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Effect of educational agent and its form characteristics on problem solving ability perception of students in online task based learning media

Halil İbrahim Akyuz*, Computer Education and Instructional Technology, Kastamonu University, Kastamonu, Turkey.

Hafize Keser, Computer Education and Instructional Technology, Educational Sciences Faculty, Ankara University, Ankara, Turkey.

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Abstract

The aim of this study is to investigate the effect of an educational agent, used in online task based learning media, and its form characteristics on problem solving ability perceptions of students. 2x2 factorial design is used in this study. The first study factor is the role of the educational agent and the second factor is form characteristics of the educational agent. The educational agent plays two different roles (teacher and friend). Form factor is whether the educational agent is supported by speech bubble or not. The dependent variable of this study is problem solving ability perception. The working group of the study consists of 47 students, taking 'Multimedia Design and Creation' classes in the spring term of 2010-2011 academic year in the department of Computer Education and Instructional Technologies of Ankara Universtiy. In terms of two variables, students were assigned to four different experiment groups at random. All of the experimental studies were maintained online. Measurements regarding dependent variables were carried out online. Problem Solving Inventory (PSI) is used to measure problem solving ability perceptions. Pre-test problem solving ability perception points were controlled in order to determine the effect of experimental operations on groups and post-test points were then compared. It is determined that applied method has an important effect on problem solving ability perception of students and that the educational agent in the role of teacher is more effective than the role of friend in the development of problem solving ability perception.

Keywords: programming teaching, problem solving ability, educational agent.

*ADDRESS FOR CORRESPONDENCE: **Halil İbrahim Akyuz**, Computer Education and Instructional Technology, Kastamonu University, Kastamonu, Turkey, *E-mail address*: hakyuz18@hotmail.com / Tel.: +90-366-214-2312/123

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1. Introduction

In modern times, the need in the fields of both career and work has made the differentiation of the human profile inevitable and an increase in possessed proficiencies has become an obligation. With the speed and increase of information today, it is expected that people develop the skills necessary to investigate, to transfer data to other mediums, interpret the information, effectively use technology, take responsibility, think creatively, adapt to alterations, solve problems, communicate more effectively, work in groups, be inclined toward collaboration, and understand complicated technology systems. The need for organization and application of this increased information leads to individuals facing more challenges both in personal and business life. Jonassen (2000) states that the activities that consume most of our time are related to problem solving, and therefore an individual must know how to analyse a situation, find reasons for it, and produce rationalist solutions. Thus, problem solving skills have gained importance. In addition, information based economic systems require individuals able to both find solutions for complex problems and collaborate with others using effective communication skills. The fact that societies can compete and individuals can be world citizens is only due to contemporary education systems.

Bates (2000) emphasises that learning outcomes are not only the acquisition of high level knowledge, or simply retaining knowledge, principles or operations, but also the development of creative individuals with problem solving, analysis and evaluation skills. Thus, it can be said that the development of students who are able to utilize and who know when and where to use acquired knowledge in real life has gained great importance. Tekedere (2009) also stated that by traditional teaching methods individuals memorise most information but they may then struggle with how to apply this memorised knowledge to real life. Modern educational institutions are therefore obligated to closely follow the developments and rapid changes in information and communication technologies (ICTs), and transmit these skills to their students in order to prepare them for future contributions to society.

In order for the skills of creative thinking, effective communication, adaptation to changes, and ICT use to be brought to students, today's technological possibilities should be utilized in the process of learning and teaching. Utilization of technological potential in education is possible with education technology, depending on experimental analysis of human behaviours (Alkan, 2005). According to Keser (2000), education technology benefits from possibilities, offered by new technologies, for solution of problems met in the field of education application, as education technology is a discipline, which scientifically cures and applies problems about learning and teaching. There is a greater need than ever for more scientific and technological support in educational services, having more importance in the development and progress of an information society (Alkan, 2005).

Today, with constant changes to information systems and an increase in world population there is a need for life-long continued education. However, traditional education understanding is insufficient to meet these educational requirements. Bloom (1984) stated that while it is impossible to provide one teacher for one student, one-to-one lessons significantly increase the performance of the learner. In this process, education conception takes on different meanings. With the change of information understanding in the society, web based education comes to the fore as a result of the opinion that schools are not the only institutions to provide knowledge; person, place and time dependence in education should decrease.

There has been a significant increase in the number of users of distance education and web based education, due to internet growth, access proportions and developments in internet technologies. In our country, there has been a numerical development especially in associate degree programs since the 2008-2009 academic year. In 13 different universities, 33 distance education programs have opened, offering 13 different teaching disciplines. Since 2010, 24 universities have been carrying out distance education programs of associate degree and bachelor degree (Arslan, 2011). Total student capacity, created by these programs is 11.650 annually (OSYM, 2008). Except for the classical distance education programs, it is estimated that the total number of students, registered in other distance education programs, is about 15.000

as of 2008-2009 academic year. When the number of newly opened programs with bachelor and post graduate programs is taken into consideration, it is estimated that the e-learning student number is 53.000 except for that of Anadolu University (OSYM, 2009). With the number of the students of Anadolu University, this number is over 1.150.000. Ceyhan (2011) reports that nearly 2 million people benefit from the distance education program in Turkey, and this number is expected to reach 10 million within 10 years.

