

Argument Maps as Tools to Support the Development of New Media Literacies: A Systematic Review

Mappe Argomentative come Strumento di Supporto allo Sviluppo di Alfabetizzazioni ai New Media: Una Revisione Sistemica

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ABSTRACT

The post-digital era is characterised by the vast presence of platforms that impose their digital affordances and algorithmic control on our behaviour. This environment is challenging education and training, with implications for digital and transmedial literacy. Investigating instructional methodologies is crucial to fostering critical comprehension of such novel informational environments. Argument maps (AMs), which were first created and evaluated in static information contexts (analogical/old web), could be useful in the emergence of dynamic (post-digital) textual forms. The current paper describes a comprehensive literature review based on the above assumptions. We looked into state-of-the-art research on using AMs to handle dynamic information. We found 150 papers using a PRISMA procedure and then examined 19 of them. Our review produced pertinent data about the current state of AMs, including the types of texts on which they are used and the tools (especially digital and artificial intelligence [AI]-based) that have been employed. Our research lays the groundwork for teaching the literacies needed in new informational settings, such as multimodal, dynamic, algorithmic and data-driven contexts, with a specific focus on AMs as effective mediational tools.

ABSTRACT

L'era post-digitale è caratterizzata dall'ampia presenza di piattaforme che impongono le loro caratteristiche digitali e il controllo algoritmico sul nostro comportamento. Questo ambiente sta sfidando l'istruzione e la formazione, con implicazioni per l'alfabetizzazione digitale e transmediale. Lo studio delle metodologie didattiche è fondamentale per promuovere la comprensione critica di questi nuovi ambienti informativi. Le mappe di argomentazione (AM), che sono state create e valutate per la prima volta in contesti informativi statici (analogico/vecchio web), potrebbero essere utili nelle emergenti forme testuali dinamiche (post-digitali). Il presente lavoro descrive una revisione completa della letteratura basata sui presupposti di cui sopra. Abbiamo esaminato lo stato dell'arte della ricerca sull'uso delle AM per gestire le informazioni dinamiche. Abbiamo trovato 150 articoli utilizzando la procedura PRISMA e ne abbiamo esaminati 19. La nostra revisione ha prodotto dati pertinenti sullo stato attuale delle AM, compresi i tipi di testi su cui vengono utilizzate e gli strumenti (soprattutto digitali e basati sull'intelligenza artificiale [AI]) che sono stati impiegati. La nostra ricerca pone le basi per l'insegnamento delle alfabetizzazioni necessarie nei nuovi contesti informativi, come quelli multimodali, dinamici, algoritmici e basati sui dati, con un'attenzione specifica alle AM come strumenti di mediazione efficaci.

KEYWORDS

Argument Maps, Multimodal Contexts, Post-digital, New Media Literacies
Mappe Argomentative, Contesti Multimodali, Post-digitale, Alfabetizzazione ai Nuovi Media

Citation: Crudele, F. & Raffaghelli J.E. (2023). Argument Maps as Tools to Support the Development of New Media Literacies: A Systematic Review. *Formazione & insegnamento*, 21(3), 54-64. https://doi.org/10.7346/-fei-XXI-03-23_07

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Conflicts of interest: The Author(s) declare(s) no conflicts of interest.

DOI: https://doi.org/10.7346/-fei-XXI-03-23_07

Submitted: July 13, 2023 • **Accepted:** July 28, 2023 • **Published:** December 29, 2023

Pensa MultiMedia: ISSN 2279-7505 (online)

Authorship: Conceptualization (F. Crudele, J. E. Raffaghelli); Data analysis (F. Crudele, J. E. Raffaghelli); Methodology (J. E. Raffaghelli); Writing – original draft (F. Crudele); Writing – review & editing (F. Crudele, J. E. Raffaghelli)

Acknowledgments: This work was supported by the Doctoral Program in Pedagogical Sciences of Education and Training – SPEF (Curriculum Pedagogical Sciences) of the University of Padua.

1. Introduction

Every interaction we have with people is influenced by what we have been thinking, reading or listening to, raising the possibility of misunderstandings and disputes. Data collection and processing can be difficult (Colombo, 2018). Several researchers have raised grave concerns about people's poor world knowledge and incapacity to explain and defend their viewpoints on controversial matters (Moretti, 2010).

This is particularly true nowadays when the media context is facing critical changes. The so-called *New Media* (Balaban-Sali, 2012) have become a fundamental part of our everyday lives. New media relate to the presence of platforms such as Facebook, Twitter, YouTube and TikTok, among others. As has been pointed out in the literature, they are changing the way people communicate with each other, search for information and participate in discussions of different kinds (Balaban-Sali, 2012). Nonetheless, the presence of non-human "digital agents", such as recommendation systems, chatbots, deepfakes (Nguyen et al., 2022) and dynamic visualisations, based on the massive mining of the data from our interactions with the digital, have set the stage for new approaches in communication, reflexivity, opinion formation, identity, and civic participation (Van Dijck, 2014; Hobbs, 2020). Today, the term "quantified self" has entered the common lexicon. It suggests how technology is deeply embedded in the acquisition of data on aspects of a person's daily life, from the food consumed to mood to mental and physical performance (Lupton, 2013).

We interact with extensive, complex digital systems based on algorithmic programming, which, at the same time, are so pervasive that they make themselves invisible (Cortiana, 2017). Through these elements, it has become extremely easier to access and disseminate information that is written and unwritten, true, and untrue (Cortiana, 2017). All this raises strong questions about the educational needs for living in what we might call a "post-digital" society (Selwyn et al., 2021) and post-digital education science (Means et al., 2022).

In the face of these post-digitisation assumptions, the relationship between new technologies and their role, especially in the sphere of learning, has been probed (Ranieri, 2019; Danielsson & Selander, 2021). From this perspective, the lack of attention to digital skills training is highlighted not only by students but also by teachers, especially those in training, who report a lack of specific offerings (Ranieri & Bruni, 2018; Ranieri, 2019). Associated with this is the non-spontaneity of the transition from theorising about the potential benefits of media to inclusion in education (Ranieri, 2019, 2022). Educational pathways need to fill this gap with targeted digital literacy interventions and train people to "act digitally" rather than undergo it (Ranieri, 2022, pp. 58).

Hence, in stratified terrain, it is no longer enough to read and reconstruct an argument that is already complex and problematic (Calvani et al., 2009). Digital literacy increasingly involves new media (Scolari, 2019) and data (Raffaghelli & Stewart, 2020) as part of post-digital education (Selwyn et al., 2021). This epidemic has caused huge shifts in digital media consumption, intensifying negative platform-related

occurrences (Williamson et al., 2020). Therefore, a critical digital attitude is needed to fully appreciate the pros and cons of technology (Raffaghelli, 2022). New abilities are needed to comprehend, interpret and critically evaluate the digital world (Scolari, 2019; Pangrazio & Selwyn, 2019; Carmi et al., 2020).

