3-DIMENSONAL AND INTERACTIVE ISTANBUL UNIVERSITY VIRTUAL LABORATORY BASED ON ACTIVE LEARNING METHODS

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ABSTRACT
The purpose of this study is to develop a 3-dimensional interactive multi-user and multi-admin IUVIRLAB featuring active learning methods and techniques for university students and to introduce the Virtual Laboratory of Istanbul University and to show effects of IUVIRLAB on students'attitudes on comminucation skills and IUVIRLAB. Although there are many computer simulations and virtual laboratory applications, the model introduced in this study has a uniquecharacteristics in terms of being a 3-dimensional, interactive virtual laboratory that enables students to learn in cooperative groups, and is the first in its kind due to its qualities of enabling multi-admin. and multi-user operation, having a special software compatible to run on ipad, iphone,

android and smart phone platforms, and having been designed on the basis of active learning approaches. A survey was used in order to determine the views of students about and students stated quite positive views about IUVIRLAB implementation.

Keywords: active and collaborative learning, new communication technologies, innovation, education, e-learning

1. INTRODUCTION

In terms of rendering education and teaching more meaningful and lasting, a wide variety of teaching materials are utilized for emphasizing on the fundamental points of topics, and keeping students' interest, attention and eagerness for learning high. Within the education process, the necessity of presenting information through various means gives providence to the utilization of new information technologies instead of the conventional educational tools and materials (Isman, Kaput, 1991). The primaries of these are the materials prepared with the aid of computers. Because computers are capable of saving, processing and displaying a great number of information. Furthermore, the capability of computers to present information in visual, audial forms and through interactive means creates a great potential for education (Ornstein and Lasley, 2004). Effective use of computers within the educational process increases the quality level of educational materials.

Virtual laboratory programs are defined as programs that are adapted according to the students' and teachers' needs, and that integrate modeling, simulation and information technologies in order to create an environment of high interaction. In addition to this definition, virtual laboratory programs are also defined as highly interactive and educational computer tools that include multimedia, audio, images and videos and that run according to a certain logical sequence and within mathematics rules (Guzzi, 2005). According to another definition, virtual laboratories are environments developed to provide students with the means to access experiments at the desired place and time, and to make education with mobile tools possible (Alkouz et al., 2008). Yet another definition describes virtual laboratories as interactive learning environments that utilize computer technologies, simulations and various learning technologies in order to carry the face-to-face laboratory activities into the digital medium (Scheckler, 2003). On the other hand Prieto-Blázquez et al. (2009), who set forth a new definition by examining and synthesizing several conducted studies, defined virtual laboratories as interactive virtual learning environments that are adapted according to students' and teachers' needs and that embody all pedagogical, technological and human-specific resources in order to perform applied experiments. These programs also include a software system, Simulator and smart teaching systems (Scherp, 2002). Virtual laboratories are simulations of real laboratories. Their most prominent feature is a highly interactive user interface. In a virtual laboratory program, the user can move objects, use laboratory equipment and carry out experiments by using mouse and keyboard. In short, virtual laboratories can be described as simulation-based multimedia (Scherp, 2002). Jeschke (2001) reported the characteristic features of a virtual laboratory as being virtual, complex, flexible, structuralist, an experimental approach to intangible objects, trial-error approach, 7/24 accessibility and reliability. Examining these characteristic features shows that these programs can be used in creating the ideal environments that will help learning and teaching. The criteria required to be included by a virtual laboratory in order to realize all these characteristic features are reported as follows:

- Criteria concerning the menus, icons and links used in simulation programs,
- Criteria concerning the text format included by simulation programs,
- Criteria concerning the instruction and help functions used in simulation programs,
- Criteria concerning the audio and visual narration used in simulation programs,
- Criteria concerning the colors and visual elements used in simulation programs,
- Criteria concerning the design of the animations used in simulation programs, and
- Criteria concerning the design used in presenting the results obtained from simulation programs (Nikoukaran, 1998; Serra, 1999).

On top of these, Jensen (2004) also added the criteria of drag-moving objects, orientating by selecting models and pressing on control panels, rotating models, playing animations as desired, text panels, communicating through audio and video, and viewing presentations at all times and as many times as desired through a virtual projector.

While the short-term objective of virtual laboratory programs is to provide a supplementary method for real laboratories, their long-term purpose is described as to actually replacing real laboratories (Jeschke, 2001). In addition, virtual laboratory programs are also in demand in cases where complex, expensive, difficult, labored and hard to comprehend technical experiments are to be carried out (Scherp, 2002). Being a necessity in education also in pedagogic terms, virtual laboratory environments enhance students' problem solving skills,

support investigative learning scenarios, adapt to individual learning methods, support supplementary learning scenarios, demonstrate the effects of other areas through applications, increase students' motivation and encourage teamwork (Jeschke, 2001).

In addition to these, virtual laboratory environments provide 7/24 accessibility by removing the barriers of time and location, do not require learners to be gathered in a physical location, bring along cost saving, enable high levels of interaction, enhance learners' motivation and eagerness to learn, provide safe experiment and monitoring opportunities and allow life-long learning (Yang, 2003; Leung, 2001; Kolokotronis, 2003; Nikoukaran, 1998; Sung and Hwang, 2013).

Virtual laboratory programs have not become widespread as much as they were intended to be due to the limited number of producer and software developer companies, the difficulty and time consumption of the production process and the high cost of software (Jensen, 2004). Also the physical conditions (hardware, supplementary software, etc.) that are necessary for using virtual laboratory programs in a correct and fit for the purpose way need to be met. It is reported particularly for internet-based virtual laboratories that, users' motivation levels tend to fall due to long waiting durations caused by slow network connections (Bowman, 2002). Due to all these reasons, teachers who plan to carry out courses through virtual laboratories have to consider the possible problems concerning technical inadequacies, lack of face-to-face communication and the consequent falls in students' motivations, and have to take the necessary measures (Jensen, 2004).

The studies conducted in the recent years indicate that the active learning applications carried out in learning centers enhance students' interest, attitude and motivation concerning the course as well as the success of learning, and also make positive contribution to the development of students' social qualities (Linder, 1993; Marioni, 1989; Wandersee, Mintes and Novak, 1994). Active learning is a learning process where the learner bears the responsibility of the process, is provided with the opportunities of making decisions and self-regulation concerning various aspects of the process and is pushed to utilize its mental abilities through complex educational tasks during learning (Acikgoz, 2003). Theoretical bases of active learning rest on constructivism and its variant in the field of learning, cognitivism (Acikgoz, 2003). According to cognitivism, the student adds what is newly seen or heard on top of those that are already known. By organizing and categorizing information the student develops, tests and interprets hypothesis, in a sense structures knowledge (Acikgoz, 2003). As it can be understood from this, constructivism and cognitivism address the learning process rather than the teaching process, and set forth various related explanations and suggestions.   Active learning emerged as a consequence of some researchers concerning what students should do in order to be able to structure knowledge. In terms of information processing, constructivism establishes the basis of active learning.

