Teach Me How to Argue: A Survey on NLP Feedback Systems in Argumentation

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10th Workshop on Argumentation Mining - 7th December 2023

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Introduction

Background: Necessity of critical thinking skills

- Digital era = of information → Harder to evaluate its quality

→ Need to be able to | *navigate* through this information

= objectively analyze information and draw a rational conclusion

= develop **critical thinking skills**

HOW?

- Strong argumentation → Strong critical thinking skills

(Pithers and Soden, 2000; Behar-Horenstein and Niu, 2011)

Computational argumentation

- Computational argumentation assists users in improving their arguments

- Various applications:
  - Mining arguments (Al-Khatib et al., 2016)
  - Assessing arguments' quality (El Baff et al., 2018)
  - Reconstructing implicit assumptions in arguments (Habernal et al., 2018)
  - etc.

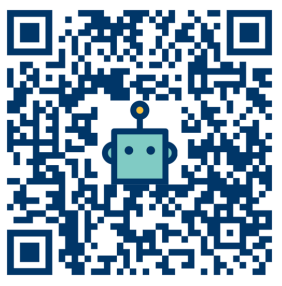
- Assist students' learning & reduce teachers' workload (Twardy, 2004; Wambsganß et al., 2021)
  - But cannot still deeply explain and visualize how an argument can be improved!

Gap between current and desired argumentative systems

- **Aim**: Exploration of current argumentative feedback systems for improving critical thinking skills

- **Contributions**:
  - Combine features of feedback systems into four distinct dimensions
  - Survey and categorize 108 papers into these dimensions
  - Discuss remaining challenges and potential ways to overcome them
  - Creation of a website to easily find our references

https://kmilia.github.io/teach_me_how_to_argue/



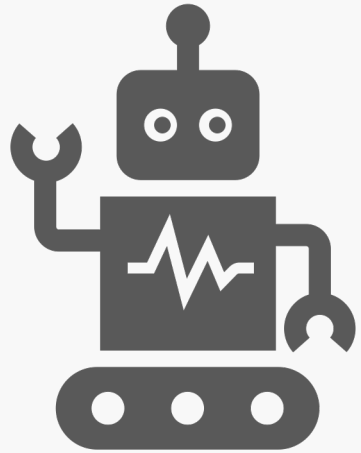
Dimensions of the survey

Richness of explanations = What?

cuisine is not healthy.

Indeed are not healthy.

Your argument has an invalid generalization.



- Shallow feedback
- Not enough details...

Richness of explanations = Why?

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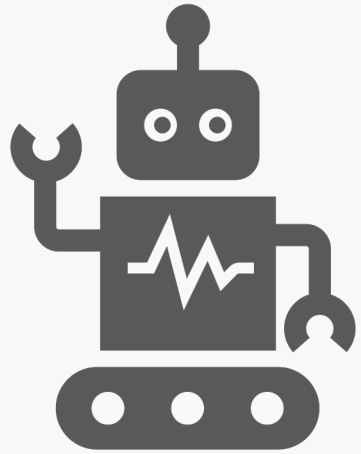
Indeed are not healthy.

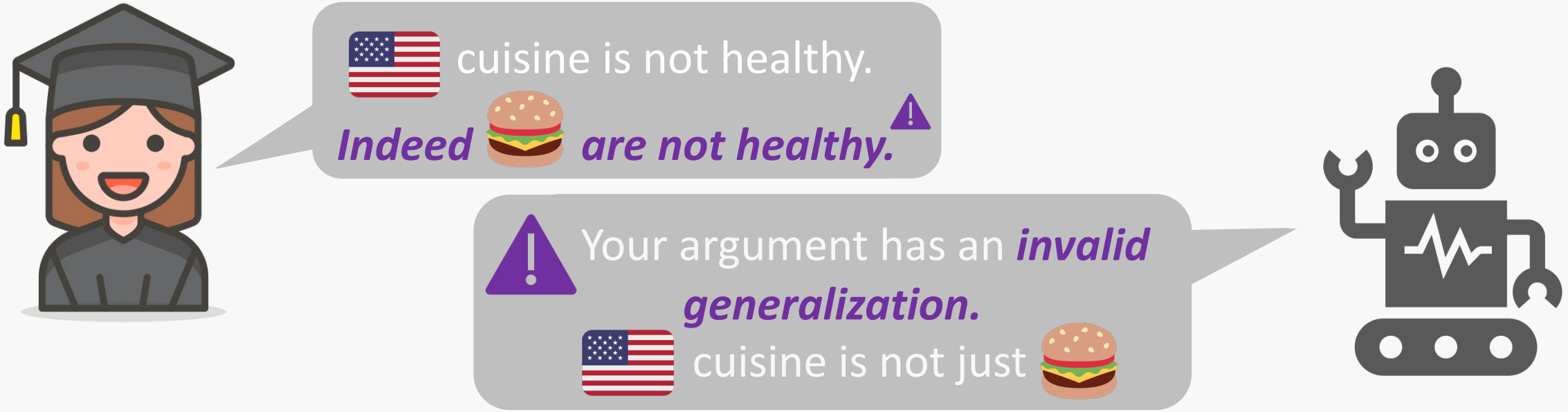
Your argument has an invalid generalization.

