Using Computational Argumentation to Support eParticipation

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# Table of Contents

ABSTRACT ............................................................................................................................................ 4

1. Introduction .................................................................................................................................. 4
   1.1. Background .......................................................................................................................... 4
   1.2. Motivation and research questions ....................................................................................... 5

2. Research method ........................................................................................................................ 6

3. Arguments and Dialogues .......................................................................................................... 6

4. Computational models of argumentation ................................................................................... 9

5. Tools Analysis ............................................................................................................................. 9
   5.1. Application Domains .......................................................................................................... 9
   5.2. Type of visualization ......................................................................................................... 10
      5.2.1. Maps and schemes category ....................................................................................... 10
         Argunet .................................................................................................................................. 10
         Arucaria ................................................................................................................................ 12
         AGORA: Participate – Deliberate ....................................................................................... 13
         bCisiveOnline ...................................................................................................................... 13
         Cohere ................................................................................................................................ 14
         CoPe_it! ................................................................................................................................. 14
         Debategraph ......................................................................................................................... 15
      5.2.2. Discussion boards category .......................................................................................... 16
         Arguehow ............................................................................................................................. 17
         Debatewise ............................................................................................................................ 17
         Parmenides .......................................................................................................................... 18
         Highland Youth Voice ......................................................................................................... 19
         Ur’Say .................................................................................................................................. 20
         Gov.uk ................................................................................................................................. 20
         QuestMap ............................................................................................................................ 21
      5.2.3. Multiple view category .................................................................................................. 21
         Trellis ................................................................................................................................... 22

6. Discussion and results .................................................................................................................. 23

7. Conclusion .................................................................................................................................. 23

8. Resources ..................................................................................................................................... 24

Appendices ........................................................................................................................................ 26
   “Appendix A: Taxonomy of the visualization argumentation” ...................................................... 26
   “Appendix B. Comparison of features for schemes and maps category” ..................................... 32
“Appendix C. Comparison of features for schemes and maps category” .......................... 33
“Appendix D. Features for multiple view category”.......................................................... 33
**ABSTRACT**
This paper analyzes different existing tools for eParticipation and collaboration from the aspect of visualization of argumentation. The domain of reference of tools, purpose for what they are designed for, the way they visualize argumentation and argumentation mechanism are discussed for each of them. Due to the lack of relevant paper of research, we aim to address this issue in this paper. The output of the research presented here was a list of features that have been practiced in the visualization of argumentation. A set of important features for each category is then derived and discussed from the comparison of the tools. Representative categories are extracted by comparing them on the aspect of visualization argumentation as our main outcome. It is hoped that future studies in the same field will use these data for future analysis.

1. Introduction
Online collaboration tools can help us to work on a specific topic or document, collectively and allow us to speed up the creating, editing reviewing of project materials as well as share ideas. This was known as a serious way to involve people in politics, and helps them to understand decision-making processes in an easier manner. Coming after two subsections will present argumentation as a foundation for all the online collaboration tools, motivation and research questions.

1.1. Background
The great interest for argumentation starts from non-experts groups such as users who claim to have found simply, natural and interactive mechanism of communication, to the experts who deemed argumentation useful for education, analysis and development of science. The reason why argumentation has found place within every aspect of life is due to the fact that critical thinking helps all of us recognize when an idea or theory is incomplete or unclear and helps us to find the truth and gain knowledge.

This art is often used to help people safeguard their beliefs or personal interests and therefore the arguments can often be found in many fields such as law, ethics, policy, philosophy and human sciences [1]. These fields are usually called “ill-defined domains” since they need solutions for “ill-structured problems”. Ill-defined domains usually can be presented in many different ways according to personal beliefs, knowledge and levels of abstraction. They are without clear goals or they can easily be changed during the discussion and therefore cannot be easily defined. In such cases the restrictions cannot be performed until a solution cannot be expressed as right or wrong, but in terms of worse, acceptable or not acceptable [1].
For example, assume that a pregnant woman before the birth of the child wants to know the sex of the child, as well as whether all internal organs are growing well. Ultrasound examination will be sufficient for this information and ensure some information which is known and stated such as baby’s physical condition. This is a "well defined" problem where constraints have been defined and are the same for everyone dealing with the same problem. In the case when the same pregnant woman should choose the best place where she can give birth to her child, she would have a couple of possibilities such as a hospital, at home or underwater method. In that case there is no right or wrong answer which is “Ill-structured” problem [1].

E-democracy is a growing area of interest for governments who wish to engage citizens in the process of participation. Generally participation has become a highly political issue over the last few years, and that eParticipation is seen as a major factor in this development. Information and communication Technologies (ICTs) allowed eParticipation to help people to be involved in politics, as well as allowing the decision-making processes easier for understanding.

To contribute the development of science and support eParticipation, scientists have developed various tools for visualization of argumentation where several systems use computational argumentation to achieve this. These tools encourage public participation in debates concerning policy issues that have been recognized as a good way to engage the electorate with political consequences. In addition, such systems for eParticipation can gather, make available, and analyze the public’s contributions to political debate.