Studies for e-learning programs in Turkey indicate that student success is low and abandonment proportion is high (Latchem, Simsek, Cakir, Torkul, Cedimoglu & Altunkopru, 2009; Simsek, 2006). In addition, these rates change according to the institution, student satisfaction regarding program structure and interaction is low, applied period and timing is not flexible enough (Parlak, 2004), and used interaction tools are not easily accessible or functional enough (Yesilay, 2004; Yildirim, 2007). However, experimental studies report that e-learning applications may be as effective as face-to-face learning. One of the main reasons for this is that not enough attention is given to the design and application of effective e-learning programs. The reality is that within most institutions there is not sufficient quality or number of staff dedicated to development and applications of these types of programs, hence, the resulting problem is inevitable.

Salim, Marzuki and Kasirun (2007) stated that in web based learning medias, students are faced with six problems according to importance sequence, which are 1) need of counselling and guidance (23,7%), 2) lack of concentrating on the study material (23,1%), 3) lack of motivation (21%), 4) need of support for exercises and applications (17,2%), 5) breakoff phenomenon (8,6%), and 6) not having fun with the learning media.

Kim (2004) stated that while using the interface an individual acts according to feelings, which are part of social cognition; and thus for the successful realization of learning, educational interventions should not ignore the social cognitive extent of learning and development.

In web based educational media, the social learning aspect of face-to-face teaching is not provided and that can leave a student feeling alone. In order to provide a sense of social learning in web based education, Kizilkaya and Askar (2006) state the need for software support that interacts simultaneously with the student, follows the student and possesses information about student giving feedback, interpreting this information and arranging the medium according to the student and if necessary support social media and most of all prevent the feeling of student loneliness. In another words, there is a need for “educational interface agents”, which will follow the student, interact with him, give feedback to him, and when necessary, even help the student to focus his attention, telling him jokes if needed as a coach or friend.

Web based learning media use the task based approach based on constructivism designed to offer specialty education such as effective time management, transference of learned information to problem solving, and virtual scenarios where students may be confronted with real life problem situations.

In task based learning, mental learning is transformed into behaviour. The learner isn’t expected to memorise information, rather he is expected to exercise mental constructions of practical tasks, while trying to complete it. In other words, it is a result of passing to learning from teaching, by expression.

The web was previously considered an information bank, where statistical structures were used; whereas, today it is considered an unlimited media containing dynamic and interactive processes.

Constructive and socio-cultural approaches aim toward the student being actively involved while structuring and making sense of information. Task based learning accepts that the collocation of communicative and constructive approaches are the best learning model (Sole & Mardomingo, 2004). The flexible and open-ended format of online application of web in multimedia may be considered as an advantage. Online task based applications are generally more frequently encountered in comparison to stable web models and offline workings have

been encountered more frequently than online ones in situations requiring interaction and collaboration (Cabot, 2000; Ganem-Gutierrez, 2003; Sole & Mardomingo, 2004). In other words, face-to-face media is used instead of interaction and collaboration to a certain extent in online media and therefore online task based learning media defrauds the autonomy of the learner and limits web based education's independence from time and place. It can be said that it limits the self-study possibility of the student.

In task based learning, tasks and media provided to the learner is perceived as a natural media, but developing language learning process it is not perceived as materials that students should learn. Enrichment of the media with meaningful activities such as problem solving, discussion and tasks encourages and forces the student to develop his language skills (Foster, 1999). The task given to the student focuses him on learning and provides context to the student. According to Pica, Kanagy and Falodun (1993) interactive tasks in particular provide transference of learned information by the student to the appropriate media. It may help the student to develop his problem solving abilities, providing him opportunities to use obtained information in daily events and context.

Rules that students should follow when completing given tasks are special to language. There isn't only one way to complete given tasks. It is expected that every student transfer learned information in order to complete the task. It is expected that every student uses known and newly acquired information in related points, explaining their meanings, and using different problem solving skills. A student learns information, but the fact that he does not know or cannot decide in which context to use it is a big problem. Tasks given to students should be tasks that help him transfer learned information to the task. Thus, development of problem solving and transferring skills are provided.

In duty based learning, there are selection, gradation and application tasks (Foster, 1999). Skehan, (1996) stated that fluency and correctness should be constructed in a balanced theoretic framework developed by him for data based learning. Willis (1996) reported on the cycle that enables students to make comparisons between planning, performance, repetition and finally two languages. Foster and Skehan (1996) showed that giving students time before the task for planning increases performance and correctness. Students make comparisons with another second language, especially if they know another foreign language previously.

It may be regarded that teaching computer programming has similar structure to language teaching in terms of structure. In both of them, it is seen that grammar and structures are similar. De Raadt, Toleman and Watson (2002, 2007) state that learning computer programming is a difficult task for students and therefore teachers seek different methods to make it easier. Matthiasdottir (2006) states that teachers use different methods to attract student attention and increase their motivation in programming language lessons and this is one of the first lessons for computer education. According to Matthiasdottir and Johannsson (2004) concerns about computer programming education for beginners and which method is preferable has been discussed by teachers for years with questions such as 'what to teach?', 'which method or style to teach in?', 'how to motivate and support the student?' and, 'which programming language to be taught?'.