cuisine is not just



- Easier to understand
- Need for implicit knowledge:
  Cobb salad = healthy salad
- Use of LLMs (Examples: Dalvi Mishra et al., 2023)
  - Find implicit components
  - Find the correct logical reasoning
  - Need for new techniques
    (E.g: chain-of-thought prompting (Wei et al., 2022))

Visualization of explanations = How?



- Multiple views (Example: Wambsganss et al., 2020)
  - Diagrams → Argumentative structure
  - Low accuracy
- Dialogue Systems (Example: Rach et al., 2020)
  - Gaining attraction
  - Challenge: user-friendliness

Interaction = Who is interacting with whom?

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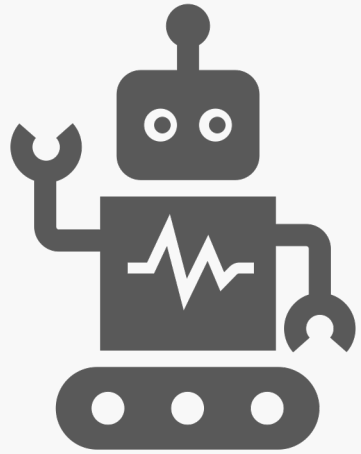
What do you mean?



- Between users (Example: Lugini et al, 2020)
  - Users debating/helping each other
  - Challenge: Need a real-class setting
- With a chatbot (Example: Wambsganss et al., 2021)
  - Based on state-of-the-art LLMs
  - 👍 Generate human-like responses

Personalization of the explanations = To whom?

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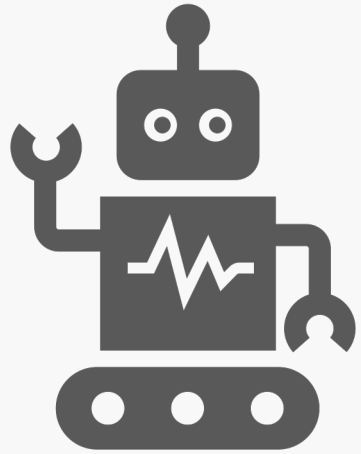
Indeed are not healthy.

Careful, you are simplifying!

cuisine is not just



- Discretization of users' levels
  (Example: Wachsmuth and Alshomary, 2022)
  - No user's background
- Personalization by users
  (Example: Putra et al., 2020)
  - Not very user-friendly
- Use of chatbots (Example: Ismail et al., 2023)
  - Tailor their responses to learners
  - Possible future direction

General open issues

General challenges identified while surveying

- Evaluating different systems
  - Relies on human → hard to reproduce and costly
  - Lack of direct comparisons between similar systems (Heuer and Buschek, 2021)

  → Need to promote open-source projects and the research of standard guidelines

- Ethics
  - Challenges: Privacy violations, discrimination, bias, etc (Hovy et al., 2017; Trust et al., 2023)
  - Need for an ethics-by-design approach (Leidner and Plachouras, 2017)

