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Justification of E-Argumentation Software based on a Needs Analysis in Education Context[*] [**]

E-Argümantasyon Yazılımının Eğitim Bağlamında İhtiyaç Analizine Dayalı Olarak Gerekçelendirilmesi

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ABSTRACT

Argumentation can be defined as a process in which claim, data, justification and supports, which are considered the basic building blocks of an argument, are connected together in a meaningful way. Especially in Science Education, argumentation method is known to have positive contributions to the learning-teaching processes. Today, there is much opportunity to integrate digital tools or software in argumentation processes for better learning outcomes. The literature points out the difficulties experienced by teachers and learners in the argumentation processes and emphasizes that digital tools or software can offer solutions to these problems. In this context, a wide variety of software is used to support argumentation processes in education more effectively and easily. The aim of this study is to examine existing argumentation software and to determine the features of a new "E-Argumentation" software, which is supposed to be a better and contemporary solution for argumentation processes, based on a needs analysis.

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Existing argumentation software is not rich in terms of multimedia usage and not compatible with group work, which is important in argumentation processes, or with three argumentation approaches in the literature. Furthermore, existing software has serious shortcomings in terms of usability and educational value. As a result, it is clear that there is a need for argumentation software which is compatible with current technologies, pedagogically useful, and has high level of usability and accessibility.
Keywords: *Argumentation, Software, Science education*

INTRODUCTION

Argumentation can be defined as a process in which claim, data, justification and supports, which are considered as the basic building blocks of an argument, are connected together in a meaningful way (Simon, Erduran & Osborne, 2006). Especially in science education, argumentation method is known to have positive contributions to the learning-teaching processes. The importance of argumentation in science education can be grouped under several headings. Firstly, argumentation is accepted as the language of science. Therefore, science cannot be said to have been learned without acquiring these linguistic skills. There is no science without language (Norris & Phillips, 2003). In this context, acquiring scientific language is extremely important for learning science. The relevant literature shows that these skills of students of various age groups develop in science learning environments where argumentation is used as a learning method (Osborne, Erduran & Simon, 2004).

Secondly, argumentation is of vital importance for the development of science literacy (Driver, Newton & Osborne, 2000). Because our basic expectation from a scientifically literate individual is to be able to ask questions, produce solutions/answers to questions asked through scientific means, or establish arguments based on evidence in daily life (Deboer, 2000).

Thirdly, argumentation serves as a framework that supports the conceptual learning/achievement of science learners. Because the conceptual learning literature bases learning not only on what is right but also on knowing what is wrong (Posner, Strike, Hewson & Gertzog, 1982). In science learning environments where argumentation is

actively used, students will justify not only why correct information is correct, but also why incorrect information is incorrect, through individual or group work. This will make significant contributions to students' conceptual learning (Asterhan & Schwarz, 2007; Newton, Driver & Osborne, 1999).

The fourth importance is that, in addition to conceptual learning, some misconceptions that are resistant and hinder learning can be eliminated through argumentation (Asterhan & Schwarz, 2009).

Fifthly, the importance of argumentation is its meaningful contributions to the higher order thinking skills (reasoning, epistemic thinking, scientific process skills, etc.) and communication skills of individuals learning science (Kuhn & Udell, 2003; Moshman, 2011). Because while students identify the components of an argument and establish rational connections between these components; additionally, it utilizes higher-level thinking and communication skills when discussing this structure within a scientific group. However, research in the literature shows that argumentation skills or tendencies to participate in argumentation are directly related to the epistemological beliefs or personal epistemologies of students and teachers (Duschl & Osborne, 2002; Kuhn, 1992, 1993; Nussbaum & Bendixen, 2003; Sandoval & Millwood, 2007). Previous studies indicate that argumentation helps students develop their thinking skills and knowledge (Mayweg-Paus et al., 2021). Therefore, it can be accepted that there is a direct and two-way relationship between individuals' epistemic reasoning and argumentation skills. Arslan, Genç and Durak (2023) studied argument-driven inquiry model. They found that implementation of this model had a positive impact on science process skills, argumentation levels and knowledge of pre-service science teachers.

Finally, the importance of argumentation includes the fact that argumentation offers opportunities for affective skills as well as cognitive skills and that it affects the motivational state of science learners (active participation, goal setting, self-evaluation, etc.) in the desired direction (Nussbaum, 2005). Because learning environments where argumentation is used provide opportunities for students to structure knowledge by going through the claim-evidence-refutation processes. Therefore, students are emotionally

inclined towards learning and their motivation increases during the mentioned process (Zhou, 2010).