2. Background

Despite being constantly immersed in communication and exchanges of information and opinions, in recent decades, there has been a pervasive preoccupation with the lack of comprehension of text and considerable difficulty in re-elaborating and expressing one's thoughts on a topic (Moretti, 2010). Today, the risk is of not being able to grasp the point of view of others after reading an article, a post or a contribution in a forum and failing to constructively engage with each other (Colombo, 2018).

Concerning this, argumentative text has always been proposed as a gymnasium for thinking and as a functional training tool for identifying different opinions and what supports them (Colombo, 2018). This textual typology, in fact, perfectly sums up the argumentative procedure: one argues a thesis about an argument and tries to provide supporting arguments, or answer various objections, to convince of the goodness of the thesis (Lo Feudo, 2018). Many students still have difficulty understanding and analysing the structure of argumentative text because it is a complicated task that requires skills that cannot be taken for granted (Alotto, 2021). The topics proposed in a text do not have a sequential nature per se (Ganino, 2020; Alotto, 2021). Very often, the key topic is surrounded by a variety of other superfluous propositions, which interfere with comprehension and increase the so-called "cognitive load" for the reader (i.e. that effort associated with memory during cognitive activities, such as learning or problem-solving) (Sweller, 1988, 2005).

Argument maps (AMs) can provide valuable support for this process. They differ from now-familiar mind maps and concept maps in that they do not merely create simple associations among concepts but make complex reasoning clearer by presenting the logical relationships between different statements (Carrington et al., 2011; Lidåker, 2018). They are designed to enable the user to keep track of the chain of reasoning (Simari & Rahwan, 2009), understand it better and be able to assess its correctness and acceptability (Alotto, 2021).

Over time, this tool has been studied far and wide to test its potential. In his study on the effects of AMs, Christopher P. Dwyer (National University of Ireland) looked at how reading and then making structured maps to represent the topic could be useful in learning and assimilating activities in the classroom (Dwyer et al., 2013). In a study done at Princeton University, van der Brugge (2018) of Melbourne University found that teaching philosophy with AMs helped students get better at critical thinking and reworking. More recent studies by Fan and Chen (2021) from the Department of Computer Science and Information Engineering at Taiwan University uncovered how a computer-assisted AM and argumentative essay-writ-

ing system supported students in learning argumentation structures and improving their argumentation skills.

The methodology of AMs, however, was conceived, constructed and used for static text types, such as the argumentative text mentioned above. Meanwhile, the information and educational scenario is moving towards decidedly more dynamic contexts. Concerning this aspect, a narrative literature review was previously conducted considering the keywords inherent to the development of argumentative skills and the need to delve into the context of literacies development, new media, and associated changes (Crudele & Raffaghelli, in press). Using the *snowballing sampling technique* (Wohlin, 2014), an attempt was made to explore the development of argumentative skills, as well as the argumentative text and AMs. Furthermore, we placed such analysis in the context of digital literacy, new media, and data literacy. Hence, four conceptual nodes were identified, and rethinking AMs in *new media* contexts was initiated.

In this study, we observed a profound evolution in how we acquire and analyse information, highlighting a gap in our thinking about the dynamism and increasingly evident fluidity of information and the pitfalls it supposes for us.

This illustrates the need for information users to be able to capture, understand and construct arguments with digital tools and within digital environments (Kress, 2010/2015). Traditional written and printed texts can no longer be regarded as the main bearers of meaning, and the very assumptions of the learner–text–understanding relationship need to be re-examined (Da Lio, 2020; Danielsson & Selander, 2021).

In such circumstances, the contribution of digital technologies to text production enacted a different process from that concerning the reading and comprehension of printed documents. Whereas the latter are generally complete, and their comprehension concerns only the skills of identifying the message contained in the text, understanding an online text, on the other hand, requires both traditional technical skills and those of tracing and reconstructing the meaning contained in the multimodal aspects of the text itself (such as images, videos, audio tracks and graphics) (Gouseti et al., 2021). It seems obvious that such a text can sometimes challenge the reading and enjoyment of the information it contains. With the right techniques, however, it is possible to immerse oneself in such a text and analyse it without difficulty (Howell, 2017).

This is proving to be less and less simple as a result of the continuous change in society, with the transition from Internet 1.0, the first phase of mass media use, to Internet 2.0, the growth phase of social networks and participatory culture on the web, and then on to Internet 3.0, which sees the web empowered and dynamized (Frau-Meigs, 2019). Not only that, today, information also encounters the global dimension of “datafication”, in which the advent of social networks and web services generates masses of digitised inputs explorable and convertible into information about people’s everyday behaviour and/or sociodemographic characteristics (Raffaghelli, 2017; Erickson, 2018). More importantly, the appropriation

and manipulation of these large amounts of data by private Big Tech companies force each person to understand algorithmic and data-intensive practices and critically learn how to navigate within them (Raffaghelli, 2018; Pangrazio & Selwyn, 2019). We are immersed in what Breiman (2001) called “algorithmic culture”, in which algorithms aggregate our news feeds, recommend products to buy, select advertisements to display and determine which news is true and which is fake (Gould, 2017). Thus, digital literacy is being integrated with so-called data literacy (i.e. the ability to search, manage and critically evaluate digital information and content on a “datafied” web) (Raffaghelli, 2018; Carmi et al., 2020).

Since 2006, there has been concern about the development of digital competence (Carretero et al., 2017; Vuorikari et al., 2022). In 2013, with the first Digital Competence Framework for Citizens (DigComp 1.0), the European DigComp, the 21 competencies that would go into outlining the digital competencies framework were defined (Vuorikari et al., 2022). Several editions followed, starting with DigComp 2.0 (Vuorikari et al., 2016) and then with the further development of DigComp 2.1 (Carretero et al., 2017) until the latest update, with DigComp 2.2 in 2022. This update not only defined the skeleton within which to arrange the details of this discussion but also offered examples of knowledge, skills and attitudes to support the critical and safe use of digital technologies. Particular attention was given to those in education and training who need to plan educational pathways to address relevant topics in modern society, such as digital skills, misinformation in social media or interaction with artificial intelligence (AI) (Vuorikari et al., 2022).

In the face of textual forms that are not only hyper-textual, dynamic and digital but increasingly data-driven and algorithm-influenced, it may be interesting to be able to reconceptualise effective supports, such as AMs, for the cognitive activity of identifying and critically discerning complex information available today.

An important first step in this direction can be traced to the interconnection between argumentation theory and AI, the development of which has been rapidly evolving over the past two decades. The first one, with its formal models of argumentation, is making significant contributions to the semantic definition of AI logic programs, while the second one is providing new formal tools for argument analysis, evaluation and information learning (Simari & Rahwan, 2009; Wambsganss et al., 2020). Indeed, it appears that research is moving towards using increasingly refined AI implementation techniques, such as machine learning, to create algorithms that automatically learn and argumentatively draw valid inferences using only the available data (Kim et al., 2022).