1.2. Motivation and research questions
These facts motivated us to study mechanisms for argument representation in the eParticipation as well as tools features such as “Type of visualization”. The objective of this research is to answer to the following questions:

1. What is the importance of argumentation for eParticipation?
2. Which mechanism for argument representation and evaluation are used in tools for eParticipation?
3. How tools for collaboration and eParticipation visualize argumentations?
4. What is the benefit of eParticipation from argumentation systems?
In this direction this paper analyzes different existing computational tools for eParticipation. It was formed a synthesis of the characteristic of each of them which will be the basis for creating categories of tools for e-participation and collaboration. The rest of the paper is organized into the following structure: The second section of this work present research method. The third part of this work was dedicated to the Theory of Argumentation and computational models for Argumentation. The fourth section is dedicated to the research method. It presents in detail process of searching, extracting the tools and information about, as well as searching for relevant papers. Due to the lack of relevant paper of research, we aim to address this issue in this paper. The output of the research presented here was a list of features that have been used in the visualization of argumentation in eParticipation. This section also indicates the progression of our own research presenting criteria and main output. The fifth section is devoted to the analyzing of tools and presenting different categories of visual models and visualization tools inside, while the final two sections represent the findings and conclusions of this analyzing.

2. Research method
The study used a “literature review” method for collecting papers, extracting tools, comparing them and analyzing the features. Following keywords were used in the searching phase: ‘Visualization’, ‘Argumentation’, ‘argumentation theory’, ‘critical thinking’, ‘diagramming’, ‘informal logic’, ‘Annotation’, ‘collaboration’, ‘argumentation for eParticipation’ and ‘collaborative decision making’ as well as the names of tools for the continued collection of material.

Based on the collected papers it was created taxonomy of the visualization argumentation which looks at the tools from the type of visualization point of view. The proposed taxonomy discusses the following criteria: “Application domain”, “Purposes”, “Type of visualization”, “Mechanism for argument representation” and other relevant criteria explored during the research.

After “literature review”, for certain tools, we tested them by ourselves which allowed practical insight into the argumentation visualization and the features of the systems used in process of collaboration.

3. Arguments and Dialogues
As we explained, argumentation always has two sides which mean the offering of an argument presupposes a dialogue between two sides. An argument is useful in a framework of
Dialogue thus it contributes to the collective goal of the dialogue. Beside arguments, dialogue contains explanations and instruction on how doing something.

According to the D. Walton [2], any dialog containing argumentation can be identified by following points: the issue, the viewpoints of the participants, the characteristic of civility, the opposition of viewpoints and the use of arguments [2]. The issue contains statements and question that should be answered. The Viewpoints of the Participants contains presents point of view of the proponent and the respondent. The characteristic of civility is a role where participants try to prevent the other side from expressing her/his point of view in a way that other part is verbally or physically attacked. The opposition of viewpoints means that one thesis can be true only if other is not. The final step is the use of arguments with a goal to change point of view of the other side and push other party to come and accept the arguers’ point of view.

Some of the indicators that dialogue is finished Conclusion Indicators are termed "therefore", "thus", "hence", "consequently", "we may conclude that", "so", "it follows that accordingly", while Premises can often be identified by the following expressions: "Premise Indicators", "since", "for", "because", "given that", "for the reason that", "seeing that" [2].

These dialogues are identified as several different types such as negotiation dialogue, inquiry, deliberation, information-seeking dialogue, and eristic dialogue ([3], [4]). According to the Douglas Walton [2] the following table represents characteristics of each type.

For eParticipation and collaboration three types are particularly useful: Persuasion, Deliberation, Debate and Dialog.
A persuasion dialogue is dialogue where each party has different viewpoints on the same issue that means that one party is opposed to the other. In one special type of persuasion dialogue, known as critical discussion, has proposed to solve the central conflict in a way to indicate that one party's viewpoint has been successfully defended. The debate represents personal beliefs of the participants although deliberation promotes the suspension of judgment of other people's beliefs. The fact that debate tends to examine the other participants wrong is the reason why it is called oppositional. On the other hand deliberation tends to find common understanding which gives it a collaborative feature. In debate users search for weaknesses in another position while in deliberation they look for strength in another position. It also increases knowledge, enhancing the quality of decisions. The aim of the debate is to search for obvious differences suppressing other positions at the expense of the relationship while deliberation involves caring for others assuming that all participants have part of the answer to the solution. In the dialog, participants have the opportunity to exchange opinions and the topic. In this slow process they usually listen and clarify problems without decision [3].

Argumentation contains four following phases: identification, analysis, evaluation and invention. Identification has task to identify the premises and the conclusion of an argument as found in a text of the discourse. A part of this task is to ascertain whether a given argument found in a text fits a known pattern of argument called an argumentation scheme. The task of analysis is to find implicit premises or conclusions in an argument that need to be made
explicit in order to properly assess the argument. The parameters of the sort found in natural
language texts of discourse tend to leave some premises, or in some instances the conclusion,
implicit. An argument containing such missing assumptions is traditionally called an
enthymeme. The task of evaluation is to determine whether an argument is weak or strong by
general criteria that can be applied to it. The task of the invention is to construct new
arguments that can be used to establish a specific conclusion.

4. Computational models of argumentation

Computational model of argumentation contains following layers: Logical layer, Dialectical layer, Procedural layer, Rhetorical layer. The Logical layer applies argumentation schemes to make effective arguments. The dialectical layer offer structuring, evaluating, and comparing arguments, and supporting moderation while Rhetorical layer helps participants to select and present arguments. Use case diagram (Figure 2) is divided into the mentioned layers. As we can see one person may hold more than one function, some functions may be combined or some functions may need to be differentiated further.

5. Tools Analysis

At the base of reviewed papers, 9 tools were extracted for visualization of argumentation for eParticipation. The following two categories were extracted: “Map and schemas” and “Discussion boards” categories. The category of maps included tools that present argumentation by showing diagrams composed of nodes, boxes and arrows. In the category of Discussion board tools which use different kind of forums and blogs were included. After literature searching, it was clear that there is a small number of papers related to the discussion board category. This was the reason why for certain tools user account was created on the system of tool that allows testing of the same and practical insight into the visualization and the features of the systems used in process of visualization.