Today, there is much opportunity to integrate digital tools or software in argumentation processes for better learning outcomes. The literature points out the difficulties experienced by teachers and learners in the argumentation processes and emphasizes that digital tools or software can offer solutions to these problems (Noroozi, Dehghanzadeh, et al., 2020). Today, internet is a source of knowledge for learners to create arguments and counter arguments as well as feedback (Cheng et al., 2021). When existing argumentation-oriented software is examined; it can be seen that a wide variety of software is used to carry out argumentation processes more effectively and easily in education (For example; Belvedere, Argumentative, Digalo, Argunaut, Rationale). In addition, software developed for argumentation in science teaching (ExplanationConstructer, CyberTracker, Flyer, Zydeco) also stand out.

Belvedere (LILT, 2010), one of the software developed for educational purposes, is an argumentation software with multi-user support and using graphic-based diagrams. This software was developed to help students learn in the context of collaborative learning scenarios and support their claims with their own evidence. Argumentative (Sourgeforce, 2009) is mostly used to create argumentation maps. Argumentative is a non-interactive program with a simple interface used to collect and organize student opinions in written form. Digalo and Argunaut (Kishurim Group, 2013) are software used by groups of 3-7 people in a classroom environment to discuss their opposing views in the context of different scenarios presented to them and to organize data such as claims, evidence and justifications that they use in this discussion.

Probably the most useful and suitable of the existing software related to argumentation is the software called Rationale (Critical Thinking Skills, 2013). This software offers users a broader and more useful interface than others when making arguments. However, the fact that it is very difficult for a teacher to intervene in the argumentation process in this software and that the software is not based on any argumentation approach can be considered as serious shortcomings.

ExplanationConstructer (Sandoval & Raiser, 2004), one of the rare argumentation software developed for teaching science subjects, was developed as an electronic newspaper used for students to understand the relationships between scientific structures through questions-explanation-evidence in some Biology subjects. As a result of the study, they stated that students structured more creative claims thanks to the data supported by the software. Similarly, Laru et al. (2012) for a phone brand, aimed to enable students to create a claim in the context of science subjects, provide an explanation for this claim, and provide data that could justify their explanations. The findings of this research indicate that students who use the Flyer application become more courageous in making arguments and learn better.

Zydeco software, one of the prominent software in this context, aims to carry out the direct argumentation process in an interactive and internet-based way. This software can be considered the most advanced software compared to others. In a study in which Zydeco was used and its effect was investigated, it was pointed out that the teacher's intervention and contribution to the process and software is necessary for students' performance and learning thanks to the software (Delen, 2014).

Although some of the argumentation software examined were stated to provide positive contributions to students, it is obvious that none of them were developed based on three approaches to argumentation processes (Analytical model, ATBÖ-ATS and SBK). It was observed that it was either not possible or very difficult for a teacher to give instant feedback and follow the argumentation processes in the software examined. Furthermore, studies indicate that feedback is an important factor in argumentation and it is a high workload for educators (Latifi et al., 2021). Only Zydeco offers the opportunity for teachers to upload questions to the system wherever they deem necessary. However, the teacher has the biggest role in the healthy conduct of the argumentation process. For this reason, one should be able to participate in the argumentation process by intervening when deemed necessary, such as asking students additional questions and presenting counter hypotheses.

Studies conducted in the context of Türkiye are very limited. In this context, two studies named "Arguman" and "Argumantarium" were found. Among these, the Arguman (Erikli et al., 2014) project was developed as open source by a group of software developers and offers hierarchical argument maps for web users. Instead of using it in a classroom environment, it has a structure that allows web users to discuss their ideas in an open environment. Another project, Argumantarium, was developed with the support of TÜBİTAK - Scientific and Technological Research Council of Türkiye (Project Number: 109K566). When the final report and other studies of the project completed in 2012 (Akpınar, Ardac & Amuce, 2014; Akpinar, Ardac & Amuce, 2015) were examined, it was seen that the developed software has a structure in which the claims and evidence related to the topic chosen by the students were browsed through virtual rooms and selected or added. However, one of the important aspects of the argumentation process is that the student puts forward his/her own claims and supports them with his/her own evidence(s). Thus, students reveal their own perspectives and have the opportunity to develop their own skills in this sense. In the software in question, the fact that the student has the possibility of choosing from ready-made expressions in the activity rooms may hinder the determination of their own perspectives and revealing their personal development. The software in question is thought to support students' post-lesson study activities. In addition, teacher guidance, which is an important element of using argumentation in the learning process, is also missing in this software.