One innovative attempt to apply AI to academic argumentation writing practice is the pilot study of AI-supported scaffolding (AISS), an argumentation support system that would allow students to practice developing arguments and be guided by a digital scaffold in the form of prompts, examples and feedback (Kim et al., 2022). This study tested the AISS scaffold and led to promising results in terms of building stronger statements, more elaborate ideas and more

cohesive argumentative structures (Kim et al., 2022) – an excellent first contribution to how advances in AI techniques make it more feasible to design *scaffolds* for argumentation practice.

The purpose of this review study is precisely to explore and analyse the boundaries to which existing practices have gone in terms of approaches to develop an understanding of information and the critical reconstruction of meaning, as well as to identify gaps in existing research regarding the use of media to go hand-in-hand with the post-digital informational evolution we are experiencing today.

3. Methodological Approach

In this study, a systematic literature review was conducted (Bowman, 2016). A systematic review is a type of study that critically identifies, selects, and evaluates research to answer a clearly formulated and defined question (Mackenzie et al., 2012; Newman & Gough, 2020). It is a comprehensive and transparent way to conduct research that follows a well-defined protocol and runs across multiple databases, analysing, collecting, and excluding results in a replicable manner by other researchers (Bowman, 2016; Newman & Gough, 2020). In this case, such an approach seemed suitable for covering our research objective. The research questions (RQs) attempted to be answered are as follows:

- RQ1: What chronological changes have been made in research on the use and approach of AMs, notably in relation to the growing digitisation of information, in terms of paper production?
- RQ2: What informational types were most used to conduct experimentation with AMs?
- RQ3: What types of AMs have been put in place to foster the improvement of students' skills?

The RQs show differentiation made on the basis of analogue and digital information sources, AMs and a blend of the two modalities. Our goal was to encapsulate AM research on static and dynamic webs, coinciding with our backdrop problem. Therefore, we examined how the scholarly literature has addressed this unavoidable move from static (analogue) information contexts typical of the old Web to much more dynamic contexts typical of the post-digital web.

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) procedure was used to collect, evaluate, summarize, and organise Web documents (see *Table 1*). Using this method, four scientific databases—SCOPUS, ERIC, WOS and DOAJ—were scanned, two of which have mostly restricted access (SCOPUS and WOS) and two of which allow complete open access (ERIC and DOAJ). Each database used “argument maps” and “argument maps” AND “critical thinking” queries.

Identification	SCOPUS	ERIC	WOS	DOAJ	Total N
	89	21	34	6	150
Overlaps	SCOPUS	ERIC	WOS	DOAJ	Total N
	10	10	30	2	52
First step (not relevant)	SCOPUS	ERIC	WOS	DOAJ	Total N
	35	2	1	1	73
Not English	0	0	0	1	
Conference review / Descriptive papers / Opinion papers	19	7	0	0	
Not available	4	0	3	0	
Total N					25
Second step (not relevant)					6
Total N					19

Table 1. PRISMA workflow

This search produced 150 documents, 52 of which overlapped. Once these were eliminated, the first step was to screen the remaining 98 papers. At this stage, by reading the title and abstract, non-English-language papers were eliminated. Those that could not be found, conference reviews, descriptive papers and opinion papers were also excluded, preferring to opt for articles, research papers and reviews. Finally, papers that were not relevant to the intended analysis were excluded.

From this first screening phase, 73 papers were eliminated and only 25 were considered for the next screening phase. At this point, the full text of the selected papers was read. They were classified according to some previously discussed categories deemed suitable for outlining the right guidelines for delineating the perception of AMs and their use in education and learning. The categories formed a codebook and were used to code and analyse each article.

In the second screening phase, based on the cate-

gories mentioned above, two external researchers analysed seven articles (28% of the total 25 results), and agreement among the evaluators was calculated. Cohen's Kappa was 0.38, which can be interpreted as "fair agreement" (0.2 – 0.4). More specifically, starting with the percentages of agreement with the presence (85.71%) and absence (3.90%) of the attribute coded (as described in the codebook), it was possible to see that the overwhelming agreement on the presence led to the Kappa coefficient above, which must be recalled, is a probability of agreement. The actual agreement, measured as a percentage, is still relevant.

At the end of the second screening phase, six other results were deemed irrelevant as conceptual articles, a feature not highlighted in the abstracts.

The collected data were then processed using two techniques:

- Descriptive data for the 19 articles on how AMs have changed over time, incorporating informa-

tion digitisation (RQ1). Several categories were compared using this method (Table 1). The following graphs show the results.

- The same method was used to understand the study texts and AM construction technologies (RQ2 and RQ3).

We employed keyword mapping on bibliometric data to gain a better understanding of the data collected and processed and answer the three research questions (RQ1, RQ2 and RQ3) (most frequently used terms in the abstracts of the results obtained). The VOS viewer (<https://www.vosviewer.com/>) showed word co-occurrences and frequency (van Eck & Waltman, 2014). We triangulated the prior analyses to support or reject irrelevant assumptions (Table 2). Terms from 19 article abstracts constituted the corpus. Clustering frequent phrases shows their correlations in different colours (van Eck & Waltman, 2010, 2014).

Fields	Description	Subfields
Document type	Type of publication	Articles Books Chapters of a book Conference papers Descriptive papers Searches Reviews
Research topic	Relevance of the topic of the publications in connection with the research topic	Keywords
Research dimension	Research paradigm	Qualitative research Quantitative research Mixed methods
Type of information source	Text type chosen for experimentation	Analogue text Analogue and digital text Digital text Multimodal text
Type of tool	Type of instrument used to introduce the experimental variable	Analogue Ams Digital AMs
Impact analysed	Type of educational impact (learning, motivation, competence, knowledge, etc.)	Argumentative skills Critical thinking Writing

Table 2. Interpretative categories used to analyse the articles

4. Results

In the following sections, the findings are presented in response to the proposed research questions.

RQ1: What chronological changes have been made in research on the use and approach of AMs, notably in relation to the growing digitisation of information, in terms of paper production?

The time sequence is divided into five years (2004–2009; 2010–2015; 2016–2021), within which the research activity has evolved. This choice also seemed the most appropriate to trace the periods of the web's evolution and changes (initial, prosocial and data-driven)

expressed earlier. The obviously small number of papers obtained and analysed did not reveal a significant change in the trend of the research done, but progressive growth was evident.

RQ2: What informational types were most used to conduct experimentation with AMs?

It is possible to see a timid emergence along the considered period in relation to the textual typology: the five-year period 2004–2009 had 2 analogue texts (ATs), 2010–2015 had 5 ATs and 1 digital text (DT) and 2016–2021 had 7 ATs, 1 DTs and 3 mixed texts (M) (analogue and digital) (Figure 1). Thus, although the shift to digitalisation cannot be neglected, especially in the last five years (36%, four articles), the analogue still re-

mains firm. To implement students' comprehension and critical thinking skills, ATs continue to be used in instruction (64%, seven papers). For instance, there is no mention of the use of multimodal texts or digital assistance modes for visualising and/or organising subjects and information in one of the most recent

studies examined (Kaepfel, 2021). Liu and Nesbit (2018) also employed a purely analogue text form to enhance students' capacity to critically assess preconceptions and biases and rewrite a conceptually different viewpoint.