As one of the orientations concerning active learning, cooperation-based learning has a substantial part in active learning model. That is because cooperation-based learning enables the implementation of many principles of active learning. In education through cooperation-based learning, the teacher aims to have the student be aware not only of itself, but also of the other students. At this stage students learn to share, wait for their turn and care about others. Through structured activities, they learn about how others think in cooperation, react to problems and develop their spoken language skills in small groups. It is set forth that, in terms of academic success, cooperation-based learning produces more positive results for all groups of age in comparison with both competitive and individual learning methods (Demirel, 1996). Basic characteristics of cooperation-based learning require group members to be aware of that the group is a whole and that every member has responsibility in terms of the success of the group. Since in addition to student-teacher interaction also student-student interaction is included in this learning approach, a higher level of learning takes place. Cooperation based learning minimizes students stress by creating an environment where they can feel safer and more confident. It makes it possible to individualize education. It enables individuals to attain the behavior of solving all challenges together. It contributes to the development of students' critical thinking, problem solving and creativity skills. Enables the teacher to consult students in a more effective and productive way (Demirel, 1996; Grabinger, 1996).

Istanbul University Virtual Laboratory (IUVIRLAB); has a unique characteristic and is a first in its kind in terms of being a 3-dimensional, interactive laboratory that will enable students to learn in cooperative groups. By means of its multi-user and internet-accessible nature, the produced virtual laboratory has a diffirenst innovative approach to present e-learning techniques since whics is designed in a way suitable for the use of all active learning approaches that can be carried out with cooperative groups (Barkley, 2005).

2. PURPOSE

The purpose of this study is to develop a 3-dimensional interactive multi-user and multi-admin virtual laboratory featuring active learning methods and techniques for university students and to introduce the Istanbul IUVIRLAB concerning the topics of Magnetic Field and Magnetism. In practice, it is estimated that this virtual laboratory will increase students' success levels, enable them to correctly structure concepts and enhance their critical thinking and problem solving skills, as well as their capability to associate physics with their daily lives. Although there are many computer simulations and virtual laboratory applications that have been implemented in the area of physics today, the present study has a unique characteristic and is the first of its kind in terms of being a 3-dimensional, interactive virtual physics laboratory that will enable students to learn in cooperative groups.

The active learning approaches on which the study is based are problem-based learning in cooperative groups, cooperative learning, project-based learning, inquiry-based learning, research-based learning, learning through invention. As known, such instructions based on cooperative learning groups that minimizes the occurrence of those unpleasant situations and maximizes the learning and satisfaction that result from working on a high-performance team.By means of its multi-user and internet-accessible nature, the virtual physics laboratory produced was designed in a way suitable for the use of all active learning approaches that can be carried out with cooperative groups (Barkley 2005).

3. STRUCTURE OF IUVIRLAB:

In this section, the structure and functions of the virtual physics laboratory will be presented.

3.1. Administrator Panel:

In this study, the system has a single master-admin. Fig. 1 shows that master-admin. panel and its parts such that the master-admin can define (add/delete/edit) multi-admin information.

Fig.1: A screenshot from Master-Admin control panel. In this panel, admin can add/delete/edit multi-admin, see results for each of periods.
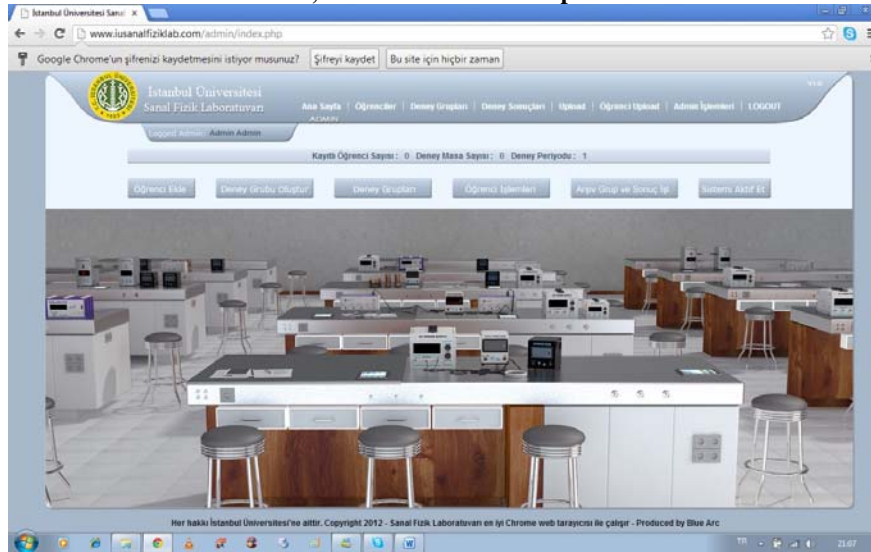

With multiple applications, multiple administrators can be defined for enabling different departments of universities or schools to conduct laboratory studies. The editing multi-admin. panel is shown in Fig.2 in detail.

Fig.2: Multi-admin identification page on the Master-Admin control panel. Master-admin can determine mutli-admin using by his/her information.
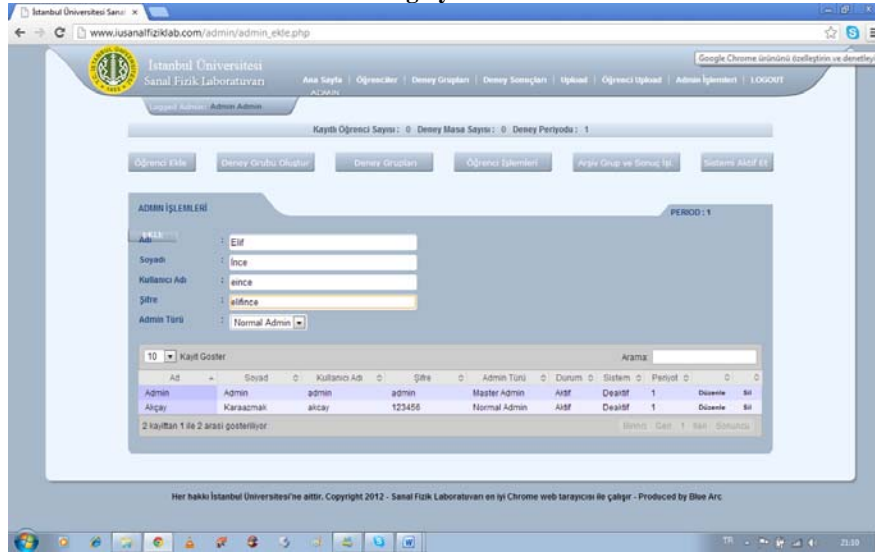
Each multi-admin can add/delete/edit students' information, define a username and password for each student, select group members and group's experiment at the beginning of periods, see the results of the groups, activate the system. A multi admin control panel screenshot is shown in Fig. 3.