Considering the importance of group work in argumentation applications, it can be said that there are significant deficiencies in this regard in the software examined. Although it seems possible to include more than one student in the process in front of a single screen or interface, it is important to allow each student to express his or her own opinion in group studies. The single interface systems mentioned do not allow different views to be expressed in terms of the argumentation process, where group work is required and used. This situation is seen as an important deficiency and a point that needs to be eliminated.

In addition, in the majority of the software examined, there are claims, evidence, arguments, etc. produced by students. It can be seen that the expressions are recorded as

text-based. In some software, simple multimedia elements are also used. Considering today's information and communication technologies, various multimedia tools can be easily used in internet-based applications without creating speed/performance problems, and the educational technologies literature is quite developed in this sense. From this perspective, it was seen that the software examined was not rich in terms of multimedia use.

Although these software were created to solve problems directly mentioned in the literature, they are far from our national context. Again, most of the software and classroom applications have a structure that targets the development of teachers and students in separate ways. Another dimension is that software that aims to enable teachers to achieve this transformation is implemented without taking into account the difficulties they experience in argumentation practices in real classroom environments. If the software to be developed is to be adopted by teachers, it must have a bottom-up structure that takes into account teachers' current knowledge and beliefs rather than a top-down feature. The software mentioned above does not seem to take this dimension into account. At this point, the software to be developed must take into account the context of our country and have an innovative perspective, such as being based on needs analysis of teachers' existing knowledge and beliefs.

The aim of this study is to examine existing argumentation software and to determine the features of a new "E-Argumentation" software, which is supposed to be a better and contemporary solution for argumentation processes, based on a needs analysis.

METHOD

In order to examine existing argumentation software and to determine the features of a new "E-Argumentation" software, which is supposed to be a better and contemporary solution for argumentation processes, based on a needs analysis, two steps were followed; Literature Review and Delphi Study.

Literature Review

In the first step of the needs analysis, literature review was conducted taking into account the studies carried out in the last 10 years through ERIC, Web Of Science, ULAKBİM and education-related indexes included in the ISI Database (Australian Education Index, British Education Index, Academic Search Premier, Teacher Reference Center). In the review carried out, it was tried to reach studies on technology integration for argumentation applications, the problems encountered by teachers and students in the argumentation process, and the interventions and solution suggestions made on these problems.

In order to increase efficiency during the literature review, a two-stage scanning process was carried out. In the first stage, a search was carried out through the keyword combinations; Afterwards, the keywords of the publications reached as a result of this scanning were examined and the word combinations used during the scanning were updated. In the second stage, the scanning was repeated using these new keywords and the process was terminated as it was seen that no new keyword combinations were found.

After scanning, a total of 119 studies that were deemed relevant in terms of subject area were included in the content analysis. All studies were examined by field experts, and the analysis results were presented to other experts to ensure harmony between evaluators regarding the identified codes-categories and themes.

Delphi Study

In the second step of the needs analysis, a Delphi study was conducted with the participation of academics who are experts in the fields of argumentation and software development and expert teachers who are familiar with argumentation practices. The main aim at this stage is to conduct a Delphi study in which the suggestions of all stakeholders who are experts in the field are taken into account.

The Delphi study was carried out with the participation of 10 expert teachers and 6 academicians (1 Professor, 3 Associate Professors, 2 Dr. Lecturers) who had previously taken part in projects related to argumentation and showed high level development. Three

of the participating academics are science educators specialized in the field of argumentation, and the other 3 are field educators specialized in educational technologies/software development. All of the academicians who participated in the study are field experts who have previously participated in various projects as facilitators or experts/speakers in their fields of expertise and have numerous publications.