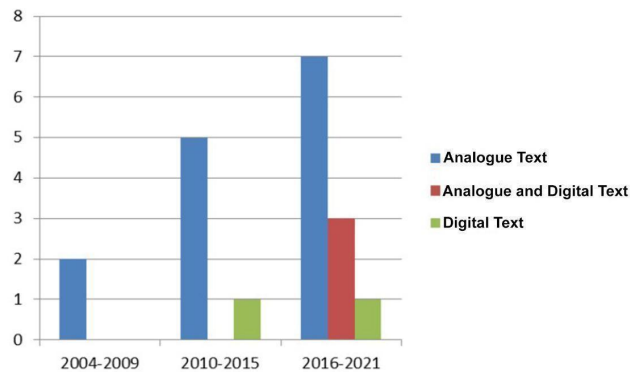


Figure 1. Type of information resource by time range

Further exploration of the literature focused on the relationship between the textual typology investigated and the type of map used. An interesting finding emerged: although AT was mentioned, both analogue (43%; six papers) and digital (50%; seven papers) maps were used. Take, for example, two studies published in the same year, in Indrawatiningsih et al. (2020), relying on analogue information, analogue AMs were implemented to support students' mathematical argumentation skills, whereas in Sönmez et al. (2020), computer-assisted argumentation mapping was used, more specifically with the support of *Reason!Able* software.

Equally interesting is how analogue AMs were used in the only case where the text had digital elements (Kabata Memi & Karaku, 2021). In fact, in this study, starting with an online social education platform with which to digitally use and collect the necessary information, it was preferred to work with an

analogue argumentative map to assess the students' academic performance.

It emerges that in the face of the data-driven and algorithmic manipulation present in most of the web, there is no reflection on a clear overcoming of the analogue in favour of the digital. Instead, a kind of mixture between the two approaches remains firmly in place. This certainly opens up reflections on which more space will be given in the following section.

RQ3: What types of AMs have been put in place to foster the improvement of students' skills?

If, however, one were to explore the use of the tool type in comparison with the identified timeline, the research seems to have focused exponentially on the dynamic and digital developments of maps over time (Figure 2).

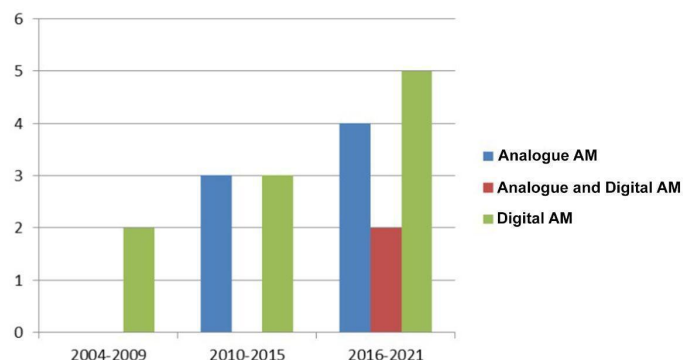


Figure 2. Type of instrument used by time range

However, the digitality glimpsed in these papers seems, for the most part, focused on the mere use of digital devices to take advantage of textual content and to support the construction of AMs. Take, for instance, the study by Gargouri and Naatus (2017), in

which critical thinking was conducted, and the first hints of digitality were translated into the implementation of the use of Mindmeister.com software (<https://www.mindmeister.com/it>) to support the construction of AMs.

Picking up then on a much more recent result of Uçar and Çevik (2020), it is also possible to see here how we talk about digitisation first in terms of learning activities carried out on a variety of online teaching methods and then in terms of the use of software, such as Argunet (<http://www.argunet.org/browser/>), for map construction. The only element of difference, therefore, lies in the software used to construct the maps.

The exploration up to this point seems to compose a truly varied picture that needs much more in-depth reflection. Specifically, there is a need to reflect on the impact uncovered by the experimental interventions. Over the past decade, research has focused exclusively on analysing the extent to which the use of AMs influences critical thinking and argumentative skills. In particular, studies that used analogue texts and analogue AMs investigated the improvement of critical thinking (43%; three papers) more than the development of argumentative skills (29%; two papers). These papers revealed how AMs helped not only in the identification and understanding of the concepts expressed but also allowed one to be open to different points of view, starting from one's own evaluation of the arguments (Kabata Memi & Karaku, 2021; Kaepfel, 2021; Dwyer et al., 2013). Thus, a deep connection was found between AM and critical thinking, a partic-

ularly necessary skill to become more objective and aware, especially nowadays, when, in the words of one study participant, it is easier to “stay in the bubble created around us as a result of algorithms and analytics, which adapt the world to your opinion” (Kaepfel, 2021, p.5).

Studies that have employed digital AMs, on the other hand, have focused purely on the development of argumentative skills (60%; six papers). These papers highlighted how the use of digitised teaching and working environments, as opposed to analogue ones, allowed the reuse, easy editing and revision of teaching materials, not only with greater flexibility but also with greater adaptation to the teaching project. In this regard, specifically, the work of Uçar and Çevik (2021) highlighted how the use of a digital tool to support the construction of AMs also offered a model of sentences and argumentative structures, on the basis of which one could model one's own argumentative proceeding – a kind of scaffolding to the increase of argumentative skills.

To complete the picture, we will now introduce the keyword map. The most frequent terms are represented by the largest and closer nodes. Four main clusters emerged, as illustrated in *Figure 3*, through the use of different colours.