Fig. 3: A screenshot of Multi-admin control panel in detailed
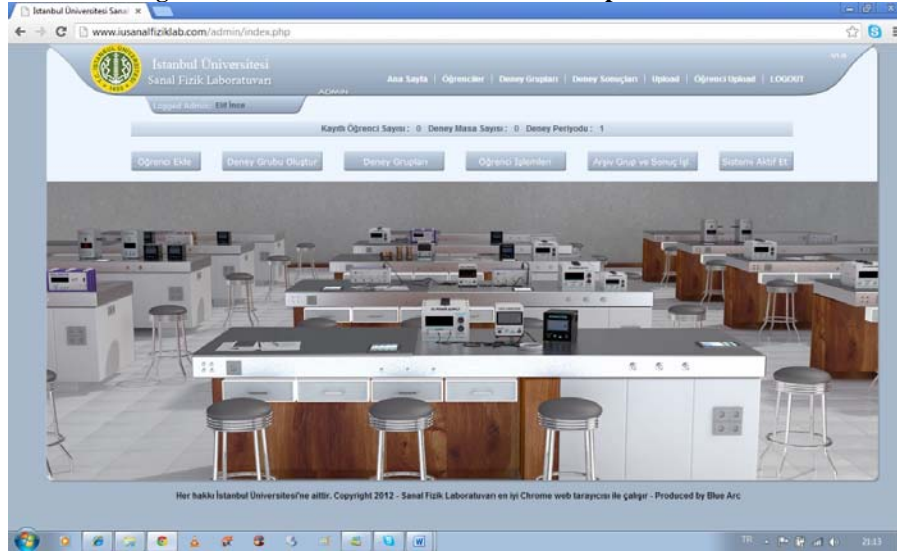
The tasks to be performed by the multi-admin in order to render the system operable are listed below step by step:

- With the defined username and password, the multi-admin logs into the http://www.iusanalfiziklab.com/admin/ website and adds users (students) and the information pertaining to the students into the database. The multi-admin's user (student) identification page is shown in Fig.4. The multi-admin can add students to the database including the students' number, name-surname, university, division, class, semester and year information.

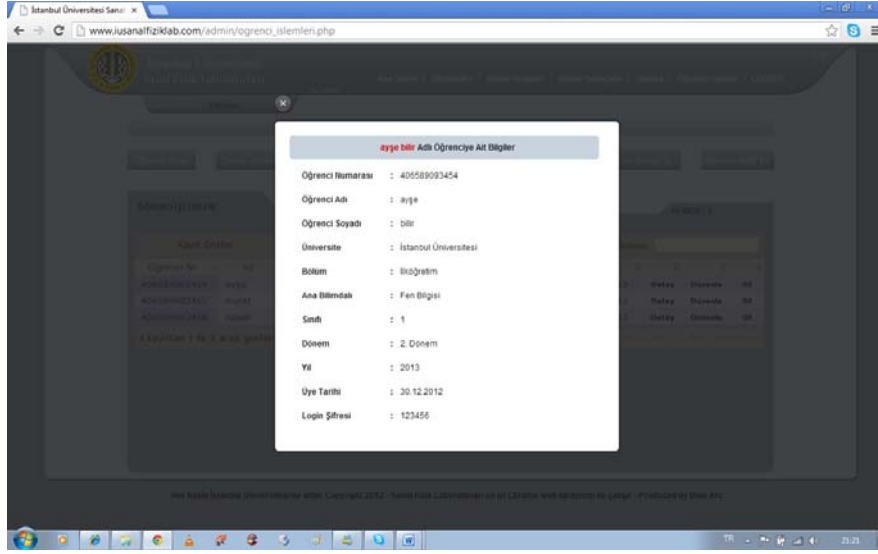**Fig. 4: A screenshot of Multi-admin's user (student) identification page.**
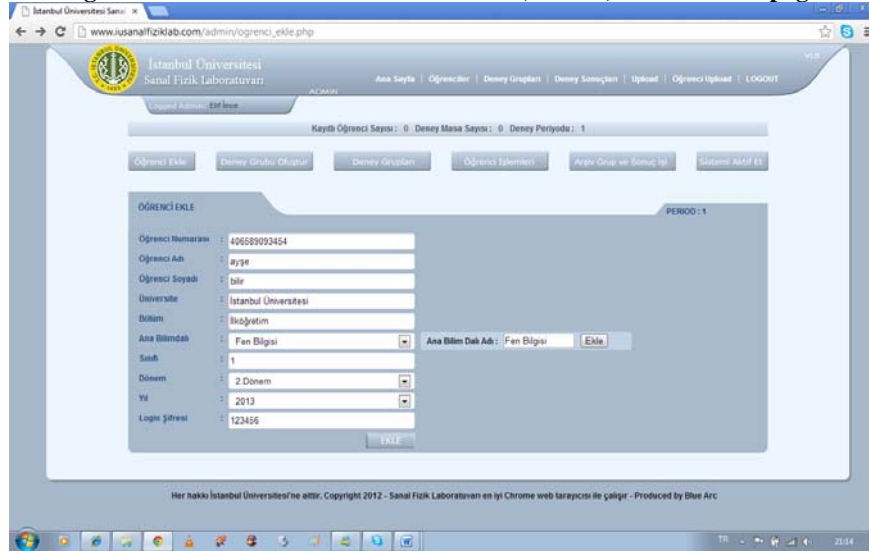
- Student information can be changed at all times. The page where the multi-admin regulates the changes in user (student) information is presented in Fig.5-1 and Fig.5-2, respectively.