The two following subsections describe following criteria for categorizing tools: Application domain and Type of visualization.

5.1. Application Domains

Two main categories of application domain were detected. Educational category teaches critical thinking and discussion skills are tested in an educational environment. General application domain gives possibility to create, connect, and share ideas and argumentations of any type. Collaboration domain offers team problem solving and real-time collaboration.
5.2. Type of visualization

In this section are briefly described representative tools in the following categories: Maps and schemas and Discussion boards. To obtain more insight how tools for each category generally visualize argumentation, we provided snapshots some of the tools.

5.2.1. Maps and schemes category

Basically schemes and maps have been created with motivation to help teach and develop skills of critical thinking necessary for writing scientific works for example [5]. They give us possibility to have fast overview over the state of a debate as well as possibility to remember complex argumentation structures while logical reconstruction offers evolution of arguments with detailed analysis and dialectic strategies. It can help us to be focused on important parts of the debate by reducing irrelevant or redundant information [5].

To visualize arguments maps produce diagrams composed from the box and arrow where the premises and conclusions are formulated as statements. The statements are represented by nodes which are connected by lines to display interfaces and arrows representing their direction [1]. Simple argument contains a reason (known as premise) and contention. This structure is depicted in diagrams where every reason contains at least two distinct claims, known as co-premises and every significant term or concept in a simple argument must appear in least two claims (co-premises or contention). When we have multiple premises some of the tools map it, by putting each premise in its own claim box or presenting all the premises together in one reason box below the contention while between connection’s box and reasons are mostly used arrows [6].

Tools in this category mostly do not offer blogs, sharing tools or possibility for uploading materials. All features for this category are presented in Appendix _. Following sub-sections will describe in detail representative tools in this category.

Argunet

Argunet is a software tool (Figure 3), for visualizing the structure of complex argumentations and debates which lies in the theory of dialectical structures and as such allows multi-level argument-based reconstruction [7]. In this theory dialectical relations (Figure 4) are set by the logico-semantic relations between the arguments, premisses as well as conclusions. Relations between propositions establish relations between arguments. The Argunet contains two editors, the graph editor and argument editor and involves four steps in the reconstruction of the debate.
Editors are placed adjacent to each other so the user can simply follow both of them. The first step is sketching out the main ideas and important relations in the graph editor which allows the user to keep track of the complete picture. In the second step its reconstructing arguments and arguments are represented as a list of propositions. Additional information such as references, hyperlinks and resources can be stored with arguments. In the penultimate step we define semantic relations between propositions by drawing red or green arrow from one to another argument top in the graph editor. If an argument supports a sentence of another argument, a green arrow is drawn from the former to the latter; otherwise the red arrow is drawn from the former to the latter. If the relations have been logically reconstructed arrow is drawn trough boxes. When the arrow is dashed it means that the support relation is not logically reconstructed. If we click on the arrow we can see which sentences are defined as equivalent or contrary. Sentences are visualized as framed white boxes and arguments as color boxes. Organizing complex debates is in the final step. First of all, if graphs become too large visualization of different elements can be moored. In this step we have possibility to see debate graph as well as a sub graph of it. This possibility allows us to visualize how a debate is composed. This tool can be used locally on a single computer as well as over the internet in collaborative mode. The collaborative mode allows multiple clients to work together on the same debate in real time. If user wants they can easily copy back and forth between local and online debates. Because of the all mentioned characteristics it can be used in online debating, for collaborative research and reconstruction projects or as an e-learning application ([8], [9]).
Abbildung 4: Dialectical structure of Argunet

Arucaria

Arucaria is software for argument analysis, diagramming and representation, useful for education and research [10]. This system provides a point and click interface [1] which supports the diagramming process where argument structure is described using XML [10]. Relationships between arguments, claims and reasons are drawn as a tree. The main window, the schemes editor and AraucariaDB online repository are the main parts of the software. The main window (contains two panels) at the base of loaded text file, allows constructing of argument diagram which is shown in the right panel. The text in the left panel cannot be edited after it has been loaded into the software but components can be deleted from the diagram as well as “undo” or “redo” features. By default, text in the left panel contains only labels but the software allows producing a full-text diagram which contains premise or conclusion of each node [10].

Reconstructed enthymemes are shown in boxes with a shaded background. Refutations are presented in boxes with darkling shading and reconstructed refutations are diagrammed in boxes with hatched shading. Each premise or conclusion can be associated with one or more owners. It can be defined in the ownership editor dialog with a three-letter acronym, which is used to label a node on the main argument diagram. All nodes in a diagram as well as supported arrow can also have an associated evaluation. Evaluations are displayed as labels next to the node or arrow. Users can group schemes together into scheme sets. A scheme may be defined by defining a name, conclusion, premises and critical questions for each of them. After loading scheme sets (displayed as shaded region), each scheme can be selected. To look
for arguments, Araucaria provides an interface via the net as a connection to a database, which allows users to search the Araucaria database for arguments using several search criteria. Beside search users may add their own marked up arguments to the database. The AraucariaDB may be searched in three ways: Database can be searched by parts of the diagrams, by the name of the scheme or standard text search object. It does not yet support regular expressions in text searching. After analysis diagram can be exported as JPEG images [10].