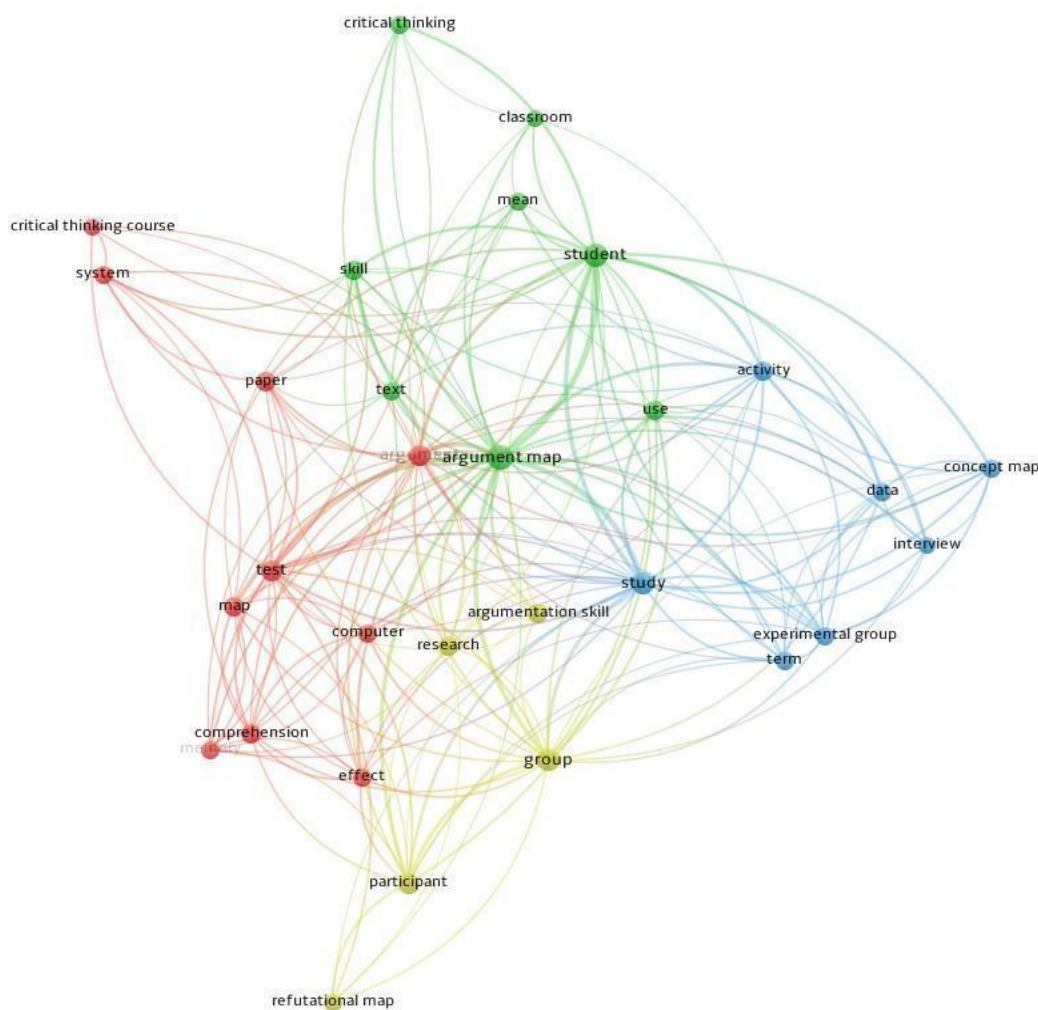


Figure 3. Representation of the bibliometric map

The most frequent word from the analysis was “argument map”, no matter how the four main groupings (clusters) develop from here, exhibiting diverse groups of terms probably reflecting semantic linkages and a focus on subjects. “Argument map” and “argument” correlated with the rest of the words differently and differentially, although they were quite near and identical.

In the first (green) cluster, it is possible to see the AMs related to concepts referring to their use in supporting students and the classroom, in terms of “critical thinking” and text comprehension, to which the words “text”, “skill”, “mean” and “use” refer. A connection is consistent with the type of impact sought in the maps and previously analysed. In the study of Indrawatiningsih et al. (2020), for example, an experiment was conducted in a class of high school students and both AT and AM were used to investigate the increase in mathematical argumentative skills. In contrast, in the study by Kaepfel (2021), with the same type of tool used, a course with maps was conducted in a university philosophy course to provide support for the development of skills, such as the critical discernment of meanings and different viewpoints.

The second (red) cluster shows the word “argument” as the central node in connection with terms such as “test”, “comprehension”, “memory”, and “map”, which support the assumption that the concept of argumentation is a necessary skill to be developed within a broader system than just the school classroom. In this case, the study of Rapanta and Walton (2016) focused on the use of digital AMs not only in support of students’ argumentative interactions but especially in view of “potential” student learning. This is one of the few findings in which the development of skills in everyday life is mentioned. In the study by Eftekhari and Sotoudehnama (2018), on the other hand, the aim was both to increase the level of text comprehension and to develop more transversal skills, such as memory and storage of the structure of an argument. It is perhaps no coincidence that both results are two of the few in which the first use of digitised mapping tools was found. In the cluster, in fact, a link appears with the word “computer”, which, however, can certainly not be translated into a present and timely reflection about the digitisation and datafication we are experiencing nowadays. However, it can be established as a thin connecting line between the inevitable influences of societal changes and the trends of the research landscape itself. Here, we might catch a glimpse of the tentative rise of the digital, but it is not enough to confirm the actual trend of developing a digital approach.

The third (blue) cluster sees the word “study” in the centre, connected then to the terms “concept map”, “activity” and “data”. A strong connection between AMs and teaching activities is always shown, but spheres of operativeness and practicality emerge. It seems, moreover, to be a clustering that emphasises the mixed methods approach required to actually immerse oneself in this topic (by the terms “interview” and “experimental group”). Consider, for example, the studies of Gargouri and Naatus (2017) and that of Kabata Memi and Karaku (2021), in which experiments were conducted to test the use of AM and conceptual, respectively, to support students’ problem-

solving skills and reading and comprehension skills of argumentative texts. In both cases, the students created moments of total immersion in activities with maps and in subsequent moments of discussion and re-elaboration of the work done. In these two investigations, a mixture of quantitative and qualitative methodologies was designed for data collection and analysis, such as quasi-experiments, tests and interviews. This, as also made explicit in the papers themselves, was done to deepen the students’ opinions and offer a supporting and complementary perspective to that offered by quantitative studies.

The last (yellow) cluster is certainly the smallest but very interesting. The central word “group”, which makes definite relationships with the words like “participant”, “refutational map” and “argumentation skill”, seems to outline all the part of active participation in the discussion that argumentation and AMs try to bring to light and develop. In Liu and Nesbit’s (2018) study, for example, we can glimpse a path of refutational maps constructed to investigate the level of critical thinking of students working in groups. In addition, therefore, to the main objective decidedly in line with the other findings previously mentioned, the element of active participation in information gathering and discussion activities in groups also emerges. Additionally, with the study by Uçar and Çevik (2021), it is possible to detect the path of analogue AMs to increase argumentative skills, which are integrated with a peer feedback moment. The study showed that collaboration encouraged the production of more complex arguments and the consideration of different points of view.

This type of analysis is relevant in delineating the many spheres with which AMs are concerned, and the representation of the keyword cluster survey reveals significant consistency with our previous picture.

5. Discussion and conclusions

The systematic research conducted was multifaceted. This survey sought to investigate and explore the current research landscape on AMs and the extent to which their use in dealing with increasingly digitised information has been considered. The systematic search identified the following findings.

Certainly, the truly insignificant number of results is in itself a relevant finding, which points to a rather interesting lack of research into the potential of AMs in the context of new media literacies. The articles of the last decade emphasise a preponderant use of analogue texts, except for a few instances in which texts and tools with more digital elements were also being considered. However, the digitality that is glimpsed seems to have a mostly instrumental aspect. Recently, software has been developed to support topic mapping and smart boards or online platforms to navigate and collect information and subsequently build maps. As we have already explored in our theoretical framework, these technical approaches have potential, but there is a need for deeper theoretical and practical reflections to offer cross-cutting paths to critically immerse oneself in emerging datafication (Raffaghelli & Stewart, 2020).