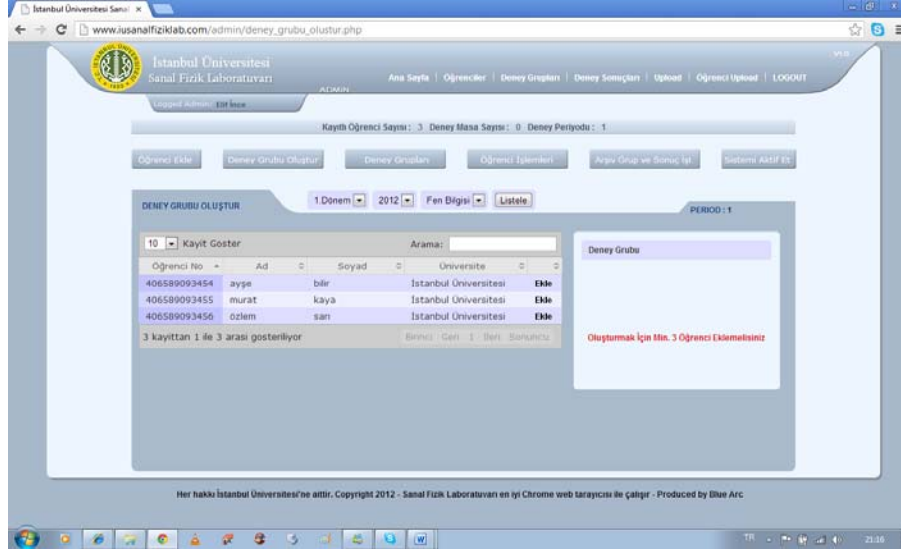**Fig.5-1: A screenshot of the page where multi-admin regulates the changes in user (student) information.**
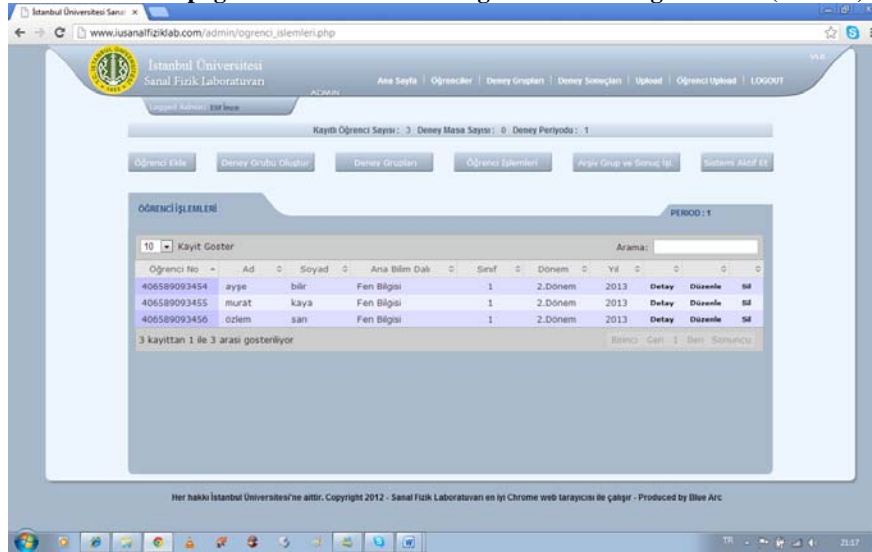
Fig. 5-2: A screenshot of the page where multi-admin regulates the changes in user (student) information in detailed.


- After students are added, the multi-admin adds the experiment to be carried out and the group of each student to the user table and creates the experiment groups. These steps can be seen in Fig.6-1, Fig.6-2 and Fig.6-3, respectively.
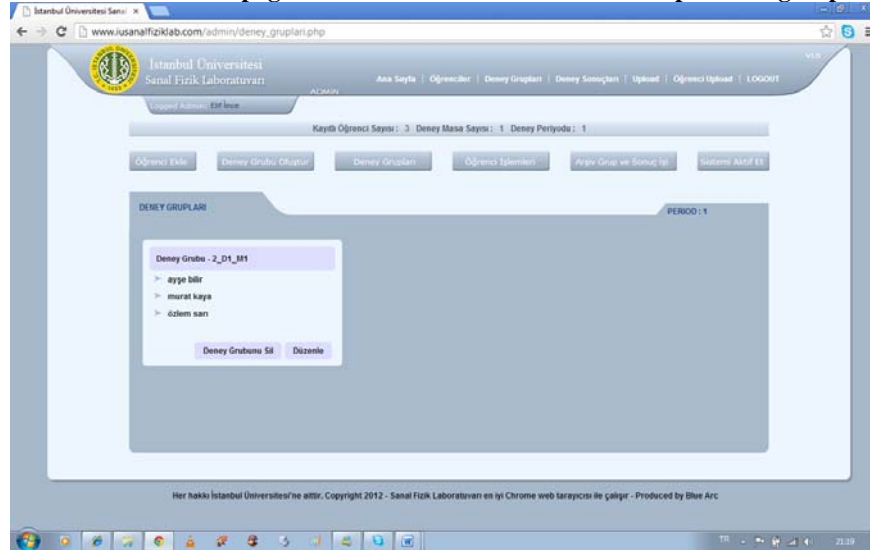
Fig. 6-1: A screenshot of the page from where multi-admin enters students into experiment groups

Fig. 6-2: A screenshot of the page from where multi-admin enters /edits students into experiment groups
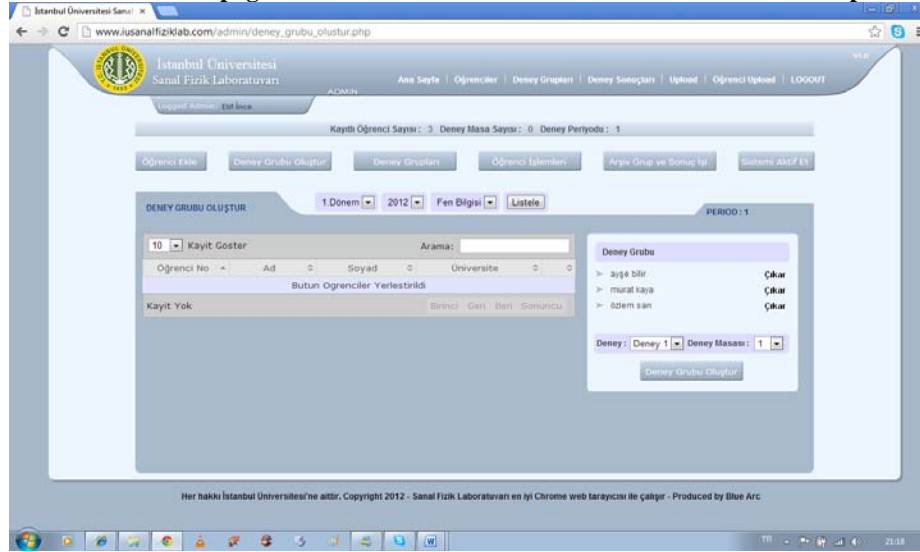
Fig. 6-3: A screenshot of the page from where multi-admin can see experiment group members.

