Upper Secondary School Students' Design of Arguments in Essays

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SPECIAL COLLECTION: REMEDIATION OF LEARNING

RESEARCH

ABSTRACT

This article explores how arguments are made in student essays through the use of writing and visual resources. The data set comprises 54 essays with a passing grade from students in their final year of upper secondary school in Sweden. The data is analysed using a multimodal approach to knowledge representation on arguments in essays, involving analysis of textual composition and content in both written text and visual resources. The study gives an insight into how students design essays in relation to academic requirements, how their arguments realise epistemological commitments, and what affordances are given through the use of writing and visual resources. The results reveal that academic argumentation varies considerably between the essays. There is an overrepresentation of written and declarative knowledge in the essays, where the arguments are grounded in various web-based sources, and visualisations are used for making conceptualisation and classification more salient in writing. Both written and visual resources offer affordances in the making of arguments on the bases of the modes for communication. This article concludes that there are many high demands of knowledge defined for the task of preparing for higher education, which are not easily represented in the students' arguments in essays.

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INTRODUCTION

At upper secondary schools in Sweden, students need to learn how to write an academic essay before they begin higher education. The ability to make comprehensive arguments in formal academic writing is key to success in higher education, so requirements for learning academic writing have been specified in steering documents in all upper secondary schools in Sweden. The demand for well-grounded arguments is high and, due to the increased digitalisation in society, different media and resources now offer a wide range of information for meaning-making. Students are now able to create knowledge representations and make arguments visible in any form (Selander, 2017). Recent studies highlight the array of multiliteracies, which expand concepts such as literacy, text and argument to include modes other than writing that may evoke and induce argumentation (Lea and Street, 2006; Archer, 2010; Cope and Kalantzis, 2009; Lillis and Scott, 2007; Howell, Butler, and Reinking, 2017; Huang and Archer, 2017). Even in the field of academic writing, studies reveal a notable interest in argumentation and how multimodal engagement in writing can contribute to meaning-making (Archer, 2016). However, little attention has been given to students' essay design within the frame of academic writing practice in upper secondary schools in Sweden. Many of these schools provide students with resources such as supervision and writing templates, which often contain guidelines for what an essay should contain in terms of structure and content. Nonetheless, students' arguments are shaped differently depending on the learning objectives and on the qualities recognised by the individuals within these different learning practices (Kress and Selander, 2011). Ideas of how to design argumentation in school essays, which need to be framed within an academic writing discourse, are shaped by an interplay between available resources and sources, active individuals, traditions and educational objectives. These qualities are also developed and formed within various writing cultures in schools (Svärdemo Åberg, Calissendorff and Ståhle, 2018). Nevertheless, the recognition of argumentation quality often relies on students' ability to evaluate sources, integrate concepts and ground their reasoning (Kim and Hannafin, 2016; Nygren and Guath, 2019; Solli, 2019). Students need to represent various kind of knowledge (Krathwohl, 2002) that relate to educational objectives defined in curricula. To be able to represent such knowledge, they can combine writing with visual resources in their making of arguments in essays. How students choose to make arguments visible in their essays is the focus of this study. This study thus addresses the relatively unexplored area of how upper secondary school students design academic essays. The aim of the study is to explore how arguments are realised through the use of writing and visual resources in student essays and to recognise the challenges of representing academic argumentation so that students will be prepared for higher education. The article addresses three research questions:

(i). How are written text and visual resources arranged in the essays?
(ii). What content is designed and what epistemological commitments does this content reveal?
(iii). What are the affordances of using visual representations for argumentation in essays?

RESEARCH OVERVIEW

In this overview, the research on phenomena and concepts relevant to this study will be organised into four themes: *writing within academic genre, argument in writing, multimodal argument* and *knowledge representation.* The research overview connects to New literacy studies (Lea and Stierer, 2000; Ivanič, 2004; Lea and Street, 2006; Barton, 2007) and to multimodal design-oriented perspective (Selander and Kress, 2010; Björklund Boistrup and Selander, 2021) and will be used as a theoretical framework to understand how arguments are realised through the use of writing and visual resources in student essays.

WRITING WITHIN ACADEMIC GENRE

Research on argumentation is mainly associated with verbal argumentation, which is most often realised in written form (Mitchell and Riddle, 2008). In both upper secondary school and higher education, students learn to write essays within the framework of the academic genre in order to show how they handle different types of knowledge. When students handle different types of knowledge, such as factual knowledge, conceptual knowledge, procedural knowledge and meta-cognitive knowledge (Krathwohl, 2002) and then translate them into written products, it is often described as academic writing (Lea and Street, 1998; Ivanič, 2004). Writing essays in the academic genre usually requires "linguistic clarity, scientific transparency, objectivity, critical-analytical competence, analysis, accuracy and adaptation to prevailing written language norms" (Ask, 2007, p. 16). Research shows that genre-based writing is linked to certain social situations and activities that shape the framework for writing. The academic genre is often characterised by subject-specific ideas and norms for how texts should be designed, where certain linguistic features and text-types of semantic-functional structure characterise the text to varying degrees (Ledin, 2001). Although academic writing is characterised by certain conventions, there are several other ways for students to represent knowledge within an essay. Academic writing

should thus not be seen as one type of text, but as a cluster of texts that have different communicative and epistemic purposes that are shaped by specific learning and social practices (Ivanič, 2004; Lea and Street, 1998). The overall epistemic purpose of an essay may differ, with some goals being descriptive or explanatory, while others are interpretive, normative or predictive, but they all have motives for realising different arguments and knowledge contributions. Essays may be seen as disciplinary and textual heterogeneities (cf. Lea and Stierer, 2000). Finally, there is an agreement that academic argumentation in essays is shaped by the work of scientists through domain-specific contexts and literacies within different scientific disciplines (Hyland, 2002; Macken-Horarik, Devereux, Trimingham-Jack and Wilson, 2006; Wingate, 2012).