The Codewitz Project realised in 2003 highlights the problems students and teachers face when learning computer programming is investigated. In this study, it is seen that students do not agree regarding the difficulties in learning programming, and they answered both easy and difficult nearly in the same proportions. In the same study, nearly 66% of the students stated that they learn computer programming in lessons and the best way of programming is doing homework by self-study.

Also, differentiation of information level of students during the lessons, especially in face-to-face learning applications, leads to bored students who lose motivation. The fact that some students are in higher levels and more willing to start programming without waiting for others as well as being motivated to learn according to their own capacity while expecting assistance from the teacher when they encounter a problem, appears to be a problem. In face-to-face teaching, class attendance and the reluctance of students increase due to these mentioned

reasons. Ideally, students should work with teachers in a more productive environment and teachers should guide and help students, while working with student program encodings.

Theory is not definitively separate from application. Usher and Bryant (1987) emphasize that it should be accepted that theory and application are interactive and enrich each other. In order for students to become professionals, it is important that they are able to transfer scientific information to application, and with information also able to produce theories through application. Thus, task based learning is based on the structure connecting theory to application. It is taken into consideration that the start point of application tasks is theory and task based learning provides guidance and knowledge to better understand the tasks (Harden, Laidlaw, Ker & Mitchell, 1996). Associating knowledge and application of skills is among the objectives of task based learning. Thus, real learning is provided. It focuses on the character of teaching skills. As a result, development of skill is provided by using it. In other words, skill is developed by using task based learning (Harden et al., 1996)

When an individual is asked to explain reasons for his behaviour, he seldom wants to simply explain reasons, principles, assumptions and values, which they think of as correct, instead of answering by accessing knowledge that they have. In fact, it is clearly seen that values and assumptions are hidden in behaviours and should be considered as an effect of learning. From this point of view, task based learning is valuable. Students can analyse and see the principles and reasons for behaviours related to the task. Also, they learn how to apply these principles in different contexts by investigating the principle's general structure.

Achievable difficulty level: Presentation is difficult in conception and grammar when teaching computer programming. Well planned tasks are at a level that students can achieve, namely neither too hard nor too easy. If tasks are too difficult, this may lead to students unable to complete tasks and therefore loss of interest in subsequent work. If tasks are too easy, it may lead to the student feeling that the lesson was of little value. In task based learning, tasks in differing difficulty levels are given each week.

If the student is learning language, communicating with other people, they are given a task that they may face in daily life. English teaching may be generally defined as completing a verbally given special task. An advantage of task based learning is to provide students with a focus on the achievement of their goals, besides enabling them to use the possessed skills (Pools-m, 2011).

Problem solving is defined in the dictionary as the "application of previously obtained information to new and unknown situations; total of high cognitive processes such as understanding that there is a problem, describing problem, producing temporary solutions (assumptions) and questioning rightness of these solutions" (Budak, 2005). The literature offers differing definitions regarding problem solving. Problem solving is a situation affected by targets, needs, skills, habits and attitudes (Oguzkan, 1989). Baysal (2003) defines it as finding solutions whereby an individual can cope with the obstacles preventing him from achieving his goal. Mertoglu and Oztuna (2004) define it as "to know what to do in situations where one doesn't know what to do depending on problem concept". Sternberg and Grigorenko (2000) define it as "to find a solution for problem situations and to cope with difficulties" (Tok & Sevinc, 2010). D'Zurilla and Nezu (1982) define the term problem solving as the process in its natural medium and name it "social problem solving" and emphasize that problem solving finds resolution in real life in the social medium (D'Zurilla, Nezu & Maydeu-Olivares, 2002). Kneeland (2001) mentions that problem solving is a cognitive and behavioural process, that includes the selection of an option and application of it, the forming of effective options to cope with specific situations. Problem solving is a process since an individual is aware of and feels the problem until he finds a solution for it (Guclu, 2003).

According to this, problem solving processes require research with controlled activities in order to achieve a clearly outlined goal, which is not easily reached. A critical factor for coping with problems that are out of the ordinary is to be able to make a selection from banked potentially applicable strategies and to develop the ability to adapt these strategies to work in any given problem situation. Solving the problems we face involves certain effort and work. All

problems that present will not find resolution, and individuals may work to solve problems in differing ways (Tekedere, 2009). The problem solving ability and situation of an individual is closely related to their perception of the problem.

Problem solving perception helps the individual to effectively adapt to the environment in which they live. Thus, all individuals should learn problem solving skills. Some problems have right answers and certain solutions, while others have no certain answers. The solving of these problems requires interdisciplinary knowledge, multiple thinking processes and creativity (Mertoglu & Oztuna, 2004). Specializing in problem solving is required to be successful in activities pertaining to science, art, business and politics.