- … More to be discussed during the Poster session

Conclusion

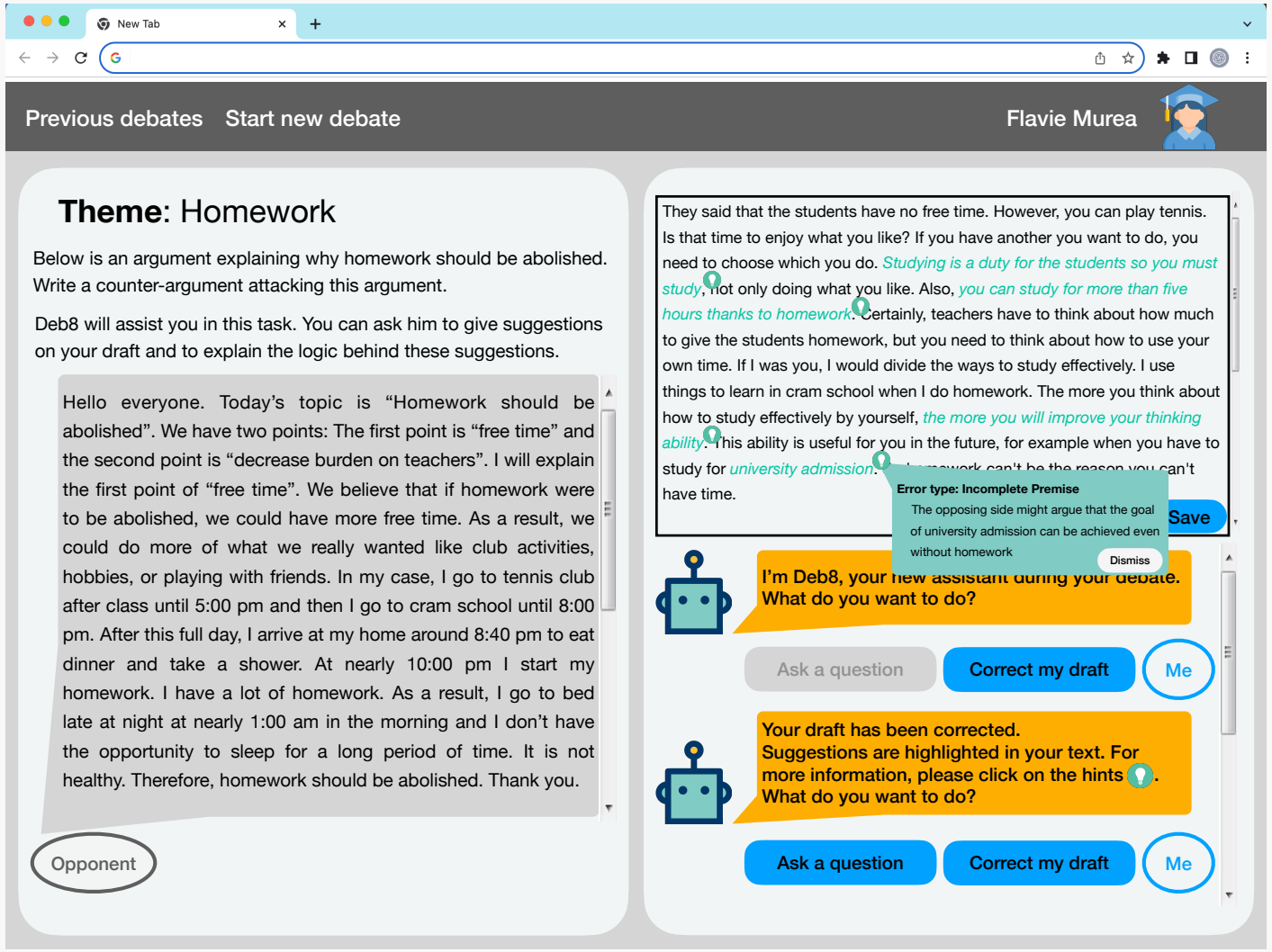
Summary

- Overview of current systems used to teach argumentation based on:

1. What is an error?
   Why is it an error? → Richness
2. How is the error visualized? → Visualization
3. Who is interacting with whom? → Interaction
4. To whom is given the feedback? → Personalization

- Identified several open issues: Evaluation Methods, Reasoning…

Towards an end-to-end system for the user



Preliminary sketch of an end-to-end system to learn argumentation

- **Goal:** prototype a system to improve students' critical thinking

- **Measure:**

f(feedback + interface) =

Which effects on learning critical thinking?

Appendix

Argumentation : a definition

Argumentation = Field of elaborating and presenting arguments
to engage in debate, convince others,
and eventually reach agreements