ARGUMENT IN WRITING

In academic discourse, the understanding of the term 'argument' is often related to a philosophical construct of claims, premises and conclusions, and to methodological beliefs and practices that impact the construction of scientific and evidential reasoning (Matta, 2019). A conventional written argument refers to fundamental elements or components that consist of a set of claims supported by data (evidence) and warrants (explanations). This view of an argument is mostly influenced by the work of Toulmin (2003), who states that all these operations are integral to arguments. However, in the research, there are several different approaches to viewing an argument. According to Rapanta, Garcia-Mila and Gilabert (2013), an argument can be viewed either as a form, strategy, goal or function. The form approach is mostly influenced by the work of Toulmin (2003), where a consistent and valid argument is built upon interdependent components such as claim, data, warrant and backing. All these components are needed in an argument because a claim or proposition can never be recognised as legitimate without grounds and warrants. By using the model of Toulmin, the various forms of argumentation can be mapped. Another more strategic approach focuses on the social discursive activity, in which individuals move arguments in a direction necessary for a dialogical contribution, e.g., arguments and counterarguments for the purpose of rebutting each other's propositions. In such a view, the primary focus is not on argumentative acts, but on dialogue acts such as clarification, explaining and questioning, which are seen as co-constructive in the making of argumentative dialogue. The goal and function approach focus on what the arguments serve in the discursive process. This view, which is an approach that this study adopts, provides a wider interpretive lens on the whole discursive process of writing, on the interplay between different representations of knowledge statements, and on how they are used in essays in educational contexts. Accordingly, and related to Wingate (2012), the process of building arguments consists of three components. The first component is about analysis and the evaluation of content knowledge, where students must learn to distinguish between relevant and irrelevant information and be able to analyse and evaluate content knowledge. The second component is that students must develop their position by comparing and contrasting evidence. The third component relates to the presentation of that position in a logical and coherent way. On that account, this study refers to argumentation as the whole communicative act in an essay. Argumentation may consist of a number of arguments that provide statements (arguments and counterarguments) about a certain knowledge area and evidence (literature and empirical data) that express the reasoning of positioning ideas, perspectives, results and conclusions on a specific subject. An argument can also be established in a mix of other modes, where writing in an essay is the main mode co-operating with visual resources for the purpose of conveying meaning (Huang and Archer, 2017).

MULTIMODAL ARGUMENT

Studies of argumentation have mostly been dedicated to verbal language, writing and speech. However, there is a growing interest in multimodal argumentation and what other modes (e.g., visual) can be used in combination with writing to construct meaning in texts (Groarke, 2015; Kress, 2017; Archer, 2016; Huang and Archer, 2017). In this multimodal approach, argumentation and its meaning can be transformed and remade within modes or across modes (Kress, 2010, p. 124; Kress, 2017, p. 44). The argument can be established either one mode at a time, or by an intertwined mix of many modes. However, the same argument can be made in different modes at the same time and juxtaposed, or the modes can realise parallel or contrasting arguments. An argument can thus refer to representation that provides means of dealing with "differences" (Kress, 1989, p. 11; Huang and Archer, 2017, p. 64). These scholars consider that an argument produces stability and changes knowledge (Huang and Archer, 2017). An explanation of how meaning may shift in arguments, is what Kress (2017) calls a 'process of transduction', i.e., the process of transforming meaning from one mode to another, such as when an epistemic idea represented in an image is translated into a verbal argument. According to Kress (2010), this relates to the process of meaning-making and, in regard to argumentation, meaning can be made through various modes, where each mode has its own communicative history and affordances. The notion of affordances is central to the perspective of multimodality (Gibson, 1979; Van Leeuwen, 2005) and refers to how modes offer different choices or potentials for meaning-making (or for expressing learning and knowledge) regarding their materiality, resources and activities. A mode such as

writing can be characterised by its temporal logic, where resources in the form of words, grammar and syntax can produce meaning in entities, processes, changes and relationships. Visual resources such as images or graphs, however, are constituted by their spatial logic and can contribute to graphic possibilities (Kress, 2003). This multimodal perspective takes a functional approach to the meaning potentials (affordances) of arguments in the communicative activity. It provides for this study a holistic lens through which to describe the complex interplay between the representations of knowledge that the argumentation reveals in the essays.