**AGORA: Participate – Deliberate**

AGORA: Participate – Deliberate is a web-based argument mapping tool for collaborative argument construction and debates which use logical argument mapping. It stimulates reasoning, deliberation, creativity in collaborative as well as individual argument construction. Statements which provide a justification for a claim, a thesis, or a recommendation are located at top left corner of the screen. Reasons for the claim are at the right side [11].

User needs to choose an argument scheme (modus ponens; modus tollens; disjunctive syllogism; not-both syllogism; conditional syllogism; equivalence; [12]) to complete each statement. For example “modus ponens” can be in the form “if – then” and then the software creates the enabler so if the reasons provided are true, the conclusion will be necessarily true. All arguments maps are located under the tab “My maps” [11].

**bCisiveOnline**

bCisiveOnline is made for real time collaboration and team problem solving, decision making and planning as well as compelling presentations. The uniqueness of this tool is audio conferencing [12]. It uses set of boxes in combination with visual language to create map. The tool has predefined icons which represent following possibilities: situation, question, option, idea, pro, con, evidence, fix, example, box, requirement, challenge, and task, assigned to. They are embedded in an intuitive drag-drop interface and can be easily dragged onto the workspace. To support documents, users also can drag and drop images and web addresses from embedded web browser or their desktop. They have offered templates, notes and colors to increase their discussions, analysis or presentation. Presentations can be exported to PowerPoint while with only one click they can produce memo, white paper or summary with their decision and reasons behind it [13]. Maps can be inserted in blogs with possibility to pan, zoom, hide and show parts of the map [12].
**Cohere**

With the Cohere tool users have ability to individually or in groups annotate sections of the online text which belongs to the sphere of their interest and give a personal interpretation of the same [14]. Furthermore they can create and share their own ideas. These ideas can be personal opinions they want to organize, discuss and share online. Users also can import blogs and discussion forums to create new ideas. Ideas can be researched, organized, edited, connected, and bookmarked from users’ personal page while every idea/annotation is associated to the specific site. As such it presents a personal notebook which presents annotated websites together, created a semantic connection with the users' ideas and other people’s ideas as well as the list of groups and people with which the user shared his contents. This involves two main functionalities of Cohere: classification of annotations and semantic connections between notes. Each semantic connection is represented as a triple node-link where each element can have a different author. The collaborative annotation function is enabled by in-context and cross-content discussion informed by several web sources. If the annotations are on the same webpage they have a pink border otherwise they have an image which is symbolic for another webpage [14].

**CoPe_it!**

CoPe_it! Is a web-based platform created with aim to make easier supporting of argumentative collaboration learning as well as to foster the growth of and augments the collaboration within communities. First of all users must be registered to use this platform after which they have possibility to create individual or collaborative workspace or join to the existing workspace. A workspace can be public or private and is identified by the title given during its creation process. A public workspace is accessible by all community members while a private workspace is reserved only for creator of it. Inside of a workspace they can share ideas, comments, notes and multimedia documents (pictures or videos, etc.) called Collaboration Object. Collaboration Objects may be efficiently transformed into other types of Collaboration Objects. For example, the Comment may be transformed to an Idea or a Note and vice versa. The date, name of the creator and the name of the object is shown with collaboration object. They can be grouped together while colored rectangles can be used for grouping related objects. Objects are connected with arrows where the width and color of the arrow may be selected by the user. Users also can add a legend of the interrelation between the two objects [15].
Uploading of Collaboration object is allowed from a personal computer or from the Internet. After determining the desired material in the workspace, it can be moved around the workplace in order to be organized and visualized. In addition it is possible to group it or interrelate it. The working environment contains two panes: the main pane contains the workspaces where the user works. Additional pane contains tools for searching the web which allows users to search the web inside of the tool. It also contains a quick links bar, a bookmarks area [15].

CoPe_it! Offers possibility for aggregation, categorization and structuring information, providing different levels of details and mechanism to support information filtering. Filtering mechanism allows users displaying only items that show up certain criteria. The History mechanism provides insight into the development of the workspace through time such as updated relationships; uploaded items etc. while the workspace tool provides an overview of maps and enable an easy and quick navigation [16].

During the manipulation of workspace, users have the ability to use different visualization environments such as: Desktop view (Default view), Forum view, Formal view and Context view [15]. In Desktop view users may insert collaboration objects or provide links to web resources which is visualized accordingly in 2D “canvas”. Forum view shows articles sorted by creation date in the vertical direction. Formal view displays items in a hierarchical way with tree structure where the root of the structure is the name of the view. Tree structure is completed with all items which are linked together with the scoring mechanism following the number of positions and their weights [15].

**Debategraph**

Debategraph is an online portal (Figure 5) created with the aim to help groups collaborate on complex issues [17]. It allows individual debate and dialogue maps (and the graph of interrelated maps) through different types of bubble, box tree and outline views that have complementary strengths and that are accessed via the View menu. There are many places and cases where we can use DebateGraph such as Conference reporting and engagement, creating our own maps, discovering clusters of interrelated topics, embedding maps on our own website, facilitating group dialogue, making and sharing posters, making decisions and managing action arising, network governance, teaching and collaborative learning and telling non-linear stories. In Conference reporting and engaging participants can build on the conference theme before, during and after the event.
Furthermore organizations can use DebateGraph to create their own maps and limit searches to their own organizations maps as well as embed them in their own website or on multiple websites where any changes on one of them will be immediately updated across all others websites or explore clusters of interrelated maps. This is very helpful for live meeting. Building the maps between meetings allows all participants to follow and join the process at any time. If we need to guide people through key point of the topics we can create posters. This type of collaboration helps globally distributed networks to deliberate on very complex and interrelated problems.