Teacher candidates have to cope with problems presented in both in business and personal life. According to Ormrod (1989) problems consist of givens, targets and operational components. Information such as givens, mentions the targets and the situation; operation means the actions required to solve the problem (Wang & Chiew, 2010). The field in which targets and all possible ways to solve the problem is called 'the problem field'. The important thing is for the individual to have potential and possible solutions in the problem area (Bender, 1996). Actually, these problem fields are structures that already exist in the human brain. An individual produces a solution and conducts experiments in his mind before he physically realizes it. As problems become different according to context, structure and complication, their resolution processes become different as well (Jonassen, 2000). Jonassen (2000) also formed a typology according to problem solving type; these are logic, algorithm, story, rule using, making decision, problem solving, diagnosis-solution, strategic performance, situation analysis, design, and dilemma problems.

Problem solving is an activity, which requires subject field information and selection and use of cognitive strategies appropriate for the situation. The objective to problem solving is to find the tool to achieve the goal and set it to work (Senemoglu, 2005). Problem solving requires effort and ability and this can be learned and developed by education. Studies indicate that problem solving ability can be taught by many differing approaches and models varying from mathematical models to computer simulations (Demirtas & Sonmez, 2008). Demirtas and Sonmez (2008) also state that problem solving is a process and an approach that can be taught and therefore, should be included in curriculum.

As in all scientific processes, problem solving should be realised by following steps. Even though problem solving shows differences according to the problems and the individuals, the main steps of problem solving are indicated below (Senemoglu, 2005):

- Problem understanding,
- Planning for solution,
- Application of plan,
- Evaluating results.

It is common knowledge that all through history people have solved or attempted to solve problems using the trial and error method. However, in modern times we have defined additional and varying problem solving strategies.

The process of problem solving begins with the perception of the problem and finishes with evaluation. Social, economic, political and technological changes in social structure have become more complicated. Our times are marked by the speed with which change occurs and this leaves an individual facing new problems and challenges each day. According to Gagne (1985), the principal purpose for educational programs should be teaching students how to face inevitable challenges with both in-subject fields and in all areas of their lives (Senemoglu, 2005).

2. Study Objective

The objective of the study is to examine the role of educational agents in education medium, supported by an online task based educational agent and the effect of speech bubble on the

problem solving perception of the learner. Sub goals of the study are given below within the framework of foreseen general objective;

1. Does the role of education medium, supported by an online task based educational agent have an effect on the problem solving skills of the learner?
2. Does the fact that the educational agent is supported by a speech bubble in education medium supported by an online task based educational agent have an effect on the problem solving skills of the learner?

3. Methods

4. Research Model

In this study, 2 x 2 factorial design of real test models is used. Factorial design is used to test main and common effects of two or more variables on dependent variable (McMilan, 2000). The first factor of the study consists of the role of the educational agent, and the second consists of form characteristics. An agent has two differing roles; teacher and friend. Form factor is whether the educational agent is supported by a speech bubble or not. In this study where factors have two different levels, the effect of these two variables on problem solving perception is investigated. The research model is displayed in Table 1.

Table 1. Research Model

2x2 Factorial Design		2nd Factor (Form of Educational Agent)	
		No Speech bubble	Speech Bubble
Factorial (Role of Educational Agent)	Teacher	Educational agent in teacher role, not supported by speech bubble (A)	Educational agent in teacher role, supported by speech bubble (B)
	Friend	Educational agent in friend role, not supported by speech bubble (C)	Educational agent in friend role, supported by speech bubble (D)

Research took four weeks. Students were required to complete the tasks given to them every week. Students were supported by educational agents in web based learning medium while they were performing these tasks. PSI was applied online in the web based learning medium before experimental operation started.

5. Research Group

The research study group consists of 47 students, taking “Multimedia Design and Creation” classes in the spring term of 2010-2011 academic year, in the department of Computer Education and Instructional Technologies of Ankara University. These students were assigned to four different experiment groups at random. Distribution of students to experiment groups is shown in Table 2.

Table 2. Number of students according to experiment groups

Type of Educational Agent	Number of Students
In friend role, supported by speech bubble	12
In friend role, not supported by speech bubble	11
In teacher role, supported by speech bubble	12
In teacher role, not supported by speech bubble	12
Total	47

6. Medium and Process

In the web based learning medium developed within the framework of this study, four different educational agents, educational agent roles and form characteristics of which become different, are prepared. These educational agents presented lessons in lectures to students, according to their own tasks. At the end of the lesson, the teacher gave the students tasks they were required to complete in that week. Educational agents developed vocalized lectured lessons with contents by "media semantics character builder" programs and Loquendo text to speech programs made SCORM coherent, being integrated with content by Adobe captivate 5.0 program. After it was made SCORM coherent, it was made accessible to students each week. Educational agents that welcome the students into the education medium and that chat with the students were developed by Media Semantics Character Builder program, using Turkish artificial intelligence (AIML). It was designed to enable educational agents to chat with student users about general subjects. When students enter in the lesson sites, the educational agent, to their right on the screen, welcomes them, vocalizing their name. Then according to the group of the student, they are welcomed with an appropriate greeting by either 1) an educational agent in teacher role supported by speech bubble, 2) an educational agent in teacher role not supported by speech bubble, 3) an educational agent in friend role supported by speech bubble, or 4) an educational agent in friend role not supported by speech bubble. For example, an educational agent in the role of teacher greets "Hello, welcome Ismail Talha", while an educational agent in friend role greets "What's up?, Welcome Ismail Talha". The salutation screen of an educational agent in the teacher role supported by a speech bubble is shown in Figure 1.