KNOWLEDGE REPRESENTATION

This approach of multimodality emphasises that knowledge is given content and form, and that meaning-making and knowledge representations are realised through different modes and communicative activities (Selander, 2017). This assumes that knowledge about different subjects or ideas about the world is recognised through semiotic representations, which are related to conventions and existing cultures of recognition in scholarly disciplines (Kress and Selander, 2011; Northedge, 2003). A knowledge representation focuses on the material realisation of students' interest, understanding and semiotic engagement on epistemological work, and on how this representation relates to certain kinds of access to knowledge about a phenomenon (Lindstrand and Selander, 2022). This relates to the notion of 'epistemological commitment', which concerns the mode's ability to provide a certain lens on the world due to its materiality and specific logic in representing knowledge. A representation of knowledge can also realise different types of knowledge (e.g., episteme, techne, fronesis [Selander, 2017, p. 22]) in different cognitive ways such as expressing how to remember, understand, apply, analyse, evaluate and create knowledge (Krathwohl, 2002, p. 215). For example, an epistemological commitment that is about understanding or applying conceptual knowledge (episteme) can either be expressed in writing, in an image, or as a combination of both. This conceptual knowledge can be represented in writing by using descriptions of basic factual elements, classifications derived from theoretical domains and figurative language (Danielsson and Selander, 2016), or in an image by visualisation of factual objects or elements. However, these modes offer potentials that make them more or less suitable for representing complex knowledge representations. Furthermore, choosing a certain representation from a certain epistemological domain or discursive community (Northedge, 2003; Macken-Horarik, et al., 2006), means contributing knowledge of the phenomenon in a certain way. The knowledge representations that these modes (verbal and visual) provide offer both potentials and limitations depending on the epistemological idea that is taken on as a communicative task in the argument. According to a goal and function approach (Rapanta et al., 2013), an argument refers thus to whatever mode is most central in the communication, whether it has functional load or what mode is the most suitable for the task and has functional specialisation (Kress, 2017). To summarise, the notion of argument has been used in different ways in academic discourse, and it is one of the most discussed competences in the field of education due to its importance in developing knowledge competences. However, only a few studies have explored written argumentation in upper secondary school essays, and even fewer have emphasised learning skills and the use of visual resources as a complement to written essays.

THE PRESENT STUDY

CONTEXT OF STUDY

This study examines how arguments are realised through the use of writing and visual resources in essays written by upper secondary school students. The essays used in this study were written for a mandatory diploma project (*gymnasiearbete*) done in the final year of upper secondary education, where students need to plan, implement and evaluate collected results. According to steering documents, students need to develop competences such as "scientifically based working skills" (*vetenskapligt grundade arbetssätt*) (Swedish National Agency for Education, 2012, p. 1) to prepare for higher education. They need to learn research strategies and skills relevant for academic writing and how to make scientific arguments with language proficiency and formal structure. A passing grade for this essay is a prerequisite for the final exam in upper secondary school. Furthermore, the essays need to be based on learning outcomes that are defined in three descriptive areas in the syllabus: (1) facts and understanding, (2) skills, and (3) judgment and approach (Swedish National Agency for Education, 2012). Fourteen key competences are highlighted as quality aspects of what knowledge representations an essay should use, such as relevant knowledge on the chosen knowledge area, skills regarding the use of concepts, theories, methods for answering questions, and the ability to take responsibility, critically evaluate sources, and illuminate issues from different perspectives. These key competences are thus emphasised in teaching, assessment and grading. The diploma project can be awarded either a pass or a fail grade which relate to the learning outcomes of the diploma project. However, information on how the competences should be weighted is not provided in the documents or grading criteria. However, the Swedish National Agency for Education (2012: 4) emphasises the importance of assessing the essays to a *preparatory* level for university and not to the level of higher education.

EMPIRICAL DATA

This study is part of a wider research study of empirical material (interviews, focus groups and essays) from three upper secondary schools in Sweden. According to the interviews with supervisors, all the schools provided writing templates and documents to guide the students in developing key competences, such as using theories, models and methods in their essays. At the beginning of the diploma project, the students got to choose the subject they wanted to investigate. A supervisor was appointed and supervisory meetings usually took place on a few occasions throughout the learning process. The supervisors said that they encouraged the students to do both literature studies and analyses of empirical data. The students were obliged to write texts in an academic style and encouraged to also use multimodal resources such as pictures, graphs and tables to convey meaning in their essays. At the end of the diploma project, all students got to present and defend the results of their essays in a seminar. Almost every essay was approved by the supervisor before the seminar was carried out as a final closure of the diploma project.

The empirical material of the study consisted of 54 essays written for the social sciences diploma project at the three schools. Eighteen essays from each school were selected by the schools' supervising teachers. All these essays were written by students who had had both low and high levels of writing achievement during their education. Only essays from students who had given their permission were included, and all students were over eighteen years of age. The students completed the diploma project over two semesters and the results were presented in their final written essays, which were then assessed and graded.