The map is built in three steps. The first step is presenting subject through ideas. The second step is creating relationships between ideas and the final step is presenting ideas and relationships visually [18]. The view menu gives possibility to toggle between different visualizations of the map or parts of the map. A lot of possibilities is allowed here such as: Bubble views, Tree views, Radial Graph views, Box views, Outline views, Page views and Document views ([17], [18]).

5.2.2. Discussion boards category

For debating and analyzing this category provide argument contribution types using Pro and Cons section. This section mostly contain two vertical columns (Supporting and Opposing), next to each other. In that column are boxes within which are the participants' comments. In very rare situations this section is presented in one column with color dots that indicate supporting and opposing arguments or as a question / answer forum. Argumentation boxes contain users’ information which is sometimes followed by like a button or other
relevant information such as number of votes. In order to sustain the argument some tools offer the possibility of uploading images or video.

As an important element in the visualization of arguments is detected blogs, forums as well as voting systems.

Blog feature helps users to understand how the tool works. This feature usually present instruction manual tools, snapshots and other useful tools information. These articles as well as arguing topics can be shared. Beside Blogs some of the tools provide Forums as well. Forums are mostly used for additional Discussing, Organizing and connecting between participants. With different characteristics they concerning focusing, argumentation and the production of constructive activities are used [20].

“The voting process is a logical approach to capturing the resulting group dynamics of the discussion and the type of tool to do this could be the following three dimensional visualization “ [20]. Most of the tools in this category offer an embedded voting mechanism that resolve disagreements. All features for this category are presented in Appendix C at the end of this report. Following sub-sections will describe representative tools of this category.

**Arguehow**

Arguehow is a web-based system which provides discussion board to help users distill their positions rather than debate in the general domain. It offers a broad range of topics in categories such as: celebrity & pop culture, general issues, politics, art & literature, consumer goods, lifestyle, sports & games, business, current events, miscellaneous, science & technology. It also offers top topics, hot users as well as hot comments for one week selecting newest comments, highest reputation and random comments in separate columns. Arguments for and against selected topics are represented in two columns (one below the other) where users in separate boxes can see the arguments, authors and the number of votes [21]. This interface allows users to start a reputation from 50 which can be increased or decreased according to the votes [12].

**Debatewise**

Debatewise is a web-based platform created with the aim to better inform users who like to make decisions on the basis of gathering information. They have a possibility to spread their opinions to a wider audience, gather more supporters and the opinion of others use their opinion to refine their arguments [20].
After creating an account and logging into the system user get Dashboard with three windows offering topics: In Right Now window, information about posts, visited pages, categories, tags, details about the discussion. The dashboard can be changed in the sense of removing one of the mentioned windows. Debate can be initiated in the following categories: Current Affairs, Sport, Arts and Entertainment, Business and Religion. When the user chooses the desired categories and topics, getting page in which system offers three tabs: Home, where they can see the advantages and disadvantages for actual title which are shown in a column titled Pros and Cons below. The card is entitled Discussion where the user has a retrospective of all the comments (forum) and the History tab, which shows the list of authors and dates for a particular post and button Compare Revisions. This allows users to see the retrospective of opinions for and against the topics addressed [20]. History can be edited for each pro and cons point. The debates are taking place between the two teams and other users can comment and vote [12].

Parmenides

Parmenides (Persuasive ARguMENt In DEMocratieS) [22] is a web-based tool for deliberative democracy created with the aim to present political action to the public so that users can share their opinions about presented issues. This way of debating was recognized as a good way to gather public opinion about political issues and to bring democratic process into the online world. The whole system consists of the three main components: Debate creator, Parmenides interface and Analysis tool [13].

Debate creator is a part of the system where a system administrator creates a debate with all necessary data such as debate title and the question posed the initial position of debate and technical detail. Parmenides interface is a website which transfers data into the database while Java-based analysis tools take the individual critiques that users have submitted to the database and produce statistics about the popularity of individual arguments [13]. To take participation in debate it is enough that users choose desired Name or Alias.

Present policy proposals in the forum are shown through argumentation schemes and critical questions. The argumentation schemes (in front-end) are used to structure and relate gathered opinions while argumentations framework (back-end analysis tools) analyze the opinions submitted by users. The opinions of users are expressed with Yes, No or N/A (if they do not wish to provide an answer to the question) answers [13] at selected points. These answers are
written to a database so that information as to which points of the argument are more strongly supported than others can be collected.

The argumentation is done at the base of the AS1 scheme [23] described by Katie Atkinson, Trevor Bench-Capon, and Peter McBurney. This scheme represents an extension of the Walton’s sufficient condition scheme for practical reasoning [13].

Walton’s original scheme is as follows [13]:

“W1: G is a goal for agent a, Doing action A is sufficient for agent a to carry out goal G, Therefore, agent a ought to do action A. The purpose of Atkinson, Bench-Capon, and McBurney’s extended scheme, which they label AS1, is to differentiate several distinct notions conflated in the “goal” of Walton’s original scheme. [13]“

AS1 is stated as follows [13]:

“AS1: In the current circumstances R, we should perform action A, which will result in new circumstances S, which will realize goal G, which will promote some value V. [13]“

Making the Walton’s notion more explicit by separating it into action, goal and the value, AS1 provide justification of proposals for action (move from one state of affairs to another). The system contains 16 critical questions that can be considered as an attempt on the argument it is posed against.