- After the multi-admin activates the system, all users can login to the related experiment directly,
- At the end of the first experiment period, the admin deactivates the system and any user that logs in after this sees the message "Laboratory is closed".
- When the multi-admin decides to initiate the next experiment period, he or she clicks on the "next period" button and the system automatically appoints an experiment group and experiment to all users.
- After the experiment is completed, the multi-admin can monitor experiment results from the experiment table view as shown in Fig.7 below.
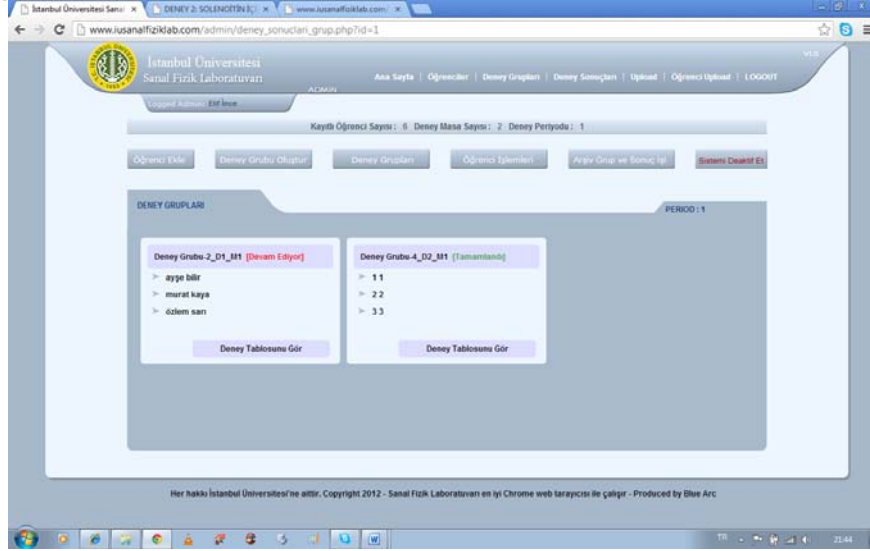
Fig. 7: A screenshot of the experiment results page the multi-admin can review.


- For each user, the system saves experiment tables in the database. A screenshot of the panel from where the results of experiment groups are saved is presented in Fig.8.

Fig. 8: A screenshot of the panel from where the results of experiment groups are saved

- The multi-admin can assign homework to users concerning the experiments realized and perform measurement-evaluation. For this purpose an upload-download section is included in the system. From here, the multi-admin can upload new homework and download finished assignments. The measurement-evaluation page is presented in Fig.9.

Fig.9: A screenshot of the upload page from where multi-admin can assign homework for measurement-evaluation purposes
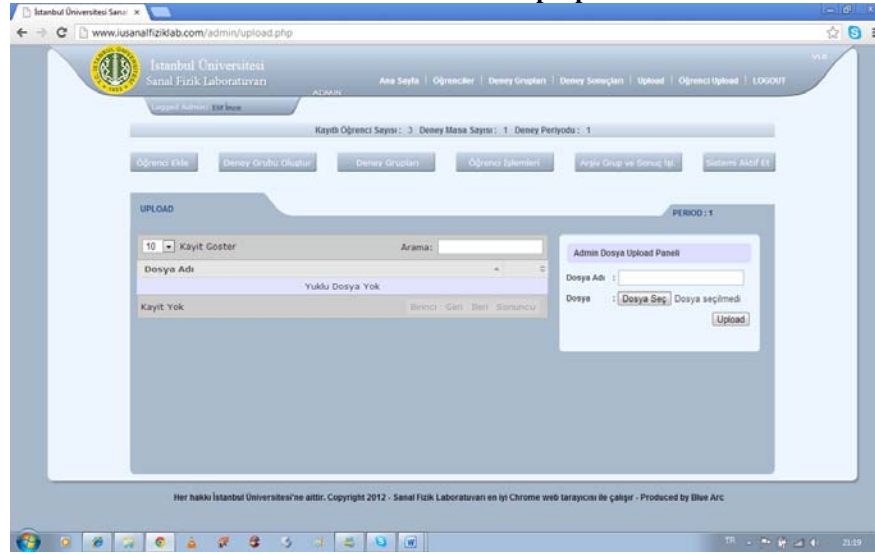

3.2. User (Student) Panel:

The multi-admin introduces the users, i.e. the students in this application, to the system by entering their names, student identification numbers, university, department, grade, semester and password information. With the username and password provided by the multi-admin., only users can access to the system. When users login, the experiments they will carry out and the other users they will carry out the experiment with are all defined. The information necessary for each user are as follows:

- With the usernames and passwords assigned by the multi-admin., students login to the system from the address http://www.iusanalfiziklab.com/. Information concerning the laboratory, experiments, how the laboratory is to be used and the experiment groups are provided in the user page.

- In order to initiate any experiment, the minimum number of users defined for each experiment needs to be logged in. A minimum of 3 users is required for each experiment, while the maximum number of users is 4. Information concerning the experiments (which students form a group and which experiments are to be made) is shown in the Details section. In this way, students are enabled to conduct the experiment while communicating and discussing through Skype for collaborative learning. Students see a "Connect via Skype" notice when they login to the system for the first time as shown in Fig.10.

Fig.10: A screenshot of the page students see when they login to the system for the first time
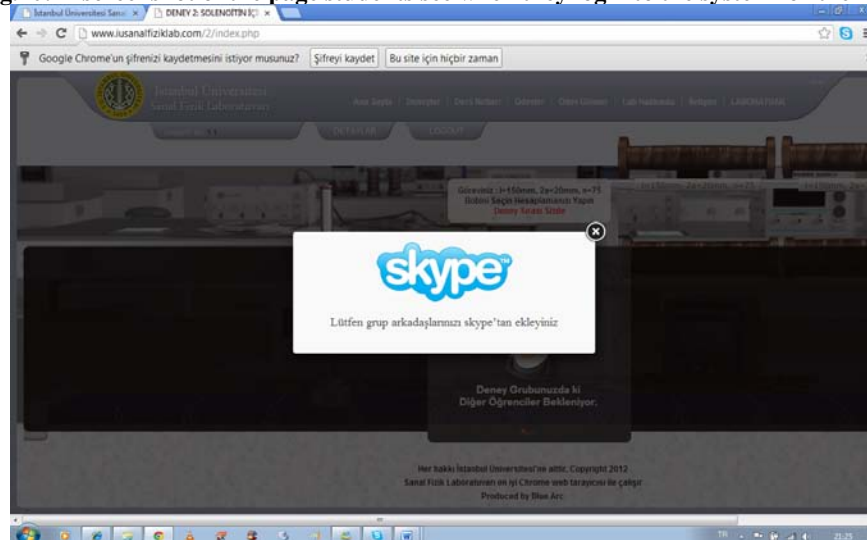
- Students also access group members' information from the "Details" section as shown in Fig.11.