DATA ANALYSIS

The analysis of the essays was based on the abovementioned research, and its ideas were used to understand the arguments presented in writing and by visual resources in the student essays (Selander and Kress, 2010). A text analysis was used to sort the data in relation to the research questions (cf. Danielsson and Selander, 2016). The analysis addressing the first research question began by focusing on the essays' textual composition. The general structure of the essays was examined in relation to layout, heading, overall thematic orientation, and what topic was foregrounded in each section, all of which referred to which information was most salient to attract the readers' attention. The analysis also focused on what types of sources were used to support arguments (i.e., Wikipedia, web and blog pages, press articles, policy documents or scientific articles), how long each essay was, and any other semiotic resources (i.e., image, graphic, table and diagram) (c.f. Zeidler and Keefer, 2003). Even the number of references included in the essay was accounted for to demonstrate the variation of semiotic work between the essays. To address the second and third research questions, all text sections were analysed to see what epistemological content was designed in essays, to gauge the proximity (closeness) to others' writing, and to assess the coherence between the writing and the visual resources used (Danielsson and Selander, 2016). The analysis of coherence referred to whether the writing and the visual resources corresponded to each other and if the use of concepts, descriptions and explanations were congruent to the taken position in the argument (Wingate, 2012). The analysis also focused on how the arguments connected to disciplinary domains (Macken-Horarik, et al., 2006; Northedge, 2003). Two main categories of proximity were inductively identified: arguments related to an 'everyday domain' were recognised by the fact that no discipline-specific concepts or terms were used to define a particular knowledge area for the students to investigate. Language that was closed to common knowledge and descriptions of self-experience enabled the identification of arguments within that domain. Representations of knowledge (Selander, 2017) from an 'academic domain' were detected by using statements and concepts related to theoretical or research-based understanding. Also, these content representations in identified domains were explored by analysing how the arguments backed up the credibility of the knowledge representation (Selander, 2017). Furthermore, and in order to handle the epistemological commitments that theses contents revealed, the analysis focused on how the written and visual representations related to certain kinds of knowledge about the phenomenon in focus (Selander, 2017; Krathwohl, 2002). This related to the epistemological ideas connecting to educational objectives and how these ideas were used in the students' arguments. The arguments themselves were analysed as different kinds of knowledge representations, such as propositional or declarative knowledge (to know what – factual, conceptual), procedural knowledge (to know how – managing research methods), and meta-cognitive knowledge (to know when – awareness of strategies, self-cognition) (Selander, 2017, p. 22; Krathwohl, 2002). In the analysis, propositional knowledge was detected by the representation of basic elements showing that the students were acquainted with the knowledge area (terminologies, theories, models, structures, classifications and categories), and which also related to the expected learning outcomes within the diploma project (Swedish National Agency for Education, 2012). Conceptual knowledge can also be realised by figurative language; therefore, the use of metaphors and analogies may relate to how content is represented (Danielsson and Selander, 2016). The analysis of procedural knowledge focused on representations of how to do something, e.g., representations of specific methods of inquiry and skills. Meta-cognitive knowledge was recognised

by representations of meta-reflection about the text, awareness of different perspectives and self-reflection or judgement (cf. Krathwohl, 2002). These knowledge representations were also connected to cognitive processes of how to organise content in different levels of complexity, e.g., through descriptions or explanations relating to the meaning of information, through analysis by breaking down material and discovering how the parts relate to each other and to the whole, and through interpretation and values relating to judgments about quality based on criteria and standards in relation to a question or theoretical foundation (Swedish National Agency for Education, 2012; Krathwohl, 2002). The analysis also focused closely on the essays that included visual resources and on what affordances these resources offered the arguments. I identified representations of the most salient arguments and how these arguments were realised by means of different semiotic resources. I also considered to what extent the chosen mode or semiotic resource conveyed ideas and knowledge representation as well as which modes and resources helped to convey the meaning of the subject matter (Kress, 2017). All arguments have been translated from Swedish to English and the process of the meaning transfer (Kress, 2017, p 45) is described in Table 1 below.

Furthermore, the results of the data analysis were iteratively examined to ensure credibility and trustworthiness (Åkerfeldt and Svärdemo Åberg, 2021). This study is explorative in nature and makes no claims of empirical generalisation, but rather it takes on the form of an idiographic inquiry offering descriptive exemplary knowledge on a particularity in a given educational context (Thomas, 2011).

RESULTS

HOW WERE WRITTEN TEXT AND VISUAL RESOURCES ARRANGED IN THE ESSAYS?

The essays' semiotic work varied according to the total number of words, the references to support the arguments within the texts, the reference list and visual resources (see Table 2). The status of sources is crucial in academic arguments and their credibility depends on how much the argumentation is substantiated with subject-specific references (Archer, 2016; Matta, 2019). The use of sources varied between the essays, from a minimum of two references to a maximum of eighty-four per essay. There were frequent references to websites and blog pages, press articles or news programmes, encyclopaedias, Wikipedia, policy documents and government reports. Three percent of the references were scientific articles or undergraduate theses. Fifteen essays used visual resources to convey meaning, either by giving new, similar or supplemental information to

COLLECTED DATA – STUDENT ESSAY (SWEDISH)	PROCESSING THE DATA	AN EXAMPLE OF ARGUMENT IN THE ORIGINAL SWEDISH TEXT	AN EXAMPLE OF ARGUMENT TRANSLATED TO ENGLISH TEXT
Arguments in written form	Writing provides statements/ representations about a knowledge area. Some parts of the original text are included in the analysis so that Swedish and English-speaking readers can determine the fidelity and accuracy of the meaning in the translated written text.	Meaning is shaped through graphical applications (letters/numbers), semantics (meaning) and grammar (wordings and sentences). Eg., Detta är min slutsats: Hippocampus är centrum för nybildning av nervceller och nervceller behövs för att korttidsminnet ska fungera på bästa sätt.	Meaning is shaped through rearticulation in the same mode but in a different language. Eg., This is my conclusion: The hippocampus is the centre for new nerve cell formation and nerve cells are needed so that the short-term memory should work in the best way.
Arguments by the visual resources	Visual resources provide statements/representations about a knowledge area. Some visual resources are combined with written statements where the meaning in one mode is transduced to another mode.	Meaning is shaped through semantics (meaning) and visual structure and expressions.	Visual meaning is shaped through rearticulation in the same mode but the meaning in writing is translated to English.

Table 1 The process of remaking meaning.

WORDS PER ESSAY	REFERENCES USED IN ARGUMENTS PER ESSAY	REFERENCES IN A LIST PER ESSAY	ESSAYS WITH VISUAL RESOURCES
Min – 1 423 words	Min – 2 references	Min – 4 references	15/n54
Mean – 6 096 words	Mean – 26 references	Mean – 17 references	
Max – 11 661 words	Max – 84 references	Max – 68 references	

Table 2 Variation of words, references per essay, references in list and essays with visual resources.

the writing. The visual resources, such as images, graphs and tables, were placed in sections where results were presented.

