factors of the game-based learning used by the elementary teachers with different genders.

Levels	Gender	Qty	Average	Standardized Residual	t
Relevant training	Male	175	2.65	0.98	3.12*
	Female	400	2.39	0.90	
Resource	Male	175	3.06	0.61	2.41*
	Female	400	2.93	0.58	
Incentive policy	Male	175	2.70	1.03	3.61***
	Female	400	2.41	0.78	

* $p < 0.05$; *** $p < 0.001$

Table 5. Table of the one-way ANOVA of the whole and levels of the influencing factors of the game-based learning used by elementary teachers with different educational backgrounds.

Levels	Group	Average	Standardized Residual	ANOVA					Post-hoc test
				Source of variation	Quadratic sum	DOF	Average quadratic sum	F	
Knowledge	1	3.18	0.91	Inter-group	6.90	3	2.30	4.42*	3>2
	2	3.45	0.74		294.09	571	0.51		
	3	3.67	0.66	Intra-group	301.00	574			
	4	3.75	0.68	Total					
	2	3.07	0.58						
	3	3.14	0.47						
	4	3.13	0.25						
Resource	1	2.30	0.41	Inter-group	4.06	3	1.35	3.89*	2>1
	2	2.99	0.61		198.57	571	0.34		3>1
	3	2.97	0.56	Intra-group	202.63	574			
	4	3.25	0.44	Total					

* $p < 0.05$

1 = college; 2 = university; 3 = master; 4 = doctor.

4.3.3. *The category of college*

The data in Table 6 show: In the factors of influencing the usage of the game-based learning, the differences of the elementary teachers with different colleges in the aspects of knowledge, motive, related training and incentive policy are significant. By comparison, in the aspect of knowledge ($F = 2.64$, $p < 0.05$), the teachers studied in management college are significantly higher than who studied in normal college, arts college, business college and other colleges in non-option; and the teachers studied in education college are significantly higher than who studied in normal college and arts college.

By comparison, in the aspect of motives ($F = 3.44$, $p < 0.05$), the impact of that on the teachers studied in normal college and management college is significantly higher than that of who studied in business college; and the teachers studied in education college are significantly higher than who studied in arts college, and the teachers studied in management college are significantly higher than others out of the options. By comparison, in aspect of related training ($F = 2.35$, $p < 0.05$), the teachers studied in normal college and education college are significantly higher than who studied in arts college; the teachers studied in education college are significantly higher than who studied in business college. In the aspect of incentive policy ($F = 2.30$, $p < 0.05$), the teachers studied in normal college are significantly higher than who studied in business college.

Table 6. Table of the one-way ANOVA of the category of college and the whole and levels of the influencing factors of the game-based learning used by elementary teachers.

Levels	Group	Average	Standardized Residual	ANOVA				F	Post-hoc test
				Source of variation	Quadratic sum	DOF	Average quadratic sum		
Knowledge	1	3.49	0.72	Inter-group	8.16	6	1.36	2.53*	3>1
	2	3.42	0.70	Intra-group	292.83	568	0.51		3>2
	3	3.89	0.68	Total	301.0	574			3>5
	4	3.57	0.66						3>7
	5	3.43	0.82						6>1
	6	3.68	0.71						6>2
	7	3.41	0.72						
Motive	1	3.18	0.57	Inter-group	6.86	6	1.14	3.59*	1>2
	2	2.92	0.62	Intra-group	188.83	568	0.33		3>2
	3	3.41	0.47	Total	195.69	574			1>5
	4	3.14	0.44						3>5
	5	2.91	0.71						6>2
	6	3.11	0.57						3>7
	7	3.02	0.57						
Relevant training	1	2.58	0.94	Inter-group	12.21	6	2.035	2.35*	1>2
	2	2.25	0.82	Intra-group	491.39	568	0.865		6>2
	3	2.20	0.84	Total	503.60	574			6>5
	4	2.47	1.01						
	5	2.24	0.81						
	6	2.63	0.94						
	7	2.46	1.00						
	4	2.94	0.58						
	5	2.96	0.59						
	6	3.00	0.58						
	7	2.93	0.62						
Incentive policy	1	2.69	1.07	Inter-group	10.44	6	1.74	2.30*	1>2
	2	2.40	0.61	Intra-group	428.49	568	0.75		1>5
	3	2.56	0.69	Total	438.93	574			1>7
	4	2.52	0.76						
	5	2.13	0.80						
	6	2.49	0.79						
	7	2.46	0.91						

* $p < 0.05$

1 = normal college；2 = arts college；3 = management；4 = science; 5 = business; 6 = education.

4.3.4. *Teaching seniority*

The data in Table 7 indicate that: In the factors of influencing the usage of the game-based learning, the differences of the elementary teachers with different teaching seniorities in the three aspects of motive, related training and resource are significant.

By comparison, in the aspect of motive, the teachers with the teaching seniorities of 1-5 years and 6-10 years are significantly higher than that with more than 16 years; in the aspect of related training ($F = 4.78$, $p < 0.05$), the teachers with the teaching seniorities of 1-5 years are significantly higher than that with 11-15 years and more than 16 years; in the aspect of resource ($F = 4.56$, $p < 0.05$), the teachers with the teaching seniorities of 6-10 years are significantly higher than that with 11-15 years and more than 16 years.