In the first stage of Delphi study, one-on-one semi-structured interviews were held with each of the stakeholders whose selection was described above. In these interviews, first of all, a short presentation was made to the participants introducing the aims of the study, and then the interview questions were asked within the framework of the "E-Argumentation Needs Analysis Protocol" developed by the researchers. "E-Argumentation Needs Analysis Protocol" questions are as the following:

1. What are the problems you experienced in the implementation process of argumentation-based science teaching?
2. What are the problems your students experience during the argumentation-based science teaching process? Could you tell us about your observations?
3. What are your solution suggestions for the problems you encountered during the argumentation processes? Can you explain?
4. What can you tell us about the currently existing technological platforms and software that support argumentation-based science teaching? So do you know these by name or content?
5. What kind of E-Argumentation software do you dream of?
6. What are the limitations of currently existing argumentation software?

During the interviews, an attempt was made to obtain rich data in the context of the needs required for E-Argumentation Software. In this context, participants were asked about the problem situations they and their students encountered during argumentation practices, their solution suggestions for these problem situations, and their opinions (limitations, benefits and expectations) regarding technology integration into argumentation practices.

The interviews were conducted online over the internet. Each interview lasted an average of 40 minutes and was recorded with the permission of the participants. Later, these audio recordings were deciphered and subjected to content analysis.

In the second stage of Delphi study, a 5-point Likert type survey with 45 items was created as a result of compiling the categories and themes obtained from the content analysis of the Delphi interviews conducted in the first stage. The features that a software that will support argumentation practices in science teaching should be included in the survey; It is discussed in 3 dimensions: pedagogical features (19 items), technological features (17 items) and information/content features (9 items).

In the second stage of Delphi study, this survey, organized in online format, was delivered via e-mail to a larger group of experts (42 science teachers and 20 field expert academics) and the participants were asked to evaluate each item in order of importance (5-point rating; 1: Not at all important, 5: Very important) was requested. During the data analysis process, median values for each item were examined and items with medians below 5 were excluded from the importance ranking. Among the remaining items, it was accepted that consensus was reached for the items with an interquartile range value (IQR) of 1.00 and below 1.00.

When the analysis results are examined, the median values of all items except items 7, 10, 12, 13, 14, 28, 36 and 42 are 5; It is seen that the interquartile range values are 1.00 or below and the averages of all items are above 4. In light of these findings, the participants reached an agreement in terms of the importance level for the 37 items. It seems that there is a consensus that these 37 items should be taken into account in the E-Argumentation software to be developed.

FINDINGS

Findings Derived from the Literature Review

As a result of the literature review, regarding the difficulties encountered by teachers and students in the argumentation processes; It is observed that students' poor argument

quality and the lack of argument components, especially claim, data and justification, are noted (Demircioğlu and Uçar, 2014; Lu and Zhang, 2013; McNeill, Gonzalez Howard, Katsh Sınger and Loper, 2017). In this context, in some studies in the literature, students mix argument components and use them interchangeably (Çoban, Akpınar, Baran, Kocagül Sağlam, Özcan, & Kahyaoğlu, 2016; Osborne & Patterson, 2011). In the process of justifying claims, they often make biased decisions based solely on their own personal experiences (Jönsson, 2016; Sandoval & Çam, 2011). It has been observed that during the discussion process, they perceive opposing claims as a personal attack and defend the rightness of their own views regardless of the circumstances (Lin, Fan & Xie, 2020; Kabataş Memiş, 2017).

When the main problem situations encountered by teachers are examined, it is revealed that they have difficulty in writing questions/giving feedback suitable for argumentation (Huang, Wang, Huang, Chen, Chen & Chang, 2011; Prusak, Hershkowitz & Schwarz, 2012; Schwarz Schur, Pensso & Tayer, 2011); they have difficulty in evaluating the quality of their arguments (Aktamış & Hiğde 2015; McNeill, Gonzalez Howard, Katsh Singer & Loper, 2016; Namdar & Salih, 2017; Öztürk, 2017); that they may need support in time management (Aktamış & Atmaca, 2016; Karaer, Karademir & Tezel, 2019; Namdar & Demir, 2016; Namdar & Tuskan, 2018) and that they find the in-service training on argumentation inadequate (Kayaduman, Sırakaya & Seferoğlu, 2011; Namdar & Tuskan, 2018; Türel, 2012) was understood. In this context, it is important to create instructional designs for teachers to effectively apply argumentation in the classroom. For this, it is necessary to follow the trends in the world and take serious steps to integrate innovative technologies and learning environments. It is possible to find traces of steps taken in this direction in the literature. With the integration of technology into argumentation practices, process control in discussion will become easier (Berland, 2011; Zhang & Quintana, 2012); With the effect of recording the discussion environment, it will become easier to give feedback and evaluate the quality of arguments (Huang, Chang, Chen, Tseng & Chien, 2016; Huang, Wang, Huang, Chen, Chen & Chang, 2011; Lu & Zhang, 2013; Zhu, Lee , Wang, Liu, Belur, & Pallant, 2017) is constant in the literature.