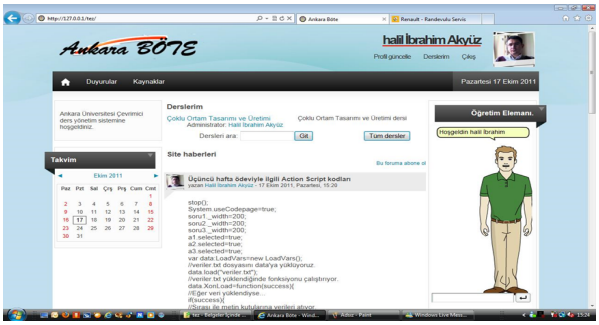

Figure 1. Education agent in teacher role supported by speech bubble

Figure 2 presents the salutation screen of the educational agent in teacher role, not supported by speech bubble. In this page, an educational agent in teacher role presents a salutation message by voice only.

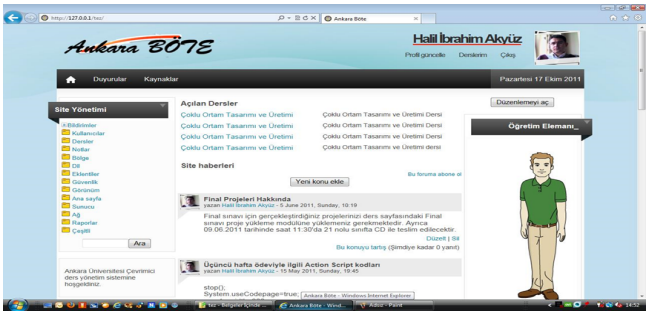

Figure 2. Education agent in teacher role not supported by speech bubble

In all media, students can ask the educational agent questions about daily subjects by typing his question into the text box. The educational agent attempts to answer, looking to the XML data base. When it does not understand the question, it gives evasive replies such as "I have no information about this subject" or "I don't know, either". As it does not give the same replies to

the questions it cannot answer, it is believed that this application creates the feeling of interaction with a real person for the students. To come up with answers to the questions, artificial intelligence sign language (AIML) and AIML XML codes, developed by Topcu, Sen and Amasyalı (2010) and adapted by the researchers are used.

7. Data Collection Tool

In this study, Problem Solving Inventory (PSI) is used to measure the problem solving ability perception of students. PSI was developed by Heppner and Peterson (1982) and thereafter adapted to Turkish by Sahin, Sahin and Heppner (1993). PSI was taken on 244 university students for internal consistency of the scale, developed to evaluate how an individual perceives behaviours and attitudes regarding problem solving. The Cronbach alpha coefficient was found to be 0,88; and reliability coefficient of split half was found to be 0,81. The high point obtained through the scale indicates problem solving perception is low, and the low point indicates problem solving perception is high. Point range of the scale is between 32 and 132. There are a total of 35 clauses in the scale with only three not graded.

The scale adapted to Turkish consists of six factors, they are:

1) hasty approach (13th, 14th, 15th, 17th, 21st, 25th, 26th, 30th ve 32nd clauses, alpha=0,78),

2) thinking approach (18th, 20th, 31st ,33rd ve 35th clauses, alpha=0,76),

3) avoidant approach (1st, 2nd, 3rd, ve 4th clauses, alpha=0,74),

4) evaluator approach (6th, 7th, ve 8th clauses, alpha=0,69),

5) self-confident approach (5th, 23rd, 24th, 27th, 28th ve 34th clauses, alpha=0,64), and

6) planned approach (10th, 12th, 16th ve 19th clauses, alpha=0,59).

Before and after experimental operation, problem solving ability perception points of students were obtained online by PSI.

8. Findings and Discussion

Descriptive statistics of subscale and total points, obtained before experiment through PSI to measure the effect of educational agents on problem solving perceptions according to education agent type in the same medium are given in Table 3.

Table 3. Problem Solving Inventory, averages of pre-test points, standard deviation and normal distribution test results

Scale Sub-dimension	Educational agents	N	Average	SD	Kolm. Sim. Z	P
Hasty Approach	With friend bubble	12	29,41	7,89	0,43	0,99
	With teacher bubble	11	31,09	6,77	0,44	0,98
	Without friend bubble	12	27,33	9,12	0,62	0,82
	Without teacher bubble	12	28,08	8,21	0,48	0,97
Evaluator Approach	With friend bubble	12	7,41	2,42	0,81	0,52
	With teacher bubble	11	8,18	2,67	0,48	0,97
	Without friend bubble	12	8,91	3,80	0,43	0,99