4.3.5. *Online hours for teaching needs every week*

The results of the one-way ANOVA analysis (see Table 8) indicate that the significant difference is only shown in knowledge in the factors of influencing the usage of the game-based learning among the elementary teachers with different online hour for teaching needs every week. By comparison, in the aspect of knowledge ($F = 5.06$, $p < 0.01$), the teachers with more than 21 online hours for teaching needs every week are higher than the teacher with 1-10 online hours.

Table 7. Table of the one-way ANOVA of the different teaching seniorities and the whole and levels of the influencing factors of the game-based learning used by elementary teachers.

Levels	Group	Average	Standardized Residual	ANOVA				F	Post-hoc test
				Source of variation	Quadratic sum	DOF	Average quadratic sum		
Motive	1	3.22	0.57	Inter-group	6.40	3	2.13	6.43**	1>4
	2	3.14	0.57	Intra-group	189.29	571	0.33		2>4
	3	3.07	0.54	Total	195.69	574			
	4	2.93	0.62						
Relevant training	1	2.75	1.01	Inter-group	12.34	3	4.11	4.78*	1>3
	2	2.52	0.96	Intra-group	491.26	571	0.86		1>4
	3	2.40	0.87	Total	503.60	574			
	4	2.33	0.91						
Resource	1	3.04	0.63	Inter-group	4.75	3	1.58	4.56*	2>3
	2	3.11	0.57	Intra-group	197.88	571	0.34		2>4
	3	2.90	0.56	Total	202.63	574			
	4	2.90	0.60						

Remarks: 1.* $p < 0.05$ ** $p < 0.01$

2. Groups: 1 = 1-5 years; 2 = 6-10 years; 3 = 11-15 years; 4 = more than 16 years

3. n.s. = not achieve the significant level

Table 8. Table of one-way ANOVA of the different online hours for teaching needs every week and the whole and levels of the influencing factors of the game-based learning used by elementary teachers.

Levels	Group	Average	Standardized Residual	ANOVA					Post-hoc test
				Source of variation	Quadratic sum	DOF	Average quadratic sum	F	
Know-ledge	1	3.34	0.84	Inter-group	7.79	3	2.59	5.06*	4>2
	2	3.46	0.70	Intra-group	293.20	571	0.51		
	3	3.56	0.74	Total	301.00	574			
	4	3.88	0.78						

* $p < 0.05$

2.Groups: 1 = 0 hour; 2 = 1-10 hours; 3 = 11-20 hours; 4 = more than 21 hours

4.3.6. *Whether have participated in the related study on game-based learning*

From the data in Table 9, in the aspect of incentive policy, it is learned that the person who participated in related study is significantly higher than who did not participate in. The result is not found in literatures, and the reason of calculating this result is that they expect in the incentive policy of the person who participated in related study is higher than that of who did not participate in.

5. Conclusion and Suggestion

In this study more than half of the surveyed elementary teachers used game-based learning in their lecture. Moreover, most of the teachers who have integrated it felt that they can use game-based learning in class successfully. In this study, however, the usage of game-based learning was unaffected by gender, educational background, teaching seniority and weekly hours online for teaching purposes. The subject that was studied by the teacher in college did affect that teacher's use of IT. The researchers conjecture that the duration of contact with information technology varies among college courses, affecting the intention to use IT required for game-based learning. This study finds that teachers who participated in related studies were more likely to integrate game-based

Table 9. Table of t-test of the whole and levels of influencing factors of the game-based learning used by the elementary teachers who participated or not participated in the related study on that.

Levels		Number	Average	Standardized Residual	t
Incentive Policy	Yes (participated)	157	2.64	1.08	2.40*
	No (not participated)	418	2.45	0.77	

* $p < 0.05$

learning successfully.

Analysis of the factors that affect the use of game-based learning by elementary teachers with different personal backgrounds yields the following results.

(1) The factors of relevant training, available resources and incentive policies made a bigger difference to the use of game-based learning by males than by females.
(2) Knowledge and resources had a greater influence on the use of game-based learning by teachers with masters' degrees than on that by those without.
(3) Elementary teachers who studied at management and education colleges made more likely to integrate game-based learning than were those who studied at arts and business colleges. However, the effect of the availability of resources did not vary with the course that was taken by the teacher at college. Therefore, choice of subject at college will not have any negative effect on the benefits that come with the provision of information resources to teachers.
(4) Teaching seniority significantly affected the importance of motivation, relevant training and available resources, which was lower for teachers with more than 16 years of teaching experience than for other teachers.
(5) Incentive policy had a greater effect on those who participated in it than on those who did not.
(6) The usage the game-based learning among elementary teachers is significantly correlated to their knowledge and available resources.