On the other hand, there are also studies that point out that the technological-pedagogical content knowledge of teachers/teacher candidates is not yet sufficiently developed and that the currently existing educational technologies are not used for their intended purpose (Çoban, Akpınar, Baran, Kocagül Sağlam, Özcan, & Kahyaoğlu, 2016; Namdar & Salih, 2017; Pamuk, Çakır, Ergün, Yılmaz & Ayas, 2013).

Apart from these, it is seen that it is not possible to make a direct intervention with the software to be developed, but some problem situations whose effects on argumentation practices are directly felt are also included in the literature. In some of these studies, it was determined that teachers may exhibit negative attitudes towards argumentation on the grounds that the workload of the curriculum will prevent them from preparing for central exams (Ceyhan, Muğaoğlu & Tillotson, 2019; Çoban, Akpınar, Baran, Kocagül Sağlam, Özcan & Kahyaoğlu, 2016; McNeill , Gonzalez Howard, Katsh Singer & Loper, 2017). Some of the teachers think that large class sizes will prevent/make it difficult to implement argumentation practices (Aktamış & Atmaca, 2016; Ceyhan, Muğaoğlu & Tillotson, 2019; Huang, Wang, Huang, Chen, Chen, and Chang, 2011). Apart from these, it is also possible to mention the problem situations faced by students such as lack of self-confidence and difficulty in expressing themselves (Gencel & Ilıman, 2019) or environmental factors such as schools where the necessary school culture for argumentation is not developed/not willing to allocate a significant amount of time for argumentation practices (Akpınar, Ardaç & Amuce, 2015).

When existing argumentation-oriented software is examined; it can be seen that a wide variety of software is used to carry out argumentation processes more effectively and easily in education. Table 1 presents main features of the existing argumentation-oriented software. Some detailed information related to these software has already been given in the Introduction section.

Table 1. Main Features of the Existing Argumentation-Oriented Software.

	Interaction	User	Output type	Instant teacher feedback	Internet continuity	Group work
Belvedere	X	Multiple	Graphic	X	X	X
Argumentative	X	Single	Graphic	X	X	X
Digalo	X	Single	Text	X	X	✓
Argunaut	X	Single	Text	X	X	✓
Rationale	X	Single	Text	X	X	X
Explanation Contru.	X	Single	Text	X	X	X
Cyber Trucker	X	Single	Text	X	X	X
Flyer	X	Single	Text	X	X	X
Zydeco	✓	Single	Text	X	✓	X

Existing argumentation-oriented software were examined in terms of some criteria derived from the literature. In summary, most of them;

- do not provide interaction,
- do not support multiple user opportunity,
- have only text based outputs,
- do not ensure instant teacher feedback,
- have not internet continuity property, and
- do not enable group work.

Existing software is quite weak in supporting the argumentation process in this sense. Considering the interface designs and usability of the software, it is understood that they need improvement. Even the software named Zydeco and Rationale, which can be seen as having the most advanced interface, have serious problems in terms of usability and accessibility. The shortcomings of existing software include the fact that they are not constantly accessible over the internet and that interaction, which is a very determining factor in learning, is very limited in these software.

Although it does not seem possible to eliminate all these problems at once with a single software to be developed, it is thought that the software can lead to their solution in the long term. This is the main purpose of the needs analysis and R&D studies carried out.