Scale Sub-dimension	Educational agents	N	Average	SD	Kolm. Sim. Z	P
Thinking Approach	Without teacher bubble	12	7,75	3,64	0,48	0,97
	With friend bubble	12	13,50	3,58	0,59	0,87
	With teacher bubble	11	14,63	3,58	0,77	0,58
	Without friend bubble	12	11,58	4,25	0,44	0,99
Self-confident Approach	Without teacher bubble	12	11,83	4,40	0,55	0,91
	With friend bubble	12	16,50	4,64	0,66	0,77
	With teacher bubble	11	17,63	3,26	1,10	0,17
	Without friend bubble	12	15,58	5,77	0,53	0,94
Avoidant Approach	Without teacher bubble	12	16,16	5,00	0,51	0,95
	With friend bubble	12	10,83	2,97	0,63	0,81
	With teacher bubble	11	11,90	4,36	0,42	0,99
	Without friend bubble	12	8,25	3,51	0,53	0,93
Planned Approach	Without teacher bubble	12	11,91	4,98	0,47	0,97
	With friend bubble	12	10,41	3,31	0,63	0,82
	With teacher bubble	11	11,27	3,55	0,46	0,98
	Without friend bubble	12	10,66	4,37	0,51	0,95
Grand Total	Without teacher bubble	12	10,16	4,01	0,42	0,99
	With friend bubble	12	88,08	21,41	0,63	0,81
	With teacher bubble	11	94,72	21,55	0,59	0,87
	Without friend bubble	12	82,33	27,10	0,56	0,91
	Without teacher bubble	12	85,91	27,68	0,52	0,94

According to obtained points through PSI before application in Table 3, average points of students in media where educational agents exist are as follows:

1) hasty approach sub-dimension are between 27,33 and 31,09,

2) evaluator approach sub-dimension, the points are between 7,14 and 8,91,

3) thinking approach sub-dimension, the points are between 11,58 and 14,63,

4) self-confident approach sub-dimension, the points are between 15,58 and 17,63,

5) avoidant approach sub-dimension, the points are between 8,250 and 11,91, and

6) planned approach sub-dimension, the points are between 10,16 and 11,27.

The total, points are between 82,33 and 94,7. When this finding is considered, it is seen that students assigned to different experiment groups have close averages in terms of problem solving ability perception before experimental operations; namely, groups are equal to one another. One-way variance analysis was conducted to show whether sub-dimensions and total points change before experimental operation in terms of points of problem solving ability perception. According to the result of analysis, there is no significant change among groups before experimental operations.

Post-test problem solving inventory sub-dimensions of groups corrected according to pre-test and their corrected point averages are given in Table 4.

Table 4. Post-test Problem Solving Inventory sub-dimensions of groups corrected according to pre-test and point averages of hasty approach sub-dimension

Sub-dimensions	Speech Bubble	The role of educational agent				Total	
		Teacher		Friend			
		N	Corrected average	N	Corrected average	N	Corrected average
Hasty Approach	Exists	11	21,76	12	31,03	23	26,39
	Do not exist	12	22,70	12	31,74	24	27,22
	Total	23	22,23	24	31,38	47	26,81
Evaluator Approach	Exists	11	5,95	12	8,53	23	7,24
	Do not exist	12	5,97	12	8,05	24	7,00
	Total	23	5,96	24	8,29	47	7,12
Thinking Approach	Exists	11	9,52	12	14,42	23	11,98
	Do not exist	12	11,23	12	13,69	24	12,46
	Total	23	10,38	24	14,06	47	12,22
Self-confident Approach	Exists	11	11,05	12	18,98	23	15,02
	Do not exist	12	11,28	12	12,86	24	12,07
	Total	23	11,17	24	15,92	47	13,54
Avoidant Approach	Exists	11	8,11	12	9,58	23	8,84
	Do not exist	12	7,67	12	8,32	24	8,00
	Total	23	7,89	24	8,95	47	8,42
Planned Approach	Exists	11	7,29	12	11,75	23	9,52
	Do not exist	12	8,68	12	10,65	24	9,66
	Total	23	7,98	24	11,2	47	9,59
Problem Solving Ability Perception	Exists	11	63,26	12	92,12	23	78,69
	Do not exist	12	67,23	12	86,16	24	76,70
	Total	23	65,25	24	90,14	47	77,69

When Table 4 is examined, it is seen that point averages of an educational agent in teacher role, corrected according to pre-test, is lower than that of an educational agent in friend role,

and average points of educational agents, not supported by speech bubble, are lower than that of educational agents supported by speech bubbles.

In order to test for a significant difference among the points of post-test hasty approach, thinking approach, avoidant approach, evaluator approach, self-confident approach and total problem solving ability perception after experimental operation, meaningfulness of the difference among point averages of post-test problem solving ability perception corrected according to pre-test was examined, and results of two factor covariance analysis (two factor ANCOVA), conducted with this aim, is presented below. The results of two factor covariance analysis in order to determine from which factor arises the difference among point averages of Problem Solving Inventory sub-dimension of groups are shown in Table 5.