In addition, because even if using only instrumen-

tally digital media already detects slight improvements in the greater adaptability and plasticity of the student to the information he or she encounters (Chiang et al., 2016), one could reflect on a possible correlation between greater dynamism of the tool and the consequent ability to approach the dynamism of information typical of the post-digital context.

However, consider, for example, the study by Kaeppel (2021): analogue AMs were used on analogue texts in order to test the development of the level of critical thinking. In this case, despite the analogue nature of the medium, the students found the substantial utility of the course to the process of datafication in the society in which we live.

Reflection about this continuous return to analogue, therefore, leads us to ask ourselves some questions of heuristic value:

1. Can analogue still prove to be an excellent support for the approach to digital?
2. Or is it the research that has not yet moved beyond analogue to a full investigation of the facets of a medium that is fully digital in a fully digital context?

Conducting this systematic review, therefore, despite the small number of results collected, has allowed us to trace a gap in the response of the current research landscape to datafication and the development of comprehensive literacy in this process. Attention is especially to be paid to this question mark about the transition from analogue to digital.

Therefore, while the newfound desire to open up teaching and educational practices to elements of the digital is encouraging, there is still a long way to go. The fact that the role of analogue at these junctures is still poorly delineated certainly leaves one wondering as to its possible limitations and potential.

Hence, it would be necessary to undertake further research and compare different scenarios in which we respectively test the impact of using analogue-only and digital-only elements or a mixture of the two so as not to exclude any avenue for reflection. These next steps would prove to be important for a more comprehensive reading of current information needs. Future perspectives will attempt to deepen and frame AMs as a scaffold supporting the research and fruition of information immersed in dynamic and post-digital contexts.

References

This list of cited references is followed by the list of reviewed articles.

- Alotto, P. (2021). Laboratorio di argomentazione: Guida al critical thinking e all'argument thinking. In A. Sani & A. Linguisti (A cura di), *Sinapsi. Storia della filosofia. Protagonisti, percorsi, connessioni*. La Scuola editrice.
- Balaban-Sali, J. (2012). New media literacies of communication students. *Contemporary Educational Technology*, 3(4). <https://doi.org/10.30935/cedtech/6083>
- Bowman, T. (2016). *Library guides: Literature review: Systematic literature reviews*. Charles Sturt University. <https://libguides.csu.edu.au/review/Systematic>
- Breiman, L. (2001). Statistical modeling: The two cultures (with comments and a rejoinder by the author). *Statistical Science*, 16(3), 199-231. <https://doi.org/10.1214/ss/1009213726>
- Buckingham, D. (2006). *Media education. Alfabetizzazione, apprendimento e cultura contemporanea*. Edizioni Erickson.
- Calvani, A., Fini, A., & Ranieri, M. (2009). La competenza digitale nella scuola. Modelli teorici e strumenti di valutazione. *International Journal of Developmental and Educational Psychology*, 4(1).
- Carmi, E., Yates, S. J., Lockley, E., & Pawluczuk, A. (2020). Data citizenship: Rethinking data literacy in the age of disinformation, misinformation, and malinformation. *Internet Policy Review*, 9(2). <https://doi.org/10.14763/2020.2.1481>
- Carretero, G. S., Vuorikari, R., & Punie, Y. (2017). *DigComp 2.1: The Digital Competence Framework for Citizens with eight proficiency levels and examples of use*. JRC Publications Repository. <https://doi.org/10.2760/38842>
- Colombo, A. (2018). Il testo argomentativo: Presupposti pedagogici e modelli di analisi. In A. Colombo (A cura di), *Quaderni del Giscel: Vol. 11. I pro e i contro* (pp. 59-84). La Nuova Italia. <http://tinyurl.com/mryx27p2>
- Cortiana, P. (2017). Multimodalità e scrittura tradizionale a confronto: Un intervento nella scuola secondaria. *Italian Journal of Educational Technology*, 25(3). <https://doi.org/10.17471/2499-4324/915>
- Crudele, F., Raffaghelli, E. J. (in press). Ripensare le mappe argomentative nei nuovi contesti multimodali: Una revisione narrativa della letteratura. *Media Education*.
- Da Lio, E. (2020). Digital and multimodal literacies in foreign language learning: Theories and application. *Studia Universitatis Hereditatis*, 8(2), 65-79. [https://doi.org/10.26493/2350-5443.8\(2\)65-79](https://doi.org/10.26493/2350-5443.8(2)65-79)
- Danielsson, K., & Selander, S. (2021). Working with multimodal texts in education. In K. Danielsson & S. Selander (A cura di), *Multimodal texts in disciplinary education* (pp. 25-43). Springer. https://doi.org/10.1007/978-3-030-63960-0_4
- Davies, A., Fidler, D., & Gorbis, M. (2011). Future work skills 2020. *VOCEDplus. NCVER's international tertiary education and research database*. <https://www.voced.edu.au/content/ngv:49812>
- Erickson, K. J. (2018). The future of network effects: Tokenization and the end of extraction. *Public Market*. <https://medium.com/public-market/the-future-of-network-effects-tokenization-and-the-end-of-extraction-a0f895639ffb>
- Fan, C.-Y., & Chen, G.-D. (2021). A scaffolding tool to assist learners in argumentative writing. *Computer Assisted Language Learning*, 34(1-2), 159-183. <https://doi.org/10.1080/09588221.2019.1660685>
- Frau-Meigs, D. (2019). Information disorders: Risks and opportunities for digital media and information literacy? *Medijske Studije*, 10(19), 10-28. <https://doi.org/10.20901/ms.10.19.1>
- Ganino, G. (2020). Riduzione carico cognitivo estraneo e apprendimenti multimediali in un ambiente di web conference. *Reports on E-Learning, Media and Education Meetings*, 8(1), 234-239. <https://www.je-lks.org/ojs/index.php/REM/article/view/1135272>
- Gould, R. (2017). Data literacy in statistical literacy. *Statistics Education Research Journal*, 16(1). <https://doi.org/10.52041/serj.v16i1.209>
- Gouseti, A., Bruni, I., Ilomäki, L., Lakkala, M., Mundy, D., Raffaghelli, J. E., Ranieri, M., Roffi, A., Romero, M., & Romeu, T. (2021). Critical digital literacies framework for educators - DETECT project report 1. [Report, Project DETECT, Zenodo]. <https://doi.org/10.5281/zenodo.5070329>
- Hobbs, R. (2020). Propaganda in an age of algorithmic personalization: Expanding literacy research and practice.