It also contains additional tools such as tools to allow the system to gather opinions on different topics of debate, to analyze the data collected from opinions submitted through the website and tools for demographic profiling of users [23].

**Highland Youth Voice**

To encourage young people of secondary school age (11-18) of Highland to participate in democratic decision making about their lives, Ann Macintosh and her colleagues created a system which had presented novel and easy method of voting. It addresses following main questions: Is it possible to make online voting reasonably secure? Did the e-voter site engage voters’ attention and participation, with news and opinion [24]? It also had aim to reduce administrative overheads in distributing paper ballots, organizing the ballot, and counting the returns [24].
The web site contains a couple of sections, such as “HYV news”, “Your Voice” and “Reps and Election section”. The News section contains news, events calendar, and proceedings from meetings, photo journals and summaries of achievements. The Your Voice section presents a policy-debating forum [25]. Your Voice offers a series of workshops to the all young people (aged about 12-18) in the region. They can read the background to a debate, read each other comments and make their own. Background information for debate is provided by the experts. The discussion forum for the members is allowed in the Admin section while the public have "read-only" right to the Your Voice section. The reps and election section contains information about who the representatives are. The section also contained information about the HYV Executive Committee and a questionnaire for ex-members [25].

**Ur’Say**

Ur’Say presents Discussion forum in a form of a web site that allows discussion of one topic at any time. After the debate, human moderators analyze the results and present them as a short report to organizations with an interest in the findings [13].

**Gov.uk**

The Parliament in the United Kingdom offer to the citizens’ web based platform for e-petitions. It’s an easy way to influence on the government. A citizen can create, view and sign an e-petition related to any topic form the government domain of responsibility. After creation of the e-petitions government department will check the petition. During the period of one year public can sign it. If the petition collects 100.000 of signs it could be debated in the
House of Commons [26]. To create an e-petition, users must provide personal data in aim of contacting the creator about his proposal.

![Abbildung 7: A state transition diagram specifying all of the legal moves within the IBIS method](image)

The motivation for this project was idea of collecting signatures in an easy way and to communicate with participants through email [23]. Unfortunately this type of petitions suffers from the same shortcomings as paper-version. For example if the proposal is not according with some act it can be ignored. Then there is also question what happens if the petition does not encompass all of the objections that can be made against the act and there are no means by which individuals can add any other objections they may have [23].

**QuestMap**

QuestMap uses IBIS (Issue-Based Information System, Figure 7), complex problem solving mechanism designed by the Horst Rittel. IBIS mechanism was created for a conversation among stakeholders to help them to bring their respective expertise and viewpoints to the resolution of design issues. It focuses on the articulation of the main points in design issues [27]. It supports community and political-decision making [12].

A discussion ‘begins with Issue node containing a query such as “How should we do something?“ It can be also posted a Position node proposing one way to resolve our issue, and may also post some Argument nodes which support that Position. Another person may support start point with their own Arguments or may carry a competing Position responding to the Issue [27]. Other participants may post other Positions, or Arguments which support or object to any of the Positions. In addition, new Issues which are evoked by the discussion may be posted and linked into the nodes which most directly suggested them [27].

### 5.2.3. Multiple view category

This category visualizes argumentation combining first two categories. The arguments are presented through tables, graphs and arguments maps. Beside structured arguments, they offer
different types of templates that have aimed to structure and guide analytic thinking encouraging high fidelity reasoning.

They also offer graphical visualization of argumentation as well as summaries of retrieved arguments presented in tables. Trellis tool in this category is detected as representative.

**Trellis**

Trellis (Figure 8) is an interactive web-based application created in purpose of individual and collaborative conclusions in topics of interest, which use Semantic Web technologies. This tool is created with the goal to capture argumentation in any domain, grounds arguments in documents, derives consensus trust and exports semantic markup of arguments [28]. To take participations in this interface user must have an account. It allows three modes of presenting argumentation: rich, tree and table mode. In “rich mode” detailed
semantic annotation is presented with vocabulary of semantic links. “Three mode” presents basic argumentation connectors while “table mode” presents a decision making [28]. „The source for each document, including creator, publisher, date, and format, is recorded. Users can add relationships such as is elaborated by, is supported by, is summarized by, and stands though contradicted by, which the system stored in XML, RDF, and DAML+OIL [23].”

6. Discussion and results
At the end of this paper it’s introduced and compared features of all tools from the aspect of visualization argumentation. Throughout the process is made a synthesis of the characteristic of each of them which was the foundation for creating categories for visualization of argumentation. Three categories were extracted called Schemes and maps, Discussion boards and Multiple view category (Appendix B, C and D at the end of this paper).

Schemes and maps help users to be focused on important sections of the debate by reducing irrelevant or redundant data. To visualize arguments they produce diagrams composed from the box and arrow where the premises and conclusions are formulated as statements. The instructions are represented by nodes which are connected by lines to display interfaces and arrows representing their direction [1].

The discussion board category use type of forums with different characteristics concerning focusing, argumentation and the production of constructive activities [20]. For debating and analyzing this category provide argument contribution types using Pro and Cons section (two vertical columns next to each other)

Following sections will present main conclusions related to the application domains of tools and visualization types.

7. Conclusion
It was detected that tools with the same application domain use similar visual models. For instance, most of the tools for debates use discussion boards’ type of visualization while schemes are largely used in purpose of collaboration and education. The reason for selecting discussion boards for debate is the fact that this type of visualization offers the best overview of the pro and con arguments, voting and sharing system, the possibility of adding a video or a picture with argumentation, connecting and following other participants as well as sharing all materials at existing social networks. This is the reason why all processed tools for eParticipation use this visualization mode.
In the process of analyzing, one category was isolated called Graphs, contained only one tool. After detailed analysis, it was realized that this category uses identical elements of visualization as schemes categories, which was the reason to combine them into one category called schemas.