Fig. 11: The screen accessed from the "Details" section and from where students reach information on their group friends
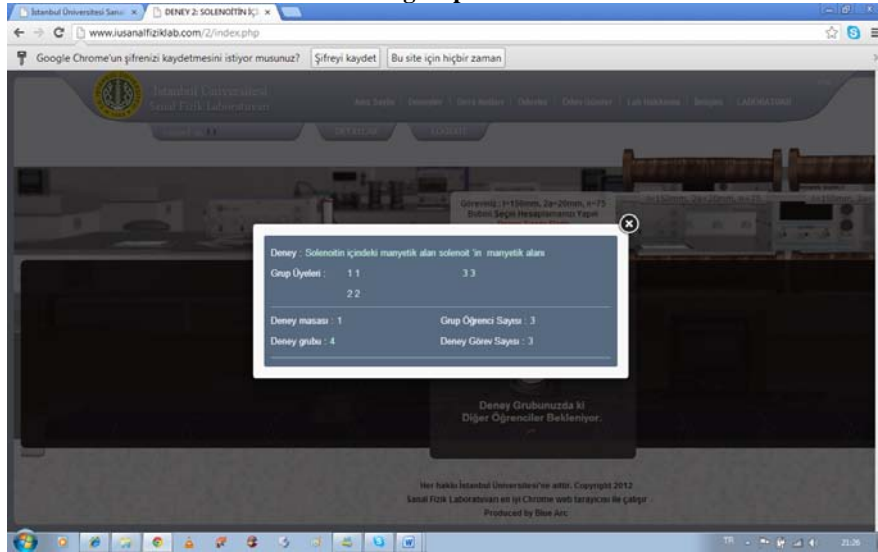
- After a minimum of 3 users are connected to the experiment in question, the system assigns a task for each user. There are at least 3 tasks for each experiment. In the case where 4 users connect to an experiment of 3 tasks, the fourth user can be the "observer". They solely observe the experiment. If there are 4 tasks defined but only 3 users connected, then the first user will perform 2 tasks.

- The task command on the screen of each user is different. During the experiment, the system notifies each user concerning the tasks they need to perform. While a user performs a task, he or she observes all changes in the laboratory such as advancing and value increasing and the experiment table of the group. These screens are demonstrated in Fig.12-1, Fig.12-2 and Fig.12-3, respectively.

Fig.12-1: A screenshot of the screen the 1st student sees while performing his or her task during the experiment

Fig.12-2: A screenshot of the screen the 2nd student sees while the 1st student is performing his or her task during the experiment

Fig.12-3: A screenshot of the experiment table of the group that has just completed the experiment
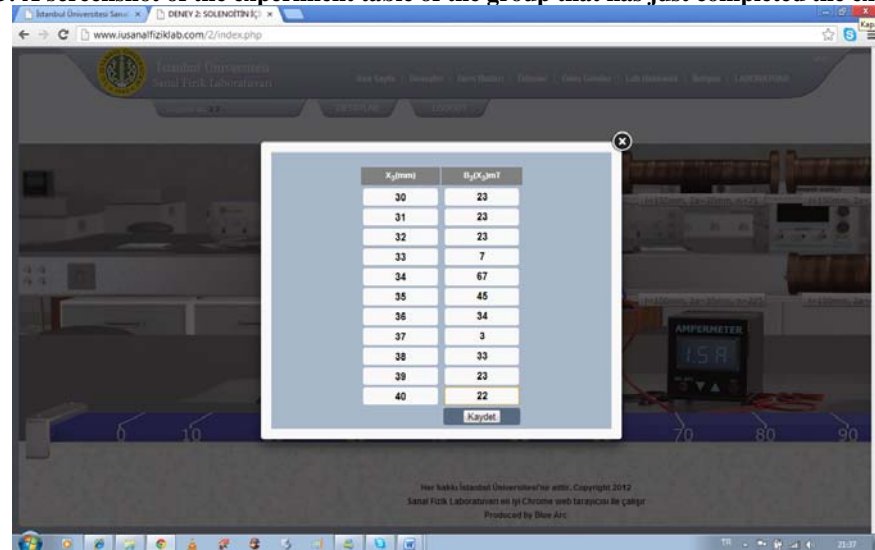

- Users can view all information, details and formulas concerning the experiment by opening the experiment guide in the "experiments" section in his or her own page as shown in Fig.13.

Fig.13: A screenshot of the students' experiment guides

- The multi-admin can assign homework to users concerning the experiments realized and perform measurement-evaluation in terms of active learning approaches. For this purpose, an upload-download section is included in the system. From here, the multi-admin can upload new homework and download finished assignments. A measurement-evaluation page for students was presented in Fig.14.

Fig.14: A screenshot of the screen from where students' upload the homework assigned by multi-admin.
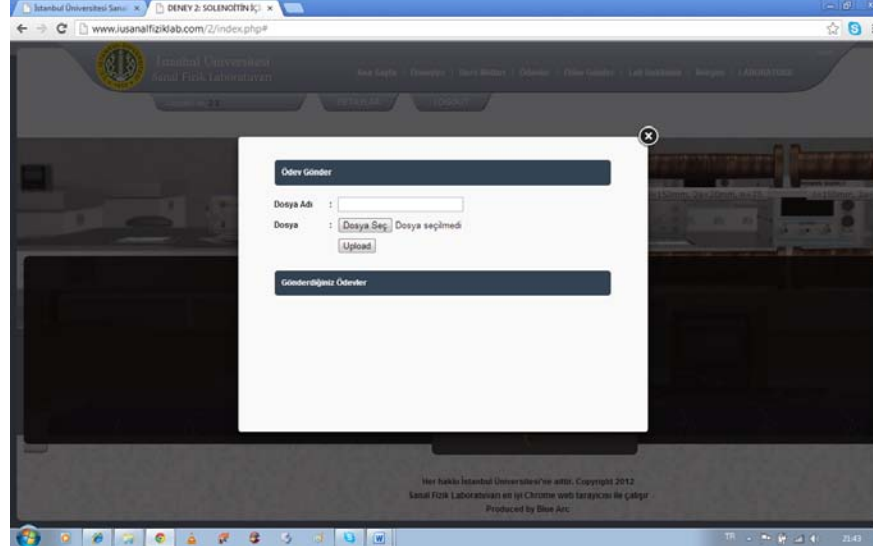
- In case one or more users go offline during the experiment, the message "waiting for other users" is displayed and the experiment resumes when all users are online again.
- After the group completes an experiment, it cannot do anything related to that particular experiment before the admin allows for the next period. In this case, users see the "experiment completed, view experiment table" message and can only see the experiment result table when logged in. The experiment result table can be seen by students for their own group as demonstrated in Fig.15.

Fig.15: A screenshot of the experiment result table the students see after the evaluation concerning their own group.

- The user (students) panel also includes information onscreen concerning how the students should use the laboratory as shown in Fig.16.