- Reading Research Quarterly*, 55(3), 521-533. <https://doi.org/10.1002/rrq.301>
- Howell, E. (2017). Expanding argument instruction: Incorporating multimodality and digital tools. *Journal of Adolescent & Adult Literacy*, 61(5), 533-542. <https://doi.org/10.1002/jaal.716>
- Kim, M. K., Kim, N. J., & Heidari, A. (2022). Learner experience in artificial intelligence-scaffolded argumentation. *Assessment & Evaluation in Higher Education*, 47(8), 1-16. <https://doi.org/10.1080/02602938.2022.2042792>
- Kress, G. (2010). *Multimodality: A social semiotic approach to contemporary communication*. Routledge (trad. it. Multimodalità. Un approccio socio-semiotico alla comunicazione contemporanea, Progedit, 2015).
- Lidåker, T. (2018). *The potential of argument mapping as a tool for teaching critical thinking in secondary school*. [Unpublished Master dissertation]. Linköping University. <http://urn.kb.se/resolve?urn=urn:nbn:se:liu:diva-149438>
- Lo Feudo, G. (2018). Serialità narrativa televisiva: Linguaggi e testualità. *Filosofi(e)Semiotiche*, 5(2), 6. <https://doi.org/20.500.11770/288939>
- Lupton, D. (2013). Understanding the human machine. *IEEE Technology and Society Magazine*, 32(4), 25-30. <https://doi.org/10.1109/MTS.2013.2286431>
- Mackenzie, H., Dewey, A., Drahota, A., Kilburn, S., Kalra, P., Fogg, C., & Zachariah, D. (2012). Systematic reviews: What they are, why they are important, and how to get involved. *Journal of Clinical and Preventive Cardiology*, 1(4). <https://www.jpcarchives.org/full/systematic-reviews-what-they-are-why-they-are-important-73.php>
- Means, A., Jandri, P., Sojot, A. N., Ford, D. R., Peters, M. A., & Hayes, S. (2022). The postdigital-biodigital revolution. *Postdigital Science and Education*, 4(3), 1032-1051. <https://doi.org/10.1007/s42438-022-00338-9>
- Moretti, G. (2010). Lucia Lumbelli (2009): «La comprensione come problema. Il punto di vista cognitivo». *Journal of Educational, Cultural and Psychological Studies (ECPS Journal)*, 1(2). <https://www.ledonline.it/index.php/ECPS-Journal/article/view/121>
- Newman, M., & Gough, D. (2020). Systematic reviews in educational research: Methodology, perspectives and application. In O. Zawacki-Richter, M. Kerres, S. Bedenlier, M. Bond, & K. Buntins (A cura di), *Systematic reviews in educational research: Methodology, perspectives and application* (pp. 3-22). Springer Fachmedien. https://doi.org/10.1007/978-3-658-27602-7_1
- Nguyen, T. T., Nguyen, Q. V. H., Nguyen, D. T., Nguyen, D. T., Huynh-The, T., Nahavandi, S., Nguyen, T. T., Pham, Q.-V., & Nguyen, C. M. (2022). Deep learning for deepfakes creation and detection: A survey. *Computer Vision and Image Understanding*, 223. <https://doi.org/10.1016/j.cviu.2022.103525>
- Pangrazio, L., & Selwyn, N. (2019). 'Personal data literacies': A critical literacies approach to enhancing understandings of personal digital data. *New Media & Society*, 21(2), 419-437. <https://doi.org/10.1177/1461444818799523>
- Raffaghelli, J. E. (2017). Data literacy in the context of big and open data: An educational challenge. *Formazione & Insegnamento*, 15(3), 299-324. <https://ojs.pensamultimedia.it/index.php/siref/article/view/2646>
- Raffaghelli, J. E. (2018). Educators' data literacy: Supporting critical perspectives in the context of a «datafied» education. In M. K. Borges, L. Menichetti, M. Ranieri (A cura di), *Teacher education & training on ict between Europe and Latin America* (pp. 91-109). Aracne Editrice. <https://doi.org/10.4399/97888255210238>
- Raffaghelli, J. E. (2022). Educators' data literacy: Understanding the bigger picture. In L. Pangrazio & J. Sefton-Green (A cura di), *Learning to live with datafication: Educational case studies and initiatives from across the world* (pp. 80-99). Routledge. <https://doi.org/10.4324/97810031368425>
- Raffaghelli, J. E., & Stewart, B. (2020). Centering complexity in 'educators' data literacy' to support future practices in faculty development: A systematic review of the literature. *Teaching in Higher Education*, 25(4), 435-455. <https://doi.org/10.1080/13562517.2019.1696301>
- Ranieri, M. (2019). Professional development in the digital age. Benefits and constraints of social media for lifelong learning. *Form@re - Open Journal per La Formazione in Rete*, 19(2), Art. 2. <https://doi.org/10.13128/formare-25353>
- Ranieri, M. (2022). Le competenze digitali degli insegnanti. In R. Biagioli & S. Oliviero (A cura di), *Il Tirocinio Diretto Digitale Integrato (TDDI). Il progetto sperimentale per lo sviluppo delle competenze delle maestre e dei maestri* (pp. 49-60). Firenze University Press. <https://doi.org/10.36253/978-88-5518-587-5.6>
- Ranieri, M., & Bruni, I. (2018). Digital and media literacy in teacher education: Preparing undergraduate teachers through an academic program on digital storytelling. In J. Cabbage (A cura di), *Handbook of research on media literacy in higher education environments* (pp. 90-111). IGI Global. Publisher of Timely Knowledge. <https://doi.org/10.4018/978-1-5225-4059-5.ch006>
- Scolari, C. A. (2019). Dalla alfabetizzazione mediatica all'alfabetizzazione transmediale. In M. Ricciardi (A cura di), *DigitCult. Scientific journal on digital cultures* (pp. 37-46). Aracne Editrice. <https://doi.org/10.4399/97888255263184>
- Selwyn, N., Hillman, T., Bergviken Rensfeldt, A., & Perrotta, C. (2021). Digital technologies and the automation of education—Key questions and concerns. *Postdigital Science and Education*, 5, 15-24. <https://doi.org/10.1007/s42438-021-00263-3>
- Simari, G. R., & Rahwan, I. (2009). *Argumentation in artificial intelligence*. Springer. <https://doi.org/10.1007/978-0-387-98197-0>
- Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science*, 12(2), 257-285. [https://doi.org/10.1016/0364-0213\(88\)90023-7](https://doi.org/10.1016/0364-0213(88)90023-7)
- Sweller, J. (2005). Implications of cognitive load theory for multimedia learning. In R. Mayer (A cura di), *The Cambridge handbook of multimedia learning* (pp. 19-30). Cambridge University Press. <https://doi.org/10.1017/CBO9780511816819.003>
- van der Brugge, E. (2018). *The use of argument mapping in improving critical thinking* [Unpublished doctoral dissertation]. University of Melbourne. <http://hdl.handle.net/11343/214519>
- Van Dijck, J. (2014). Datafication, dataism and dataveillance: Big Data between scientific paradigm and ideology. *Surveillance & Society*, 12(2), 197-208. <https://doi.org/10.24908/ss.v12i2.4776>
- van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, 84(2), 523-538. <https://doi.org/10.1007/s11192-009-0146-3>
- van Eck, N. J., & Waltman, L. (2014). Visualizing bibliometric networks. In Y. Ding, R. Rousseau, & D. Wolfram (A cura di), *Measuring scholarly impact: Methods and practice* (pp. 285-320). Springer International Publishing. https://doi.org/10.1007/978-3-319-10377-8_13
- Vuorikari, R., Kluzer, S., & Punie, Y. (2022). *DigComp 2.2: The Digital Competence Framework for Citizens - With new examples of knowledge, skills and attitudes*. JRC Publications Repository. <https://doi.org/10.2760/115376>
- Vuorikari, R., Punie, Y., Carretero, G. S., & Van, D. B. G. (2016). *DigComp 2.0: The Digital Competence Framework for Citizens. Update Phase 1: The conceptual reference model*. JRC Publications Repository. <https://doi.org/10.2791/607218>
- Wambsganss, T., Niklaus, C., Cetto, M., Söllner, M., Handschuh, S., & Leimeister, J. M. (2020). AL: An adaptive learning support system for argumentation skills. In R.