A small number of categories were defined for visualizing of arguments for the fact that the tools use very similar elements and ways of visualization.

It was determined two main categories of types for visualization of argumentation, “Schemes and Maps” and “Discussion boards” categories while the last “Multiple view” category have been derived from the first two categories. We called it “Multiple view” category because it combines elements of previously developed categories of argumentation. It visualizes argumentation not only through schemas but also various types of forms for displaying arguments. All these combined features indicate that it is developing a new class of tools for visualization of argumentation which probably has a decent feature.

8. Resources

[3] Sandra S. Hodge, Discovering Common Ground: Missouri Communities Deliberate
[4] Douglas Walton and Chris Reed , Diagraming, argumentation schemes and critical questions
[10] Chris Reed & Glenn Rowe, Araucaria: software for argument analysis, diagramming and representation, 2004
[23] Dan Cartwright, Katie Atkinson, *Political Engagement through tools for argumentation*
## Appendices

"Appendix A: Taxonomy of the visualization argumentation"

<table>
<thead>
<tr>
<th>Resources</th>
<th>Tool name</th>
<th>App. Domain</th>
<th>Purposes</th>
<th>Visualization modality</th>
<th>Mechanism</th>
</tr>
</thead>
<tbody>
<tr>
<td>[8][19]</td>
<td>Argunet</td>
<td>General</td>
<td>Multilevel argument-based reconstruction</td>
<td>MAP</td>
<td>The theory of dialectical structures</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>a) Uses nodes, color boxes and arrows</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>b) Nodes can be opened up to show arguments they support</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>c) Uses an open source federation system for sharing argument maps from a desktop tool</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>d) Uses can run their own server or use a public server, Argunet.org, which allows authors to make maps public or restrict viewing and/or editing to a specified group.</td>
<td></td>
</tr>
<tr>
<td>[1][10]</td>
<td>Araucaria</td>
<td>Education (Legal argument, and legal practice)</td>
<td>Support different typologies of users in analyzing the structure of textual arguments</td>
<td>SCHEMA</td>
<td>Rhetorical and other other methods of analyzing textual structure</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>a) Point-and-click interface in form of tree</td>
<td></td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>b) Uses nodes, boxes and arrows</td>
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<td></td>
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<td></td>
<td></td>
<td>c) Can be exported as JPEG</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>d) Use AML (open standard designed in XML)</td>
<td></td>
</tr>
<tr>
<td>[12][11]</td>
<td>AGORA: Participate - Deliberate</td>
<td>General</td>
<td>Visualize debates</td>
<td>MAP</td>
<td></td>
</tr>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>a) A web-based argument mapping tool</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>b) Uses a different types of schemas such as ponens; modus tollens; disjunctive syllogism; not-both syllogism; conditional syllogism; equivalence and constructive dilemma</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>c) Stimulate reasoning, deliberation, creativity</td>
<td></td>
</tr>
<tr>
<td>[12][13]</td>
<td>bCisiveOnline</td>
<td>Collaboration</td>
<td>Help real-time collaboration and team problem-solving</td>
<td>MAP</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>a) Uses nodes to show the kinds of discussions that it facilitates, icons and lines</td>
<td></td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td>b) Can Produce compelling presentations</td>
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<td></td>
<td>c) Can be embedded in blogs</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>No information provided</td>
<td></td>
</tr>
<tr>
<td>[14]</td>
<td>Cohere</td>
<td>General</td>
<td>Create, connect and share ideas.</td>
<td>MAP</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>a) A form of a web site</td>
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<tr>
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<td></td>
<td>b) Connection between users (and comments) are visually showed</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>c) Users can import blogs and discussion forums to create new ideas</td>
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<tr>
<td></td>
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<td></td>
<td>d) They can see the connection between their own ideas and worlds ideas and discover new people.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No information provided</td>
<td></td>
</tr>
<tr>
<td>[15][16]</td>
<td>CoPe_it!</td>
<td>Collaboration</td>
<td>Supporting collaboration and enhancing learning</td>
<td>MAP</td>
<td>IBIS</td>
</tr>
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<td>----------------------------------------------------------------------</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>a) A form of a web site</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>b) Different visualization environments such as: Desktop view which is Default view, Forum view, Formal view and Context view</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>c) Users can form groups to share maps</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>d) Maps can be imported from Compendium and entire discussions from external web forums in phpNuke format can be imported using a URL</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>e) Scoring mechanism following the number of positions and their weights</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>f) A form of a web site</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>g) Different visualization environments such as: Desktop view which is Default view, Forum view, Formal view and Context view</td>
<td></td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td>h) Users can form groups to share maps</td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td>i) Maps can be imported from Compendium and entire discussions from external web forums in phpNuke format can be imported using a URL</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>j) Scoring mechanism following the number of positions and their weights</td>
<td></td>
</tr>
<tr>
<td>Reference</td>
<td>Tool</td>
<td>General</td>
<td>Collaboration Type</td>
<td>Description</td>
<td>Framework</td>
</tr>
<tr>
<td>-----------</td>
<td>------</td>
<td>---------</td>
<td>--------------------</td>
<td>-------------</td>
<td>-----------</td>
</tr>
</tbody>
</table>
| [17][18] | Debategraph | General | Collaboration through Dialog and Debate | MAP  
- A form of a web site  
- Users can add images and videos  
- Visualizations whole map or parts of the map  
- Offers Bubble views, Tree views, Radial Graph views, Box views, Outline views, Page views and Document views of the map | No information provided |
| [27] | QuestMap | General | Collaboration | MAP  
- Allow participants to put forward ideas, pros and cons of these ideas, and questions.  
- Contains the browser, the node index window and the control panel  
- The interface contains a graphical browser on the left side, a structured index into the nodes on the top right, a control panel below the index window, and an inspection window which contains the contents of the nodes and links as well as attributes.  
- Users can apply color to indicate node and link type information, as well as node states such as “currently selected” or “matches the current query.” | IBIS |
| [21][12] | Arguehow | General | The best point supporting the position. | DISCUSSION BOARD  
- Contains Voting and Rating system  
- For and against Arguments represented in two columns (one below the other) | Web-Based Framework |
| [12][20] | Debatewise | General | To make the decision easier and spread opinions to a wider audience | **DISCUSSION BOARD**  
a) A web-based platform  
b) Debate can be initiated in the following categories: Current Affairs, Sport, Arts and Entertainment, Business and Religion  
c) Debates have Pros and Cons format (two columns)  
d) Offers the list of authors and dates for a particular post and button Compare Revisions. This allows users to see the retrospective of opinions for and against the topics addressed | No provided information |
| [23][26] | Gov.UK | Online petitions | e-petitions | **DISCUSSION BOARD**  
a) In a form of a web site  
b) Allow the public to create, sign, and deliver online petitions to the Prime Minister of Britain  
c) Made to facilitate collecting of signatures | Web-Based Framework |
| [24][25] | Highland Youth Voice | **Education**  
(Involve young people of secondary school age (11-18) to take participation in democratic decision) | Debate | **DISCUSSION BOARD**  
a) Offers online voting, e-voter, and discussion services  
b) Members get a chance to meet each other, participate in workshops, debate  
c) Contains a couple of sections: news, Your Voice and Reps and | Web-Based Framework |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th>AS1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[23][22][13]</td>
<td>Parmenides</td>
<td>Debates</td>
<td>DISCUSSION BOARD</td>
</tr>
<tr>
<td></td>
<td>Politic</td>
<td></td>
<td></td>
<td>a) A web-based platform</td>
</tr>
<tr>
<td></td>
<td>(Present political proposals to the public so that users can submit their opinions)</td>
<td></td>
<td></td>
<td>b) No necessary to have account for participating</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>c) Offers statistics about the popularity of individual arguments</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>d) Present policy proposals in the forum are shown through argumentation schemes and critical questions</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>e) The opinions of others are expressed with Yes, No or N/A answers</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>f) Contains additional tools such as tools to allow the system to gather opinions on different topics of debate, to analyze the data collected from opinions submitted through the website and tools for demographic profiling of users.</td>
</tr>
<tr>
<td></td>
<td>Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Participation of young people in constructive discussion on a series of topics)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Debate</td>
<td></td>
<td></td>
<td>DISCUSSION BOARD</td>
</tr>
<tr>
<td></td>
<td>(Discussion forum in a form of a web site that allows discussion of one topic at any time)</td>
<td></td>
<td></td>
<td>a) After the debate, human moderators analyze the results and present them as a short report to organizations with an interest in the findings</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[13]</td>
<td>Ur’Say</td>
<td>Education</td>
<td></td>
<td>Web-Based Framework</td>
</tr>
<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