All essays were organised according to an academic format, including a reference list at the end of the essay. Figure 1 shows a commonly used table of contents, presenting four main sections (introduction, results, conclusion and list of sources) and providing the reader with further information through subheadings. The same subheadings (purpose, questions, delimitation, definitions, methods and source criticism) are frequently used in many essays.

All essays began with an introduction, where the topic or problem to be investigated was stated, and the arguments of purpose, demarcation/delimitation and method were presented. The arguments about methodological considerations were realised by descriptions of what and how data were collected. The arguments related also to data collection, selection of material and credibility of sources. In some essays, the arguments for choice of method (e.g., interviews or literature reviews) were supported through references to literature about methodology and methods of data collection. The term "credibility" was mentioned in most of the essays and the students stated that they had been careful in selecting sources. Some elaborated arguments entailed values about certain experts' authenticity and trustworthiness, eg., perception of people that have been interviewed (Nygren and Guath, 2019). There were essays that explicitly referred to theory (n = 9/54) and presented theoretical concepts to support reasoning. The representation of arguments for the results was realised in sections with titles such as "results, survey, summary, conclusion, results and conclusions, discussion and results or discussion/analysis". Literature was presented as support for argumentation in literature reviews or in results and discussion sections. These sections were also the most extensive parts of the essays. Visual resources such as tables, images and graphs were presented in the results section in fifteen essays (n = 15/54). The discussion section represented the summaries and conclusions of the work presented in the essay. Summaries of results, in the form of offering possible future scenarios and highlighting new questions to investigate, were frequent. Some discussions also related to perceived social benefits. There were several variations in the composition of the essays regarding length, number of references in the text, length of reference list, and the variety of visual resources.

Innehållsförteckning

Figure 1 A table of content in essay 5.

WHAT CONTENT WAS DESIGNED AND WHAT EPISTEMOLOGICAL COMMITMENTS DID IT REVEAL?

In many of the essays, the arguments were designed through a description of topics with a contemporary relevance. The essays included many societal topics with titles such as: gender, mental health, computer game addiction, veganism, military defence, social media, body ideals, terrorism, bullying, sex education, sexual harassment, feminism, black lives matter, animal rights, homelessness, human trafficking, stress, mental illness, cannabis, hooligans or domestic violence. Many of these titles and words, such as "Stress is something everyone experiences during their lives and it's our natural reaction", related to the students' own life experiences, interests and common-sense knowledge or to problems that came from an everyday domain instead of problems identified in academic contexts (eg., Macken-Horarik et al., 2006). These arguments were also connected to sources mainly from unscientific websites and personal blogs. Representations of in-depth knowledge were, on the other hand, realised through descriptions of contemporary problems linked to reasoning and concepts, which were more or less scientifically grounded. However, many arguments were substantiated with reference to private individuals' blog sites. Sources were referenced either by putting the author in parentheses or using an internet link at the end of the argument. The majority of the essays presented references and quotation techniques according to the students' choice of reference system.

There were several examples of argumentation that resembled an academic style by realising idiomatic expression "my aim is to explore" and formal key concept "power relation" and "gender", even though the argumentation was not backed up with references based on scientific literature, but by references to press articles and blog sites. However, the writing constituted epistemic knowledge by its use of facts, e.g., by using terminology or presenting details about the core object of investigation. These representations of conceptual knowledge were realised by definitions, theoretical explanations or interpretation of literature in the writing (e.g., Krathwohl, 2002; Selander, 2017). The content was mostly designed through statements about conditions related to the phenomenon and key concepts, or to theoretical and methodological procedures of presenting empirical material. The example below (Essay 2) illustrates how

the descriptive statements were realised in a literature review and how medical concepts and terms such as "contraceptives" and "penicillin" represented conceptual knowledge related to medical history and natural science. The sources were backgrounded by footnoting, which was a common way of representing sources in the essays.

> Preventivmedel förekom inte i kommersiell utsträckning förrän i slutet av 1800-talet, utan brukades främst av överklassen (8). Penicillin fanns inte heller att tillgå på denna tiden, vilket gjorde att man behandlade t.ex. den då mycket vanliga könssjukdomen gonorré med overksamma huskurer och exempelvis syfilis med kvicksilver (vilket hade allvarliga konsekvenser för människors hälsa) (9).
> Contraceptives were not commercially available until the end of the 19th century, but were mainly used by the upper class (8). Penicillin was also not available at this time, which resulted in the treatment, for example, of the then very common venereal disease gonorrhoea with ineffective home remedies and, for example, syphilis with mercury (which had serious consequences for human health) (9).
> Argument in essay 2.

The essay quoted above has the footnotes (8) and (9) at the end of the page. The descriptive arguments served standpoints that were often backed by chronological explanations, and words and sentences were used to explain causes and effects of the specific phenomena. In another example (essay 1), the argument presented some factual and conceptual knowledge by using an explanation of the different usages of artificial intelligence (AI), using figurative language such as "to get to know its owner" [lära känna sin ägare] and "to act as a conversation partner" [agerar som samtalspartner]. The argument represented factual knowledge, where the different statements explained how specific elements were related to each other in the way AI operated a self-driving car.

> För att öva upp en självstyrande bil kan man låta AI:n läsa av och filma vägen den kör på framför sig och registrera hur föraren kör och svänger. På så sätt sätts den i träning, där målet är att bilen förstå (sic) ska varför personen väljer att just styra höger eller vänster när kameran visar på det ena eller det andra.
> When using a self-driving car, you can have the AI read and film the road it is driving on and record how the driver drives. In this way, it is put into training, where the goal is for the car to understand why the person chooses to steer right or left when the camera shows one or the other.
> Argument in essay 1.