Table 5. The results of two factor covariance analysis of Problem Solving Ability perception points according to sub-dimensions

Sub-dimension	Source of Variation	Sum of Squares	sd	Mean Squares	F	p	Eta Kare
Hasty Approach	Hasty Approach(Pretest)	9,21	1	9,21	0,39	0,53	0,00
	Form(Main Effect)	7,82	1	7,82	0,33	0,56	0,00
	Role(Main Effect)	977,19	1	977,19	42,34	0,00	0,50
	Form*Role(Common Effect)	0,15	1	0,15	0,00	0,93	0,00
	Error	969,24	42	23,07			
	Total	36031,00	47				
Evaluator Approach	Evaluator Approach (Pretest)	83,16	1	83,16	10,99	0,00	0,20
	Form(Main Effect)	0,62	1	0,62	0,08	0,77	0,00
	Role(Main Effect)	63,60	1	63,60	8,41	0,00	0,16
	Form*Role(Common Effect)	0,73	1	0,73	0,09	0,75	0,00
	Error	317,66	42	7,56			
	Total	2872,00	47				
Thinking Approach	Thinking Approach (Pretest)	153,77	1	153,77	5,62	0,02	0,11
	Form(Main Effect)	2,47	1	2,47	0,09	0,76	0,00
	Role(Main Effect)	158,36	1	158,36	5,79	0,02	0,12
	Form*Role(Common Effect)	17,89	1	17,89	0,65	0,42	0,01
	Error	1148,19	42	27,33			
	Total	8535,00	47				
Self-Confident Approach	Self confident(Pretest)	168,26	1	168,26	9,38	0,00	0,18
	Form(Main Effect)	100,17	1	100,17	5,58	0,02	0,11
	Role(Main Effect)	262,32	1	262,32	14,62	0,00	0,25
	Form*Role(Common Effect)	118,15	1	118,15	6,58	0,01	0,13
	Error	753,12	42	17,93			
	Total	10091,00	47				
Avoidant Approach	Avoidant Approach (Pretest)	2,85	1	2,85	0,23	0,62	0,00
	Form(Main Effect)	8,09	1	8,09	0,67	0,41	0,01
	Role(Main Effect)	12,06	1	12,06	1,00	0,32	0,02
	Form*Role(Common Effect)	1,91	1	1,91	0,15	0,69	0,00
	Error	505,61	42	12,03			
	Total	3868,00	47				
Planned Approach	Planned Approach(Pretest)	100,49	1	100,49	6,71	0,01	0,13
	Form(Main Effect)	0,25	1	0,25	0,01	0,89	0,00
	Role(Main Effect)	121,18	1	121,18	8,09	0,00	0,16
	Form*Role(Common Effect)	18,08	1	18,08	1,20	0,27	0,02

	Error	628,56	42	14,96			
	Total	5221,00	47				
Problem Solving Inventory Total	Total (Pretest)	2105,02	1	2105,02	10,12	0,00	0,19
	Form(Main Effect)	45,37	1	45,37	0,21	0,64	0,00
	Role(Main Effect)	7188,40	1	7188,40	34,57	0,00	0,45
	Form*Role(Common Effect)	416,90	1	416,90	2,00	0,16	0,04
	Error	8732,32	42	207,91			
	Total	303788,00	47				

When Table 5 is examined, a significant difference is noted among corrected average points of hasty approach sub-dimension of PSI of these two groups [F(1,42)=42,34, p<0,05]. In another words, in hasty approach sub-dimension, there is an important difference in problem solving perceptions of students in medium of an educational agent in the teacher role, in comparison to students in medium of an educational agent in the friend role. This finding shows that the role of educational agent is an important factor for problem solving perception's hasty approach sub-dimension. Thus, it can be said that the educational agent in the role of teacher is more successful than the role of friend in problem solving perception hasty approach sub-dimension. It is seen that PSI's hasty approach points do not show a difference according to whether it is supported by speech bubbles or not [F(1,42)=0,33, p>0,05]. In this sub-dimension, it is seen that speech bubble has no effect on problem solving ability perception. It is found that common effect of the role and form of the educational agent is not meaningful [F(1,42)=0,00, p>0,05]. In other words, role factor has no effect together with form factor on average points of students, having lessons with the educational agent in teacher and friend role, in PSI's hasty approach sub-dimension.

Table 6. The results of two factor covariance analysis of Problem Solving Ability Perception Points according to sub-dimensons