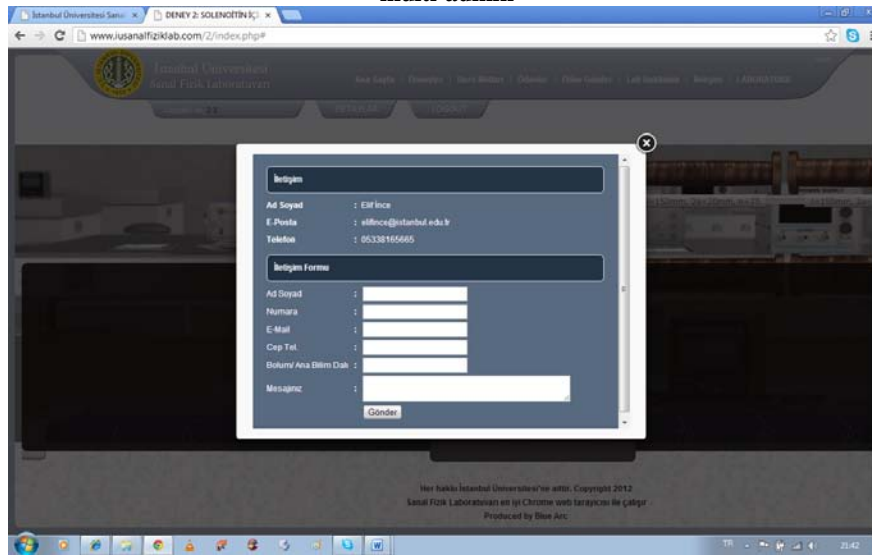**Fig.16: A screenshot of the information screen concerning how the students should use the laboratory**

- A communication page, for cases where students need to communicate with multi-admin., was constructed in the user panel and can be seen in Fig.17.

Fig. 17: A screenshot of the communication page used in case that students need to communicate with multi-admin

3.3. Structure of The System:

In this study, the tasks performed by the system are as follows:

- The Master-Admin. Enters the user name and password information of the multi-admin to the database.
- Each multi-admin enters student information, usernames and passwords to the database.
- When the system is activated by the multi-admin, all users can login to the related experiments.
- At the end of the first experiment's period, the multi-admin deactivates the system and any user that logs in after this sees the message "Laboratory is closed".
- When admin decides to initiate the next experiment period, he or she clicks on the "create the groups for the next experiment" button and the system automatically assigns the groups and experiments of all users (names of experiments change without changing experiment tables; for instance experiment 1 - table 1 becomes experiment 2 - table 1 in the next experiment).
- In order to initiate any experiment, the minimum number of users defined for each experiment needs to be logged in. A minimum of 3 users is required for each experiment, while the maximum number of users is 4.
- After a minimum of 3 users are connected to the experiment in question, the system assigns a task for each user. There are at least 3 tasks for each experiment. In cases where 4 users connect to an experiment of 3 tasks, the fourth user can be the "observer". In cases where 4 users connect to an experiment of 3 tasks, the fourth user can be the "observer". They solely observe the experiment. If there are 4 tasks defined but only 3 users connected, then the first user will perform 2 tasks.
- The task command on the screen of each user is different. During the experiment, the system notifies each user concerning the tasks they need to perform.
- In case one or more users go offline during the experiment, the message "waiting for other users" is displayed and the experiment resumes when all users are online again.
- Multi-admin can assign homework to users concerning the experiments realized and perform measurement-evaluation. For this purpose, an upload-download section is included in the system. From here, the multi-admin can upload new homework and download the finished assignments.
- The system stores all experiment tables in the database.
- After the group completes an experiment, it cannot do anything related to that particular experiment before the admin allows for the next period. In this case, users see the "experiment completed" message and can only see the experiment result table when logged in.
- As distinct from other virtual physics laboratories, in the software of the virtual physics laboratory in question, flash and java applications were not used. Instead, a special software that can run on IOS, iPad, iphone, android and smart phones was developed with html 5 software code in order to meet the requirements of the day. As is known; mobile learning technology based on ios devices are essential for education (López et al., 2013). Screenshots of the Virtual Physics Laboratory running on iPad and IOS, android (smart phone) software are presented in Fig. 18-1 and Fig. 18-2, respectively.

Fig.18-1: A screenshot of the Virtual Physics Laboratory running on ipad and IOS software

Fig. 18-2: A screenshot of the Virtual Physics Laboratory running on smart phone software

4. TREATMENT OF IUVIRLAB

The participants in this study were 60 first-year undergraduate students (average age 19-20 years). They were from the science teaching department in a public university in Istanbul, Turkey. The scientific backgrounds of the students were similar.

The IUVIRLAB includes 4 experiments concerning magnetic fields and magnetism. These experiments are; examination of the magnetic field of a solenoid, magnetic field within a solenoid, magnetic induction, and electromagnetic resonance. Before the IUVIRLAB application, students were informed about the structure of the virtual laboratory, how to use it, how to enter the website, how to see their group friends.

Students were added to the system from the Admin panel of the IUVIRLAB, passwords and the collaborative groups of each student were determined. During application students entered the "www.iusanalfiziklab.com" web address which was determined for teachers; they communicated on-line via Skype and Twitter both with their group friends and system administrator. For the application to be as realistic as possible, experiments were carried out for 4 weeks.

5. SURVEY RESULTS

In order to determine the views of students about IUVIRLAB applications, the researchers developed a 5-point Likert type survey (I certainly agree, I agree, Neutral, I disagree, I certainly disagree) composed of 48 questions regarding content, view, usage (computer, smart phones, iPad) and application (collaborative learning groups). The students' answers to the survey questions are presented in Table 1.

Table 1. Percentages of students' views determined by survey

ORDER	QUESTIONS	I certainly agree (%)	I agree (%)	Neutral (%)	I disagree (%)	I certainly disagree (%)
1	Interactive laboratory experiments are as effective as real laboratory experiments.	40.0	33.3	16.7	6.7	3.3
2	Interactive laboratory experiments are satisfying.	35.0	26.7	16.7	16.7	5.0
3	Visual elements used in interactive laboratory experiments increase interest towards the course.	18.3	38.3	26.7	11.7	5.0
4	Interactive laboratory experiments are a waste of time.	0.0	6.7	28.3	45.0	20.0
5	Interactive laboratory experiments enable permanent learning.	26.7	28.3	28.3	16.7	6.7
6	Interactive laboratory experiments are student-centered.	30.0	25.0	21.7	16.7	6.7
7	Interactive laboratory experiments are boring.	0.0	10.0	35.0	45.0	10.0
8	I lost track of time during interactive laboratory experiments.	15.0	38.3	33.3	11.7	1.7
9	I think interactive laboratory experiments make me lazy.	0.0	11.7	26.7	45.0	16.7
10	Interactive laboratory experiments increase motivation.	30.0	36.7	16.7	6.7	10.0
11	Interactive laboratory experiments increase success.	33.3	31.7	18.3	16.7	0.0
12	Interactive laboratory experiments increase interest towards the course.	28.3	26.7	28.3	10.0	6.7
13	Interactive laboratory experiments are entertaining.	36.7	30.0	25.0	6.7	1.7
14	Interactive laboratory experiments are repelling.	0.0	8.3	21.7	43.3	26.7
15	Interactive laboratory experiments increase creativity.	36.7	21.7	33.3	6.7	1.7
16	Interactive laboratory experiments influence attitude towards physics laboratories positively.	46.7	16.7	23.3	10.0	3.3
17	Interactive laboratory experiments enhance visualization of physics problems.	30.0	26.7	21.7	16.7	5.0
18	Interactive laboratory experiments enable understanding the subject more easily.	45.0	15.0	28.3	10.0	1.7
19	Interactive laboratory experiments may increase problem-solving skills.	51.7	21.7	18.3	6.7	1.7
20	Interactive laboratories have good screen readability.	43.3	20.0	20.0	10.0	6.7
21	Commands in interactive laboratories associate their own tasks functionally.	40.0	21.7	18.3	13.3	6.7
22	Signs/buttons in interactive laboratories associate their own tasks functionally.	43.3	26.7	15.0	11.7	3.3
23	Screen colors of interactive laboratories help concentration.	38.3	36.7	20.0	5.0	0.0
24	Design and operation logic of interactive laboratory sites have educational value.	33.3	28.3	23.3	10.0	5.0
25	Interactive laboratory experiments enable learning through experience and practice environment.	31.7	33.3	23.3	8.3	3.3