- Bernhaupt, F. F. Mueller, D. Verweij, J. Andres, J. McGre-nere, A. Cockburn, I. Avellino, A. Goguey, P. BjØrn, S. Zhao, B. P. Samson & R. Kocielnik (A cura di), *CHI'20: Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (pp. 1-14). Association for Computing Machinery. <https://doi.org/10.1145/3313831.3376732>
- Williamson, B., Eynon, R., & Potter, J. (2020). Pandemic politics, pedagogies and practices: Digital technologies and distance education during the coronavirus emergency. *Learning, Media and Technology*, 45(2), Art. 2. <https://doi.org/10.1080/17439884.2020.1761641>
- Wohlin, C. (2014). Guidelines for snowballing in systematic literature studies and a replication in software engineering. In M. Shepherd, T. Hall & I. Myrtveit (A cura di), *EASE'14: Proceedings of the 18th International Conference on Evaluation and Assessment in Software Engineering* (pp. 1–10). <https://doi.org/10.1145/2601248.2601268>
- ## Reviewed articles
- Brooke, M. (2015). Deconstructing academic persuasive essays by constructing argument maps and analysing means of persuasive appeal. *Pertanika Journal: Social Sciences & Humanities*, 23, 113-126. <http://www.pertanika.upm.edu.my/pjtas/browse/regular-issue?article=JSSH-S0008-2015>
- Butchart, S., Forster, D., Gold, I., Bigelow, J., Korb, K., Oppy, G., & Serrenti, A. (2009). Improving critical thinking using web based argument mapping exercises with automated feedback. *Australasian Journal of Educational Technology*, 25(2), Art. 2. <https://doi.org/10.14742/ajet.1154>
- Carrington, M., Chen, R., Davies, M., Kaur, J., & Neville, B. (2011). The effectiveness of a single intervention of computer aided argument mapping in a marketing and a financial accounting subject. *Higher Education Research & Development*, 30, 387-403. <https://doi.org/10.1080/07294360.2011.559197>
- Chiang, K.-H., Fan, C.-Y., Liu, H.-H., & Chen, G.-D. (2016). Effects of a computer-assisted argument map learning strategy on sixth-grade students' argumentative essay reading comprehension. *Multimedia Tools and Applications*, 75(16), 9973–9990. <https://doi.org/10.1007/s11042-015-2904-y>
- Dwyer, C. P., Hogan, M. J., & Stewart, I. (2010). The evaluation of argument mapping as a learning tool: Comparing the effects of map reading versus text reading on comprehension and recall of arguments. *Thinking Skills and Creativity*, 5(1), 16-22. <https://doi.org/10.1016/j.tsc.2009.05.001>
- Dwyer, C. P., Hogan, M. J., & Stewart, I. (2013). An examination of the effects of argument mapping on students' memory and comprehension performance. *Thinking Skills and Creativity*, 8, 11-24. <https://doi.org/10.1016/j.tsc.2012.12.002>
- Eftekhari, M., & Sotoudehnama, E. (2018). Effectiveness of computer-assisted argument mapping for comprehension, recall, and retention. *ReCALL*, 30(3), 337-354. <https://doi.org/10.1017/S0958344017000337>
- Gargouri, C., & Naatus, M. K. (2017). An experiment in mind-mapping and argument-mapping: Tools for assessing outcomes in the business curriculum. *E-Journal of Business Education and Scholarship of Teaching*, 11(2), 39-78.
- Gürkan, A., landoli, L., Klein, M., & Zollo, G. (2010). Mediating debate through on-line large-scale argumentation: Evidence from the field. *Information Sciences*, 180(19), 3686-3702. <https://doi.org/10.1016/j.ins.2010.06.011>
- Indrawatiningsih, N., Purwanto, P., As'ari, A. R., & Sa'dijah, C. (2020). Argument mapping to improve student's mathematical argumentation skills. *TEM Journal*, 9(3), 1208-1212. Scopus. <https://doi.org/10.18421/TEM93-48>
- Kabata Memi Memi , E., & Karaku , E. (2021). An evaluation of academic achievements through the use of argument and concept maps embedded in argumentation based inquiry. *Asia Pacific Education Review*, 22(3), 463-481. <https://doi.org/10.1007/s12564-021-09679-9>
- Kaepffel, K. (2021). The influence of collaborative argument mapping on college students' critical thinking about contentious arguments. *Thinking Skills and Creativity*, 40, 100809. <https://doi.org/10.1016/j.tsc.2021.100809>
- Liu, Q., & Nesbit, J. (2018). Conceptual change with refutational maps. *International Journal of Science Education*, 40, 1-19. <https://doi.org/10.1080/09500693.2018.1515513>
- Loll, F., & Pinkwart, N. (2013). LASAD: Flexible representations for computer-based collaborative argumentation. *International Journal of Human-Computer Studies*, 71(1), 91-109. <https://doi.org/10.1016/j.ijhcs.2012.04.002>
- Malmir, A., & Khosravi, F. (2018). The effect of argument mapping instruction on L2 writing achievement across writing tasks and writing components: A case of Iranian EFL learners. *Applied Research on English Language*, 7(4), 515-540. <https://doi.org/10.22108/are.2018.111870.1318>
- Rapanta, C., & Walton, D. (2016). The use of argument maps as an assessment tool in higher education. *International Journal of Educational Research*, 79, 211-221. <https://doi.org/10.1016/j.ijer.2016.03.002>
- Sönmez, E., Akkas, B. N. Ç., & Memis, E. K. (2020). Computer-aided argument mapping for improving critical thinking: Think better! Discuss better! Write better! *International Journal of Contemporary Educational Research*, 7(2), 291–306. <https://doi.org/10.33200/ijcer.791430>
- Twardy, C. (2004). Argument Maps Improve Critical Thinking. *Teaching Philosophy*, 27(2), 95-116. <https://doi.org/10.5840/teachphil200427213>
- Uçar, B., & Çevik, Y. D. (2021). The effect of argument mapping supported with peer feedback on pre-service teachers' argumentation skills. *Journal of Digital Learning in Teacher Education*, 37(1), 6-29. <https://doi.org/10.1080/21532974.2020.1815107>