Findings Derived from the Delphi Study

When the findings obtained from the Delphi study are examined, it is seen that most of them overlap with the findings obtained from the literature review. For example, the majority of teachers and academics who participated in the Delphi study seem to agree that students' argumentation quality is poor and argument components are missing/irrelevant, as stated in the relevant literature. In parallel with the literature, the teachers in the Delphi study stated that it would be easier to give feedback to students and evaluate the quality of their arguments thanks to the integration of technology into argumentation practices; On the other hand, they think that the course duration is not enough to complete the argumentation activities and the current in-service training is insufficient. In line with Akpınar, Ardaç, and Amuce's (2015) statements about school climate, some of the teachers who participated in the Delphi study stated that they did not receive the necessary support from their colleagues; They stated that their colleagues who continued teaching in a traditional style could hinder the adoption of argumentation practices by students. Again, regarding the school climate, some of the teachers who participated in the Delphi study stated that the discussion environment that occurs during the argumentation activities may be perceived by an outside observer (administrator, colleague or parent) as a chaotic environment and lead to the thought that there is no lesson in the classroom. In this context, Delphi teachers stated that efforts should be made

to make argumentation a school culture; They stated that it is important for students to move from lower grades to upper grades by mastering argumentation pedagogy.

Regarding the software itself, both the opinions of the participants in the Delphi study and the findings from the literature review indicate that the software;

- should have a simple and plain interface;
- should be supported by a platform that makes it easy for users to draw graphs and diagrams, create, review and share argumentation maps;
- should have visually rich content, animations and simulations should be included, and
- should provide information packages/guides to guide students throughout the process and to refer to them whenever they need.

In addition to all this, field experts in the Delphi study stated that the software to be developed should assist students in coordinating the argument components. They stated that it is important to include tools in the software that will enable discovering incompatibilities between argument components (if any). Thus, it will be possible to find solutions to the problems of poor argument quality and lack of/irrelevance of argumentation components mentioned in the literature.

Apart from these, arguments obtained specifically for the Delphi study (which is different from the literature review) such as the fact that argumentation practices have not become widespread enough due to the comparison of teacher success with the student's test success, that students have difficulty in the process of writing argumentation reports, or that the developed software should include a combination of web 2.0 tools currently used in argumentation applications.

In light of second stage of Delphi study findings, the participants reached an agreement in terms of the importance level for the 37 items. It seems that there is a consensus that these 37 items should be taken into account in the E-Argumentation software to be

developed. These items can be given under 3 dimensions: pedagogical features (14 items), technological features (15 items) and information/content features (8 items).

Pedagogical features:

1. It should include interventions (hints, limitations, etc.) to effectively establish the research question when starting the process.
2. It should contain components (descriptions such as pictures, diagrams, etc.) that make it easier for students to reach the argument from data.
3. It should contain various elements (e.g. classifier questions) that make it easier for students to distinguish between data, claim and evidence.
4. Opposing ideas should be given the opportunity to be perceived and followed by all students.
5. Students' active participation in the argumentation process should be monitored individually within the flow of discussion.
6. It should allow student-student and teacher-student interaction.
7. During the argumentation, students should be given the opportunity to make instant additions (images, links, etc.) that support their arguments.
8. Students should be encouraged to construct different argument components (claims, evidence, supports and rebuttals).
9. Students should be encouraged to use multiple sources so that they can access more reliable data.
10. It must contain components (video, case study, and scenario) that initiate and/or support the argumentation process.
11. It should record all processes that occur from data to argument.
12. It should include online argumentation reports, reflective writing activities, and online journal modules.

13. During the Online Discussion process, the path students follow in reaching the argument (e.g. the data sources they use) should be recorded.
14. Tools (e-portfolio) for monitoring individual argument development should be included.

Technological features:

1. Interface design should be simple, understandable and plain.
2. The interface should be colorful and interesting.
3. The software should be able to load quickly and run smoothly.
4. It should contain probes that will gradually guide participants to specific tasks (this is next, you should do this now, etc.).
5. Participants should be able to move on to the next step only after completing the previous step.
6. It should be able to detect the student's incomplete tasks and send a warning message to the student.
7. The software must have a data storage area capable of keeping data and records related to all processes.
8. Flipped must have content that supports learning (such as Google classroom).
9. In addition to the computer, it can also be used via smart board, tablet computer and smartphone.
10. It should include a design where the arguments of the groups are shown on the main screen.
11. It should include a platform where teachers and students share their experiences.
12. Students can upload videos, pictures, etc. of themselves. It should allow you to install the tools.
13. It should contain an area where shared videos and content are stored.

14. It should include an online discussion platform.
15. Students should be allowed to make changes to their arguments at any time.