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26	Interactive laboratory experiments enable each student to learn at his/her own speed.	30.0	33.3	20.0	10.0	6.7
27	Learning takes place in a free environment in interactive laboratories.	10.0	21.7	38.3	20.0	10.0
28	Interactive laboratory environment removes discriminations of gender, social class and geographical hindrances.	38.3	41.7	20.0	0.0	0.0
29	Interactive laboratories are suitable for life-long learning.	38.3	25.0	20.0	11.7	5.0
30	Experiment explanations included in interactive laboratories are sufficient for conducting experiments.	36.7	30.0	16.7	9.7	7.0
31	Experiment booklets in interactive laboratories are sufficient for conducting experiments.	28.3	31.7	30.0	6.7	3.3
32	Interfaces used in interactive laboratories are coherent and logical on all pages.	40.0	25.0	28.3	7.6	0.0
33	Interactive laboratories are suitable for conducting experiments and communicating with collaborative groups.	38.3	38.3	16.7	3.3	3.3
34	Functional properties of experiments included in interactive laboratories are efficient.	36.7	26.7	16.7	10.0	10.0
35	Tasks given to students during experiments in interactive laboratories increase responsibility.	48.3	20.0	8.3	18.3	5.0
36	Tasks given to students during experiments in interactive laboratories enable them learn the subject better.	33.3	33.3	20.0	3.3	10.0
37	Operations carried out by group members being observable by other members during experiments in interactive laboratories is exciting.	43.3	25.0	23.3	6.7	1.7
38	Operations carried out by group members being observable by other members during experiments in interactive laboratories is motivating.	35.0	26.7	30.0	6.7	1.7
39	Analysis of experiment results after interactive laboratory experiments enables group members to evaluate themselves.	36.7	21.7	25.0	10.0	6.7
40	The Skype screen pop-up while entering and Twitter usage in interactive laboratories excite group members.	43.3	26.7	16.7	3.3	10.0
41	Interactive laboratories enable group leaders to be determined on-line.	36.7	28.3	26.7	3.3	5.0
42	It is comforting when group members access academicians on-line in case of any problem in interactive laboratories.	35.0	31.7	20.0	13.3	0.0
43	It is pleasing when students enter interactive laboratories at home.	33.3	28.3	28.3	6.7	3.3
44	It is exciting when students enter interactive laboratories from mobile phone/computer etc...	35.0	31.7	30.0	1.7	1.7
45	It increases motivation when students enter interactive laboratories from mobile phone/computer, etc...	43.3	26.7	20.0	10.0	0.0
46	Experiments carried out in interactive laboratories are realistic.	38.3	36.7	25.0	0.0	0.0
47	I have had no problems while doing experiments in interactive laboratories.	35.0	25.0	10.0	20.0	10.0
48	Interactive laboratory environment restricts the learning of students.	3.3	11.7	31.7	40.0	13.3

As it is seen in Table 1, when the percentage of answers students gave for survey questions is analyzed, students generally stated positive views about IUVIRLAB application in the sense of content, appearance, usage and application. Especially when the characteristics specific to the IUVIRLAB virtual physics laboratory are analyzed; 35% of students stated "I Certainly Agree" for "I have had no problem while doing experiments in interactive laboratories", 38.6% said "Experiments carried out in interactive laboratories are realistic", 43.4% said "It increases motivation when students enter interactive laboratories from mobile phone/computer/etc...", 35% said "It is exciting when students enter interactive laboratories from mobile phone/computer/etc...", 35% said It is "comforting when group members access academicians on-line in case of any problem in interactive laboratories", 48.3% said "Tasks given to students during experiments in interactive laboratories increase responsibility", 33.3% said "Tasks given to students during experiments in interactive laboratories enable them learn the subject better", 43.3% said "Operations carried out by group members being observable by other members during experiments in interactive laboratories is exciting", 35% said "Operations carried out by group members being observable by other members during experiments in interactive laboratories is motivating", 36.7% said "Analysis of experiment results after interactive laboratory experiments enables group members to evaluate themselves", and 43.3% said "The Skype screen pop-up while entering and Twitter usage in the interactive laboratory excite group members"

Students were asked through which device they enter the IUVIRLAB Virtual Phyiscs Laboratory application; 31 students entered via their computer at home, 24 of them entered via mobile phones, 5 of them entered via iPad; they stated they had no problems with the website during application and those who used a computer during application stated they felt more comfortable since they could read the experiment booklet more easily.

5. CONCLUSION

According to the results of survey which was developed in order to determine views of students about the IUVIRLAB application, students stated that during IUVIRLAB; "They have had no technical problem in interactive laboratories, experiments carried out in interactive laboratories are realistic, it increases motivation when students enter interactive laboratories from mobile phone/computer/etc. and this environment is exciting, it is comforting when group members access academicians on-line in case of any problem in interactive laboratories, tasks given to students during experiments in interactive laboratories increase responsibility and enable them learn the subject more easily, operations carried out by group members being observable by other members during experiments in interactive laboratories is exciting and motivating, and that the Skype screen pop-up while entering and Twitter usage in the interactive laboratory is exciting".

Within the scope of the 3-dimensional interactive, multi-user and multi-admin IUVIRLAB project which includes active learning methods and techniques for university students and which was developed by Istanbul University. In the later phases of this pilot study, the applications of this system on mechanics, electricity, waves, and optics experiments, and realization of the magnetic field experiments generated within the scope of the study are foreseen. Further application of the IUVIRLAB will be used for experiment and control groups in order to analyze their ability to construct concepts correctly and making relationships between physics and daily life and their critical thinking, problem-solving skills. In practice, it is estimated that this virtual laboratory will increase students' success levels, enable them to correctly structure concepts and enhance their critical thinking and problem-solving skills, as well as their capability to associate physics with their daily lives. It is believed that the present study, together with any similar studies to be conducted, will contribute to rectifying the deficiencies of experimental applications in education around the world.

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