This study and that of Lin (2006) took teachers of information technology in Taipei city as objects. Lin found that the most important factors that affected the successful integration of technology into teaching were the teacher's ability to use computers, his personal interest in their use, the availability of help and the ability to have questions answered, the availability of sufficient hardware in schools and the existence of a discussion and production team. Currently, most schools have sufficient hardware, so the availability of hardware does not seriously influence the intentions of elementary teachers to use game-based learning; rather, the lack of elementary teachers' specialized knowledge of game-based learning remains the main factor that influences its use. Moreover, the results of the questionnaires herein reveal that the existence of a teaching material database is an important factor in determining whether elementary teachers use game-based learning and this fact explains the importance of the presence of a discussion and production team according to the research of Lin (2006).

The results of this research reveal that 63% of the surveyed teachers use game-based learning, but the teachers who participated in studies of game-based learning are not more. Teachers who perceive opportunities for professional development by improving their awareness of game-based learning can be expected to integrate game-based learning into their courses. Most teachers think that a teaching material database is the most important factor in determining whether they would use game-based learning. This result reveals the importance of the integration and sharing of resources.

As suggested above, the content and duration of information technology may affect teachers' intentions to participate in them: relevant studies of educational technology should teach the application of technology to teach more effectively. Meanwhile,

educational authorities should consider resource integration and sharing; a platform for so doing will not only provide new knowledge, but also enable teachers to share and learn through its use. We believe that deepening teachers' knowledge of multiple teaching methods will improve their intention to use them.

References

Cai, Z. D. (2006). *The study of current situation and elementary school teachers' attitudes of online in-service professional development training*. Unpublished master thesis, National Hsinchu University of Education, Taiwan.

Chang, W. F. (2010). *A study on influential factors contributing to elementary and junior high school teachers integration of technology in the classrooms*. Unpublished master thesis, National Taipei University, Taiwan.

Cheng, Y. C. (1994). *The impact of gender and major on the attitudes of college freshmen toward computers*. Unpublished master thesis, Tamkang University, Taiwan.

Christensen, R. (2002). Effects of technology integration education on the attitudes of teachers and students. *Journal of Research on Technology in Education*, *34*(4), 411–433.

Fan, K. C. (2010). *The effect of digital game-based learning integration into science remedial instruction on the third graders' learning outcomes*. Unpublished master thesis, Tamkang University, Taiwan.

Feng, C. L. (2006). *The effectiveness of integrating information technology into teaching in public elementary schools of Taipei city, and the relationship of teacher's teaching belief, environment factor of schools*. Unpublished master thesis, National Central University, Taiwan.

Fuller, L. H. (2000). First teach their teachers: Technology support and computer use in academic subjects. *Journal of Research on Computing in Education*, *32*(4), 511–524.

Garris, R., Ahlers, R., & Driskell, J. (2002). Games, motivation, and learning: A research and practice model. *Simulation & Gaming*, *33*(4), 441–467.

Gifford, B. L. (2004). *Teacher beliefs, learning styles, and technology implementation in rural, secondary classrooms in Massachusetts*. Unpublished doctoral dissertation, Johnson and Wales University, USA.

Gilbert, T. F. (1996). *Human competence: Engineering worthy performance*. Amherst MA: HRD Press, Inc.

Guo, W. C. (2000). *A study of computer attitude and computer literacy on policeman*. Unpublished master thesis, Central Police University, Taiwan.

Hsu, C. F. (2007). *The influences of administrative support and teacher's computer self-efficacy on teaching effectiveness of information incorporating teaching of elementary schools*. Unpublished master thesis, Dayeh University, Taiwan.

Lin, J. R. (2006). Applying hpt approach and cognitive motivators to the study of effective technology-instruction integration for Taiwan technology seeds primary schools. *The journal of National Taipei University of Education*, *19*(1), 117–148.

Lin, W. S. (2006). *The relationships among information equipment, teachers' satisfaction and willingness toward IT-Integrated Instruction in elementary schools*. Unpublished master thesis, National Changhua University of Education, Taiwan.

Pern, K. J. (2010). *Factor influencing consideration of information behaviours for undergraduate students: Taken Tamkang University as example.* Unpublished master thesis, Tamkang University, Taiwan.

Prensky, M. (2007). *Digital game-based learning.* New York: McGraw-Hill.

Ting, D. M. (1996). *The interrelationships between self-directed learning readiness, computer attitude and achievement in the students of National Open University.* Unpublished master thesis, National Chung Cheng University, Taiwan.

Watkins, R., & Wedman, J. F. (2003). A process for aligning performance improvement resources and strategies. *Performance Improvement*, *42*(7), 9–17.

Wei, Y. C. (2000). *The research of teacher education program's students to the attitude of the computer and computer literacy.* Unpublished master thesis, National Central University, Taiwan.

Whitehead, A. R. (2002). *Self-efficacy and context beliefs of teachers regarding technology: Relationship of those beliefs to technology use in the classroom*. Unpublished doctoral dissertation, Marywood University, USA.

Wu, C. C. (2006). *Design and evaluation of a digital game-based learning system in English learning activity*. Unpublished master thesis, National Central University, Taiwan.

Ye, S. Y., & Song, Y. L. (2004). *Digital game design - All areas of game design knowledge*. Taipei: GOTOP Information.