Information/content features

1. It should contain guide materials to guide teachers through the argumentation process.
2. It should be in accordance with the curriculum.
3. It should include experiments and activities appropriate to the achievements of the curriculum.
4. It should include activities for different grade levels.
5. It should especially focus on topics where misconceptions occur frequently in science teaching.
6. It should include practices that take students' individual differences into account as much as possible.
7. It should allow the use of alternative measurement and evaluation methods/techniques.
8. It should include tests to determine students' argumentation level.

CONCLUSION

In order to eliminate the problem situations regarding argumentation in science education context, mentioned in the literature and also in the Delphi study findings, there is a need for a new e-argumentation software. Both the literature review results and Delphi study results point out requirements of o new software to promote argumentation in education. Existing argumentation software do not provide interaction, do not support multiple user opportunity, have only text based outputs, do not ensure instant teacher feedback, have not internet continuity property, and do not enable group work. When these shortcomings are taken into consideration, it is clear that a solution should be produced for better

argumentation process. Researchers and educators have now much opportunity to integrate digital technology in argumentation processes for better learning outcomes. This is why it is important to point out the needs and list recommendations for a new e-argumentation software for researchers and educators. Considering the current developments in educational technology and the importance of argumentation in science education, mentioned in the study, a contemporary e-argumentation software to be developed will be a solution in this context.

The new e-argumentation software should take into account the needs analysis results of the study. In this manner the software is expected to;

- eliminate the existing problems faced by teachers and students regarding argumentation process,
- be designed and developed considering pedagogical, technological and information/content features mentioned within the findings of the study,
- have a modern and usable interface,
- be compatible with all argumentation approaches,
- be better from the existing argumentation-based software in terms of effectiveness, usability and benefit.

The above mentioned features or properties of a new e-argumentation software are listed based on a needs analysis study and points out the main differences between the e-argumentation software and the previous ones. In addition further research can be made to find out more shortcomings of argumentation software and features to be developed in this manner in more detail. Policy makers, practitioners and researchers may benefit from the findings of the study in order to design and create new software; implement and utilize them. Especially implementing such kind of e-argumentation software will provide a variety of data for researchers and educators in different learning context. This data will make it possible for researchers in science education to design and implement more

effective technology supported argumentation processes for better and effective teaching-learning experience.

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GENİŞ ÖZET

Amaç: *Argümantasyon, bir argümanın temel yapıtaşları olarak kabul edilen iddia, veri, gerekçe ve destekleyicilerin anlamlı bir şekilde birbirine bağlandığı bir süreç olarak tanımlanabilir. Argümantasyonun fen eğitimi açısından önemi birkaç başlık altında toplanabilir. Birincisi argümantasyon bilimin dili olarak kabul edilmektedir. İkinci olarak, argümantasyon bilim okuryazarlığının gelişimi açısından hayati bir öneme sahiptir. Üçüncü olarak argümantasyon fen öğrenenlerin kavramsal öğrenmesini/başarısını destekleyici bir çatı görevi görmektedir. Dördüncü önem ise kavramsal öğrenmenin yanı sıra dirençli ve öğrenmeye ket vuran bazı kavram yanılgılarının argümantasyon ile ortadan kaldırıldığına yönelik bilimsel delillerin mevcut olmasıdır. Beşinci olarak argümantasyonun önemi, fen öğrenen bireylerin yüksek düşünme becerilerine (muhakeme, epistemik düşünme, bilimsel süreç becerileri vb.) ve iletişim becerilerine yaptığı anlamlı katkılardır.*