4 Pedagogical methods = How shall we teach?

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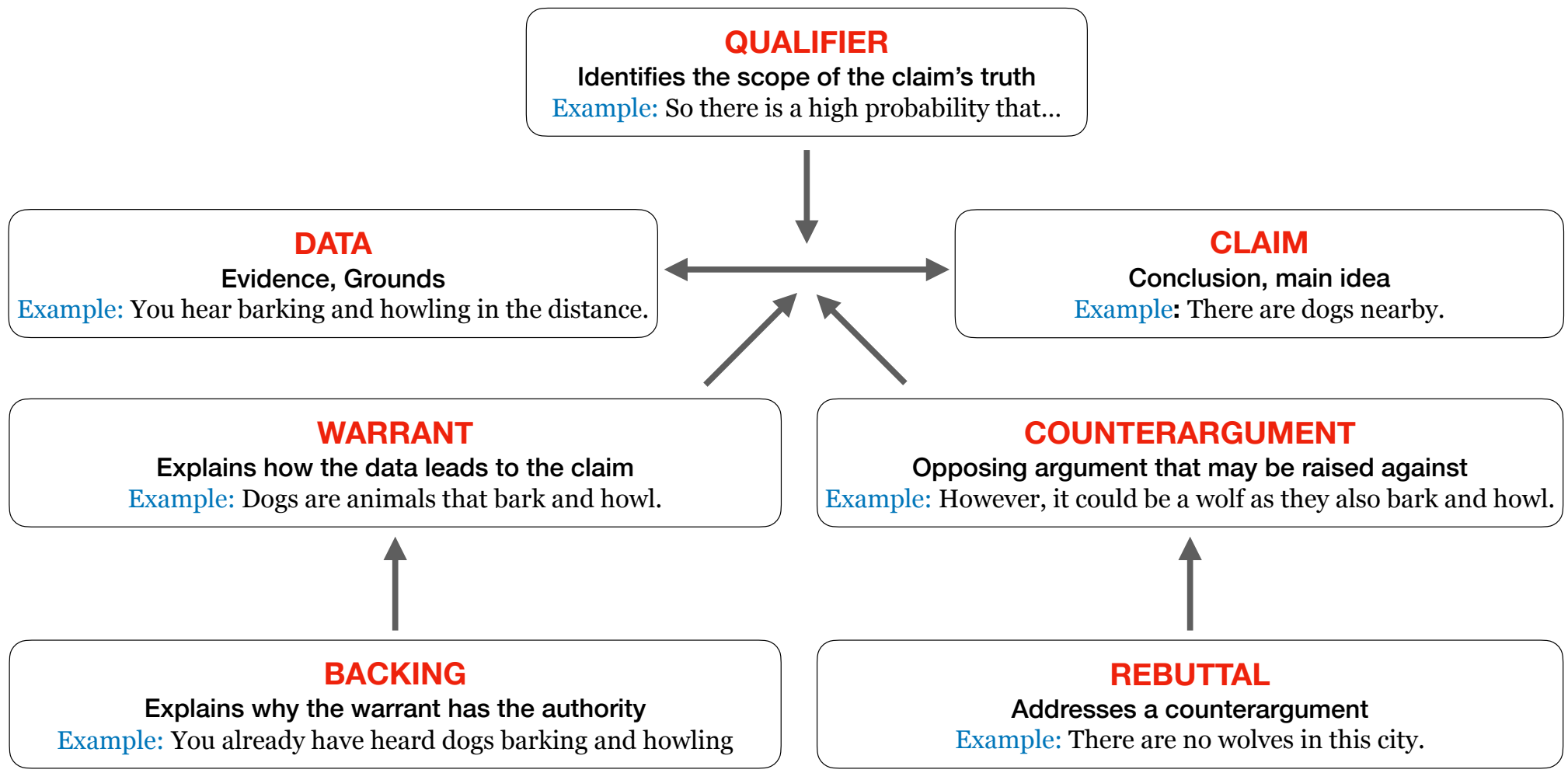
1. Toulmin Model
2. Rhetorical structure theory
3. Collaborative argumentation
4. Socratic questioning

Toulmin Model



Survey method

- Deeply read 150 papers collected in an Excel file
- Map each paper to at least one category
- Whole Survey: 108 cited papers

			What/Why	How	To whom	Who	Who	Who
Papers (with link)	**Conference**	**Year**	**Richness**	**Visualization**	**Personalization**	**Interactivity**	**Trigger**	**Role / Responsability**
A PhD Student's Perspective on Research in NLP in the Era of Very Large Language Models		2023	Gaps and potential directions for further research in NLP and specifically with LLMs					
Annotating Arguments: The NOMAD Collaborative Annotation Tool	LREC	2014						Pioneer in collaborative tools for improving arguments
VISAR: A Human-AI Argumentative Writing Assistant with Visual Programming and Rapid Draft Prototyping	-	2023		Graph Component dynamically linked to a text editor, highlighted argumentative components				Future work: collaborative settings
ArgueTutor: An Adaptive Dialog-Based Learning System for Argumentation Skills	CHI	2021		Chat No Clear history		Possibility of interacting with the system	The user asks for the feedback	
AI: An adaptive learning support system for argumentation skills.	CHI	2020		Graphs + Scores + History + Visualization of Claim and premises	5 levels of feedback (Novice, Advanced, Competent, Proficient, Expert)			
'mama always had a way of explaining things so I could understand": A dialogue corpus for learning to construct explanations.	COLING	2022			5 levels of explanations Studies to see how humans explain in dialogical settings			

Dimensions	Pedagogy How	Richness What/Why	Visualization How	Interactivity Who	Personalization To Whom	Total
References	19	32	13	10	11	85

Table 1: Cumulative count per dimension of papers referenced in our survey.