Other ways of designing content in the essays included making normative positioning for a specific perspective on the phenomenon, suggesting a solution to a certain problem, or presenting favourable comparisons to support a position. In the following example (essay 19), the argument was built from divergent sources encompassing supportive reasoning about environmentally aware people. In the first sentence, a supportive and evaluated argument was made about the choice of a vegan lifestyle, which was backed up by an internet reference and, in the following sentences, empirical statements were included to support the position taken about the benefits of a vegan lifestyle.

> Många miljömedvetna personer väljer att dra ner på eller helt och hållet utesluta kött- och mejeriprodukter ur deras kost då vegansk kost kräver mycket färre resurser i jämförelse med en traditionell västerländsk kost (17). Emelie har alltid värnat om miljön och miljöaspekten var den främsta orsaken att hon övergick till en vegansk livsstil. "Del kändes som ett naturligt beslut att avstå från det som förstör miljön allra mest", förklarar hon.
>
> Many environmentally conscious people choose to cut down on or completely exclude meat and daily products from their diet as a vegan diet requires far fewer resources compared to a traditional Western diet (17). Emelie has always looked after the environment and the environmental aspect was the main reason she switched to vegan lifestyle. "It felt like a natural decision to forgo what is destroying the environment the most", she explains.
> Argument in essay 19.

Supportive arguments for the position taken, including both explicit and implicit articulations of values and factual knowledge, were also represented in the discussion or conclusions sections. There were also representations of students' personal values through the use of pronouns, such as "I think" and "I believe", which emphasised a subjective view, (see essay 28 and 34 below).

> Jag tror dock att alla dessa orsaker till att kvinnor inte når elitnivå bottnar i samhällets kvinnosyn.
> However, I believe that all these reasons why women do not reach the elite level are rooted in society's view of women.
> Argument in essay 28.

Many essays also presented brief summaries as reminders of the arguments realised in the essays. In

the example below, the argument provided values and support from previously presented theory to back up the results that emerged in the essay. The concluding arguments also represented an applied and interpreted factual knowledge.

> Detta är min slutsats: Hippocampus är centrum för nybildning av nervceller och nervceller behövs för att korttidsminnet ska fungera på bästa sätt. Synapser blir försvagade och krymper, enligt synaptiska homeostas hypotesen vilket skulle leda till att hjärnan förlorar förmågan att ta emot sinnesintryck helt och hållet. I och med detta försämras korttidsminne vid sömnbrist.
> This is my conclusion: The hippocampus is the centre for new nerve cell formation, and nerve cells are needed so that the short-term memory should work in the best way. Synapses become weakened and shrink, according to the synaptic homeostasis hypothesis, which would cause the brain to lose the ability to receive sensory impressions completely.
> Argument in essay 34.

This argument drew conclusions about the theoretical hypothesis and provided reasoning about the cause and effect in relation to the observations made in the essay. Generally, the students presented cohesive supporting arguments that realised motives and perspectives on the ideas they wanted to emphasise in their essays. However, there were also essays that realised arguments that can be recognised as procedural and meta-cognitive knowledge. These arguments represented reflections over used materials and methods or values over conclusions and predictions, i.e., that something will turn out one way or another regarding what was theoretically or empirically investigated.

WHAT WERE THE AFFORDANCES OF USING VISUAL REPRESENTATION IN THE ARGUMENTS?

In some essays (n = 15/54), visual resources were used to convey meaning in the argumentation or to make comparisons between contrasting elements drawn from empirical data, facts or other represented meanings in both written and visual modes. In one example (see Figure 2), the student used classification of the effects of psychiatric treatment as well as numerical information retrieved from sources on a website. The argument of propositional (factual) knowledge was shaped through a writing-image dynamic, and the image had a function equal to that of the writing. The graphic illustrations and the numerical and descriptive data presented in two variables (data on effect after electroconvulsive therapy (ECT) treatment and data on memory capacity after (ECT) treatment) signified meaning potentials, both by themselves and together. Shades of colour represented quantitative information in the different categorised variables, eg., *Much better [Mycket bättre], Unchanged [Oförändrad],* and *Much deteriorated [Mycket försämrad].* The written text was the prominent mode and had functional load, but the visual properties in the graphs' form, size and colour, together with numerical information and underlying text, made the epistemic message in the argument more salient.

In another example (essay 53), the arguments were realised through conceptual reasoning in writing and by making certain concepts (e.g., prefrontal cortex) visible in an image. The text described complex neural processes and here figurative language was found in the writing (c.f. Danielsson and Selander, 2016). The term 'boxes' was used as an analogy for the short-term memory process and the descriptive argument functioned in the same way as a visual resource. The abstract phenomenon got a concrete explanation through the use of metaphors.