AS1 (Extension of the Waltons’ schemes)
**“Appendix B. Comparison of features for schemes and maps category”**

<table>
<thead>
<tr>
<th>Tool</th>
<th>Web-based</th>
<th>Arguments representation</th>
<th>Voting System/Score based system</th>
<th>Forum / Blog</th>
<th>Sharing tools</th>
<th>Logging</th>
<th>Upload additional material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Araucaria</td>
<td>YES</td>
<td>Nodes, boxes and arrows</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Argunet</td>
<td>YES</td>
<td>Nodes, color boxes and arrows</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>AGORA: Participate - Deliberate</td>
<td>YES</td>
<td>Different types of schemas</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>bCisiveOnline</td>
<td>YES</td>
<td>Nodes, icons and lines</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Cohere</td>
<td>YES</td>
<td>Boxes and arrows</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>CoPe_it!</td>
<td>YES</td>
<td>Nodes, icons and lines</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
</tr>
</tbody>
</table>
Appendix C. Comparison of features for schemes and maps category

<table>
<thead>
<tr>
<th>Tool</th>
<th>Web-based</th>
<th>Arguments representation</th>
<th>Voting System /Score based system</th>
<th>Forum / Blog</th>
<th>Sharing tools</th>
<th>Logging</th>
<th>Upload additional material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arguehow</td>
<td>YES</td>
<td>Two column system</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Debatewise</td>
<td>YES</td>
<td>Two column system</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Gov.UK</td>
<td>YES</td>
<td>/</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Highland Youth Voice</td>
<td>YES</td>
<td>/</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Parmenides</td>
<td>YES</td>
<td>Q/A system</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
</tbody>
</table>

Appendix D. Features for multiple view category

<table>
<thead>
<tr>
<th>Tool</th>
<th>Web-based</th>
<th>Arguments representation</th>
<th>Voting System /Score based system</th>
<th>Forum / Blog</th>
<th>Sharing tools</th>
<th>Logging</th>
<th>Upload additional material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trellis</td>
<td>YES</td>
<td>Tables, graphs, tree</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>