Sub-dimension Boyutlar	Source of Variance Kaynagı	Sum of Squares Toplamı	sd	Mean Squares Ortalaması	F	p	Eta Kare
Hasty Approach	Hasty Approach(Pretest)	9,21	1	9,21	0,39	0,53	0,00
	Form(Main Effect)	7,82	1	7,82	0,33	0,56	0,00
	Roe(Main Effect)	977,19	1	977,19	42,34	0,00	0,50
	Form*Role(Common Effect)	0,15	1	0,15	0,00	0,93	0,00
	Error	969,24	42	23,07			
	Total	36031,00	47				
Evaluator Approach	Evaluator Approach (Prestest)	83,16	1	83,16	10,99	0,00	0,20
	Form(Main Effect)	0,62	1	0,62	0,08	0,77	0,00
	Role(Main Effect)	63,60	1	63,60	8,41	0,00	0,16
	Form * Rol e(Common Effect)	0,73	1	0,73	0,09	0,75	0,00
	Error	317,66	42	7,56			
	Total	2872,00	47				
Thinking Approach	Thinking Approach (Pretest)	153,77	1	153,77	5,62	0,02	0,11
	Form(Main Effect)	2,47	1	2,47	0,09	0,76	0,00
	Role(Main Effect)	158,36	1	158,36	5,79	0,02	0,12
	Form * Rol e(Common Effect)	17,89	1	17,89	0,65	0,42	0,01
	Error	1148,19	42	27,33			
	Total	8535,00	47				
Self Confident Approach	Self condifent	168,26	1	168,26	9,38	0,00	0,18
	Form(Main Effect)	100,17	1	100,17	5,58	0,02	0,11
	Role(Main Effect)	262,32	1	262,32	14,62	0,00	0,25
	Form * Rol e(Common Effect)	118,15	1	118,15	6,58	0,01	0,13

	Error	753,12	42	17,93			
	Total	10091,00	47				
	Avoidant Approach (Pretest)	2,85	1	2,85	0,23	0,62	0,00
	Form(Main Effect)	8,09	1	8,09	0,67	0,41	0,01
Avoidant	Role(Main Effect)	12,06	1	12,06	1,00	0,32	0,02
Approach	Form * Role(Common Effect)	1,91	1	1,91	0,15	0,69	0,00
	Error	505,61	42	12,03			
	Total	3868,00	47				
	Planned Appoach	100,49	1	100,49	6,71	0,01	0,13
	Form(Main Effect)	0,25	1	0,25	0,01	0,89	0,00
Planned	Role(Main Effect)	121,18	1	121,18	8,09	0,00	0,16
Approach	Form * Rol e(Common Effect)	18,08	1	18,08	1,20	0,27	0,02
	Error	628,56	42	14,96			
	Total	5221,00	47				
	Toplam (Pretest)	2105,02	1	2105,02	10,12	0,00	0,19
Problem	Form(Main Effect)	45,37	1	45,37	0,21	0,64	0,00
Solving	Role(Main Effect)	7188,40	1	7188,40	34,57	0,00	0,45
Inventory	Form * Rol e(Common Effect)	416,90	1	416,90	2,00	0,16	0,04
Total	Error	8732,32	42	207,91			
	Total	303788,00	47				

In Table 6, it is seen that the difference among average points in evaluator approach's sub-dimension, according to the role of educational agent, is significant [F(1-42)=8,41, p<0,05]. In other words, the difference among evaluator approach's sub-dimensions arises from the role of educational agent, namely, the role of educational agent leads to the difference in this sub-dimension. It is seen that form factor, namely whether the educational agent is supported by speech bubble, doesn't lead to any meaningful difference among average points in this sub-dimension [F(1-42)=0,08, p>0,05]. Again, the role and form (whether the agent is supported by speech bubble or not) of educational agent have no common meaningful effect on average points of students in this sub-dimension [F(1-42)=0,09, p>0,05].

The difference among average points obtained by these two groups after experiment in terms of role through thinking approach sub-dimension of PSI is found to be meaningful [F(1-42)=5,79, p<0,05]. It is seen that form characteristics (whether educational agent is supported by speech bubble or not) of the educational agent has no statistical importance [F(1-42)=0,09, p>0,05]. Also, the role and form of the educational agent has no common meaningful effect in the thinking approach sub-dimension [F(1-42)=0,65, p>0,05].

When examining the results of two factor covariance analysis, obtained through PSI and conducted to determine which factor is effective in terms of obtained total point averages, it is seen that the main effect of the educational agent role is statistically important. [F(1-42)=34,57, p<0,05].

According to Table 6, the difference between average points of students in medium supported by speech bubble (=78,69) and average points of students in medium not supported by speech bubble (=76,70) is not meaningful [F(1-43)=0,21, p>0,05]. In addition, the common effect of the role and form of the educational agent on total points obtained through PSI, is not found to be significant [F(1-43)=2,00, p>0,05].

9. Conclusion and Recommendations

In the light of these findings, it is seen that role factor has an important effect on hasty approach, evaluator approach, thinking approach, and planned approach sub-dimensions of problem solving perception after experimentation and total problem solving inventory points. It is found that the reason for the difference in groups, in terms of above stated sub-dimensions, is the role of the educational agent. It has been determined that the role and form specialties of the educational agent have no meaningful effect, except in the avoidant approach sub-

dimension. It can be said that the role of the educational agent in the self-confident approach's sub-dimension has a meaningful effect on form specialties of the educational agent and interaction of role and form characteristics of the educational agent. In general, it is determined that the role of the educational agent, used in online task based learning medium, has an effect on problem solving ability perception. Also, it can be said that the educational agent in the role of teacher is more successful in problem solving ability perception than the educational agent in the role of friend.

In online task based learning medium, problem solving ability perceptions of students may be increased by using the educational agent in the role of teacher. The fact that the educational agent used in online task based learning medium is supported only by voice, which is more effective in terms of cognitive loading, indicates that educational agents used should not be supported by speech bubble combined with voice.

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