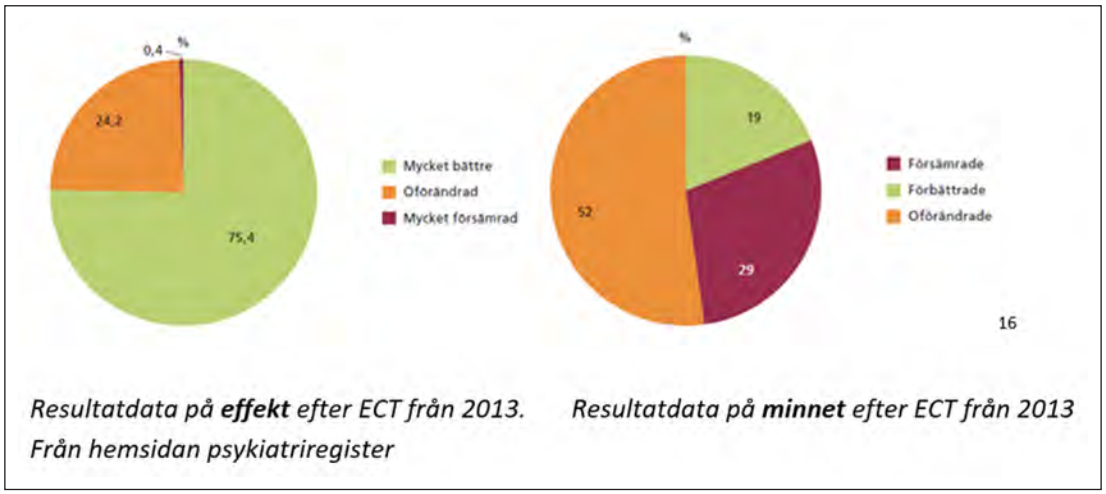


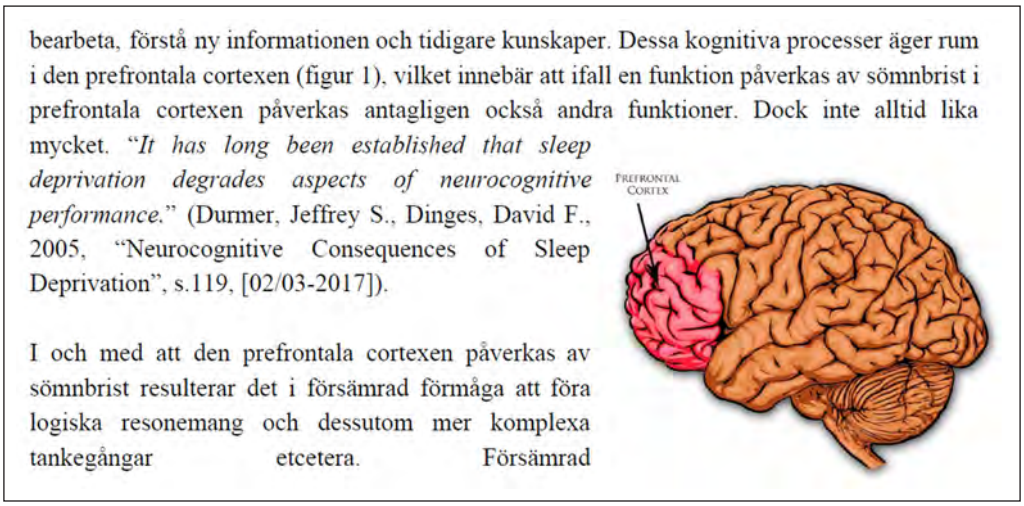
Figure 2 A graphic illustration in essay 16. Graphs originally published 2013 and retrieved by student 2017 at https://psykiatriregister.registercentrum.se.

> Millers teori om att korttidsminnet endast kunde hålla cirka 7 enheter i taget berodde på att han därmed också trodde på att människan hade ett specifikt antal "lådor" där enheterna kunde bevaras under en kort tid.
> Miller 's theory that short-term memory could only hold about 7 units at a time was because he also believed that man had a specific number of "boxes" where the units could be preserved for a short time.
> Argument in essay 53.

The writing also made it possible for the students to express temporal relations, such as first x happened and then y, and their causal relationship. The combination of writing and images worked well to describe spatial relationships (see Figure 3). The written text stated that cognitive processes "take place in the prefrontal cortex", and there was a reference to an image showing the location of the "prefrontal cortex" in red, with a black arrow pointing at the front of the brain.

This conceptional representation was prominent in the image and gave an ideational contrast to the written description in the essay. The details in the image added some illustrative parts to the creation of the argument, and the image itself may have had an epistemological specialisation (Kress, 2017) regarding the facts of the localisation of the concept 'prefrontal cortex'. However, the written text and the image presented a joint argument about the constituent parts of a cognitive process and how sleep deprivation affects neurocognitive performance. Furthermore, the arguments represented conceptual knowledge and theorising, both in the mode of writing and the image being within a paradigm of neuro cognitivism. Multimodal explanations were used to justify the claims about an empirical experiment conducted by the arguer. The argument made the interrelations between pieces of factual knowledge visible by using writing and images.

Arguments were also realised through comparisons, by identifying similarities and differences in the presentations of facts, informants' attitudes, or perceptions of a phenomenon related to different classifications or themes. Some essays also presented arguments that made comparisons between contrasting elements realised through data, facts or other represented meaning in both written and visual modes. In one essay, the arguments represented students' attitudes to freedom of expression, where the numbers of attitudes were displayed in a table (Figure 4). A question "Question 3. Do you think there should be restrictions on


bearbeta, förstå ny informationen och tidigare kunskaper. Dessa kognitiva processer äger rum i den prefrontala cortexen (figur 1), vilket innebär att ifall en funktion påverkas av sömnbrist i prefrontala cortexen påverkas antagligen också andra funktioner. Dock inte alltid lika mycket. "*It has long been established that sleep deprivation degrades aspects of neurocognitive performance.*" (Durmer, Jeffrey S., Dinges, David F., 2005, "Neurocognitive Consequences of Sleep Deprivation", s.119, [02/03-2017]).