Argümantasyonun, özellikle fen eğitimi bağlamındaki fayda ve önemine rağmen hem öğretmen hem de öğrenciler tarafından uygulamada birçok problemle karşılaşıldığı açıktır. Fen eğitimi araştırmacıları bu problemlerin çözümüne yönelik proje ve modelleri ortaya koyarak öğretmenlerin bu süreci öğrenmesi ve sınıf içerisinde öğrencilerle birlikte uygulamasına yönelik çerçeve yapılar sunmuştur. Ulusal ve uluslararası bağlamda bu çerçeve yapıların olumlu katkıları olmakla birlikte, argümantasyon pedagojisinin öğretmenler tarafından benimsenmesi ve öğrenciler tarafından içselleştirmesine yönelik sıkıntılar devam etmektedir. Bu bağlamda öğretmenlerin sınıf içerisinde argümantasyonu etkin bir şekilde uygulamasına yönelik öğretim tasarımlarının oluşturulması ve sınıf içi sürece yansımaları dikkatle incelenmektedir. Bu öğretim tasarımlarına bakıldığında son yıllarda dijital dönüşüme paralel şekilde teknolojiden yararlanıldığı ve teknoloji sayesinde fen eğitiminde argümantasyonun aktif kullanımına yönelik problemlere çözüm üretilmeye çalışıldığı görülmektedir. Çünkü birçok ülke 21. yy'ın dijital çağ olarak adlandırılmasına uygun şekilde yenilikçi teknolojiler ile öğrenme ortamlarını bütünleştirmeye yönelik ciddi adımlar atmaktadır. Literatürde öğretmenlerin ve öğrencilerin argümantasyon süreçlerinde yaşadıkları zorluklara dikkat çekilerek, dijital araçların veya yazılımların bu sorunlara çözüm sunabileceği vurgulanmaktadır. Bu bağlamda eğitimde argümantasyon süreçlerinin daha etkili ve kolay bir şekilde desteklenmesi için çok çeşitli yazılımlardan yararlanılmaktadır.

Bu çalışmanın amacı, mevcut argümantasyon yazılımlarını incelemek ve argümantasyon süreçlerine daha iyi ve çağdaş bir çözüm olacağı düşünülen yeni bir "E-Argümantasyon" yazılımının özelliklerini ihtiyaç analizine dayalı olarak belirlemektir.

Yöntem: *Mevcut argümantasyon yazılımlarını incelemek ve argümantasyon süreçlerine daha iyi ve çağdaş bir çözüm olacağı düşünülen yeni bir "E-Argümantasyon" yazılımının ihtiyaç analizine dayalı özelliklerini belirlemek için iki adım izlenmiştir; Literatür Taraması ve Delphi Çalışması.*

Bulgular: *Mevcut argümantasyon yazılımları multimedya kullanımı açısından zengin değildir ve argümantasyon süreçlerinde önemli olan grup çalışmasıyla ya da literatürdeki üç argümantasyon yaklaşımıyla uyumlu değildir. Ayrıca mevcut yazılımların kullanılabilirlik ve eğitsel değer açısından ciddi eksiklikleri bulunmaktadır.*

Tartışma ve Sonuç: *Sonuç olarak güncel teknolojilerle uyumlu, pedagojik açıdan kullanışlı, kullanılabilirliği ve erişilebilirliği yüksek argümantasyon yazılımlarına ihtiyaç olduğu açıktır. Hem*

Delphi çalışmasına katılan katılımcıların görüşleri hem de literatür taramasından elde edilen bulgulara göre geliştirilecek olan bir E-argümantasyon yazılımı basit ve sade bir arayüze sahip olmalı, kullanıcıların grafik ve şema çizmesini, tartışma haritaları oluşturmasını, incelemesini ve paylaşmasını kolaylaştıran bir platform tarafından desteklenmeli, görsel açıdan zengin içeriğe sahip olmalı, animasyon ve simülasyonlara yer verilmeli ve süreç boyunca öğrencilere rehberlik edecek ve ihtiyaç duyduklarında onlara başvurabilecek bilgi paketleri/rehberler sağlamalıdır. Çalışmada bahsedilen eğitim teknolojisindeki güncel gelişmeler ve fen eğitiminde argümantasyonun önemi dikkate alındığında geliştirilecek çağdaş bir e-argümantasyon yazılımı bu bağlamda çözüm olacaktır. Yeni e-argümantasyon yazılımı, çalışmanın ihtiyaç analizi sonuçlarını dikkate almalıdır. Bu bağlamda yazılımın öğretmenlerin ve öğrencilerin argümantasyon sürecine ilişkin karşılaştıkları mevcut sorunları ortadan kaldırması; pedagojik, teknolojik ve bilgi/içerik özellikleri dikkate alınarak geliştirilmesi; modern ve kullanışlı bir arayüze sahip olması; tüm argümantasyon yaklaşımlarına uyumlu olması; etkinlik, kullanılabilirlik ve fayda açısından mevcut argümantasyon yazılımlarından daha iyi olması beklenmektedir.

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Conflict of Interest

The researchers do not have any personal or financial conflicts of interest with other individuals or institutions related to the research.

Ethics Committee Declaration

This study was conducted with the approval of Bolu Abant İzzet Baysal University Ethics Commission dated 10.10.2018 and numbered 2018/08.