I och med att den prefrontala cortexen påverkas av sömnbrist resulterar det i försämrad förmåga att föra logiska resonemang och dessutom mer komplexa tankegångar etcetera. Försämrad

Figure 3 A text-image illustration in essay 53. Image originally published at https://medium.com and retrieved by student.

Fråga 3: Tycker du att det bör finnas begränsningar med yttrandefrihet?

	Samhälle	Sambeteende	Ekonomi	Killar	Tjejer
Ja	8	9	9	12	14
Nej	2	0	0	1	1
Vet ej	0	1	1	2	0

Man kan se att majoriteten av eleverna i varje klass tycker samma sak, dvs att det bör finnas begränsningar med yttrandefrihet.

Figure 4 A comparison based on classification in essay 41.

freedom of expression?" was displayed above the table and the informants' answers were displayed in the table as descriptive numerical data organised in different nominal scales. The concluding argument was presented beneath the table and was based on the described pattern in the table: "It can be seen that the majority of students in each class think the same, that is, there should be limitations on freedom of expression" (Essay 41).

In another example (essay 29), the arguments presented written claims about two illustrations of the character Snow White (one promotional image and the other a print screen from the movie *Snow White and the Seven Dwarfs*). The identified differences in the illustrations were argued about in the text and conclusions were drawn.

> Till en början har Snövits kroppsform ändrats en aning. Hennes midja har smalnats av en del om en jämför med bilden från filmen där hennes midja redan var liten till att börja med. Utöver detta har hennes kläder förändrats väldigt mycket.
> For a start, Snow White's body shape has changed slightly. Her waist has been narrowed a bit if one compares to the picture from the movie where her waist was already small to begin with. In addition, her clothes have changed a lot.
> Argument in essay 29.

The analysis uncovered features in the images that were not immediately obvious for the viewer. The written analysis was presented in the results section and the images (visual evidence for analysis) were located in the appendix, so the reader was required to go between the two sections to see whether the analysis was empirically grounded. Overall, in the essays that included visual resources, the students combined writing and visuals well and thereby employed the force of each mode to convey their analysis or reasoning according to the position taken in the essay.

DISCUSSION

This study sheds light on how arguments are realised through the use of writing and visual resources in student essays. The results reveal that academic argumentation varies considerably between the essays. The study gives an insight into how students design essays in relation to academic requirements, how their arguments realise epistemological commitments, and what affordances are given through the use of writing and visual resources. The arguments consist mainly of declarative knowledge descriptions, which are grounded in various web-based sources. There is an overrepresentation of written arguments, where visualisations are used for making conceptualisation and classification more salient in writing. Both written and visual resources offer affordances in the making of arguments on the bases of the modes for communication.

However, there are several challenges in representing argumentation in essays when the requirements for being prepared for higher studies are considerable. One of the challenges that needs to be addressed is the need for better representation of argumentation in relation to knowledge-relevant literature (cf. Svärdemo Åberg et.al., 2018). Learning to write in the academic genre, developing competences in declarative knowledge, and representing valid and trustworthy arguments are among the key competences and skills recognised by scholars (Ivanič, 2004; Venville and Dawson, 2010; Newell et al., 2011; Higgins, 2014; Howell et al., 2017) and in the educational objectives for the diploma project (Swedish Education Act, SFS [2010:800]). The use of sources for arguments was uneven in the essays. However, the arguments consisted mainly of descriptions or explanation which were supported by personal webpages or blogs and press articles and programmes. There was a large variation between the essays in how they showed representations of declarative, procedural and metacognitive knowledge – especially related to search abilities and evaluation competences regarding sources' epistemological value and status (Kim and Hannafin, 2016; Lindstrand and Selander, 2022). There were, however, some instances where the arguments realised evaluations of differences between sources' credibility (cf. Nygren and Guath, 2019). Another challenge in representing arguments relates to the demanding educational objectives of the diploma project (Swedish National Agency for Education, 2012). The arguments mainly consisted of descriptions about certain subjects that related to propositional knowledge, by representing facts, themes, terms and concepts. Many of the arguments were also shaped through descriptions of certain characteristics and by representing differences and similarities of conceptualised content knowledge, both in writing and visually. Despite an overrepresentation of declarative knowledge, the students shaped their arguments both in writing and with visual resources, which offered opportunities to represent factual and conceptual knowledge in new, creative ways. Images, graphs and tables were used in combination with writing to convey knowledge in the composition of the argumentation. However, less than one-third of the essays used visual resources within the argumentation itself. In order to develop the use of visual resources in writing, it seems important to understand what meaning potentials or epistemological commitments the literature and visual resources provide in the making of arguments in essays (Groarke, 2015; Archer, 2016; Lindstrand and Selander, 2022). To be able to understand what kind of knowledge different modes and resources can contribute to in the construction of arguments, there is also need to develop teaching on

academic writing, including recognition of affordances of multimodal resources and how they can be used in argumentation. Even though the written argument has the functional load and often functions as anchoring of the argumentation, the visual resources can complement and extend the meaning potential of the communicated knowledge representation (Van Leeuwen, 2005). The study also highlights the importance of giving students the prerequisites for learning various purposes and functions of making arguments in writing and by using visual resources within an appropriate educational level in schools.

In conclusion, the results of this study demonstrate the importance of giving prospective students opportunities to develop varied knowledge representation techniques and meta-reflection on how arguments can be constructed. Even making arguments grounded in relevant sources requires skills that facilitate the transition from upper secondary school to higher education.

COMPETING INTERESTS

The author has no competing interests to declare.

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