Easy access to our references: Creation of a website

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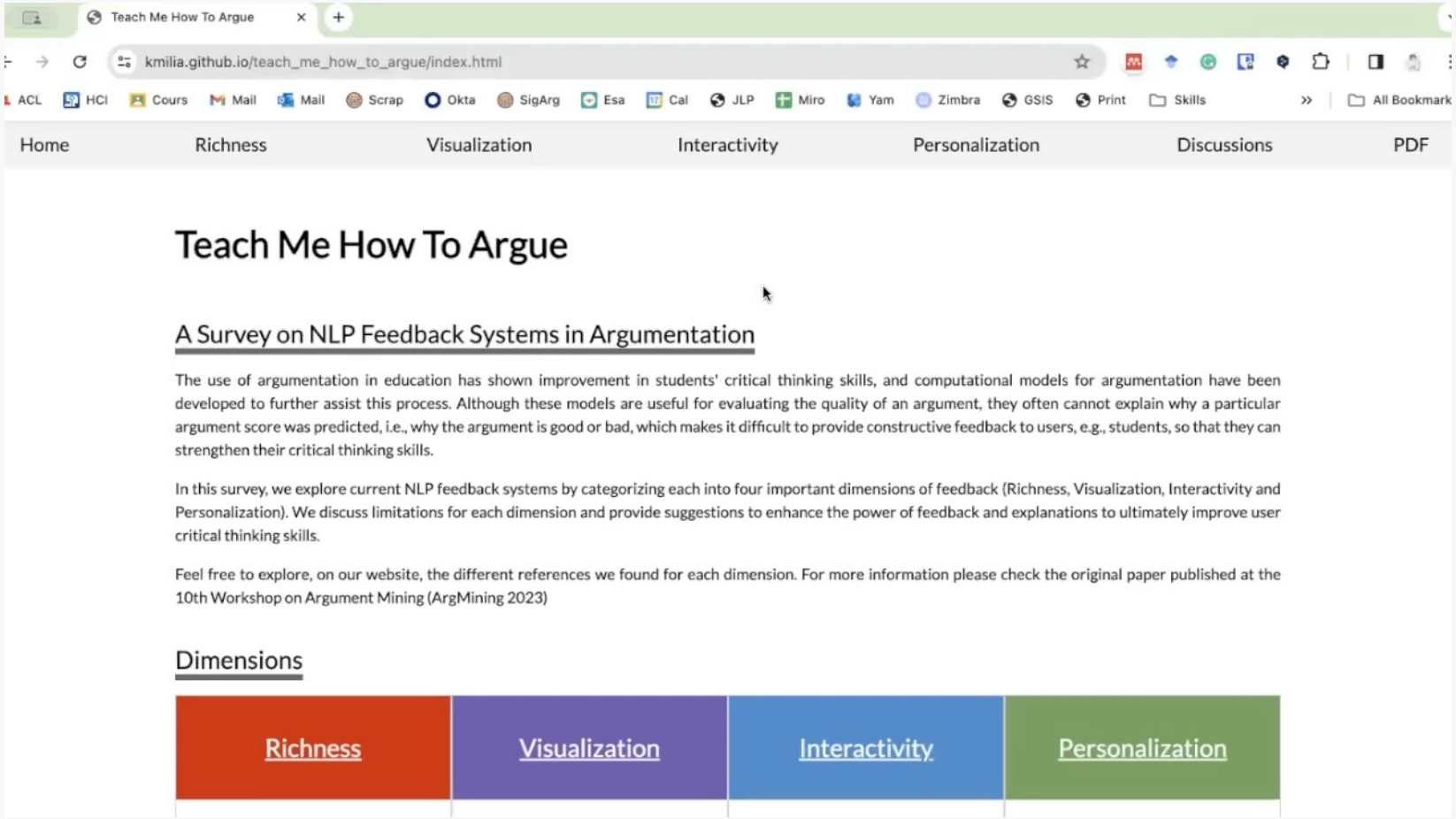


Richness of Explanations = What/Why? - Example

TYPIC: A Corpus of Template-Based Diagnostic Comments on Argumentation, S. Naito et al. EMNLP 2022

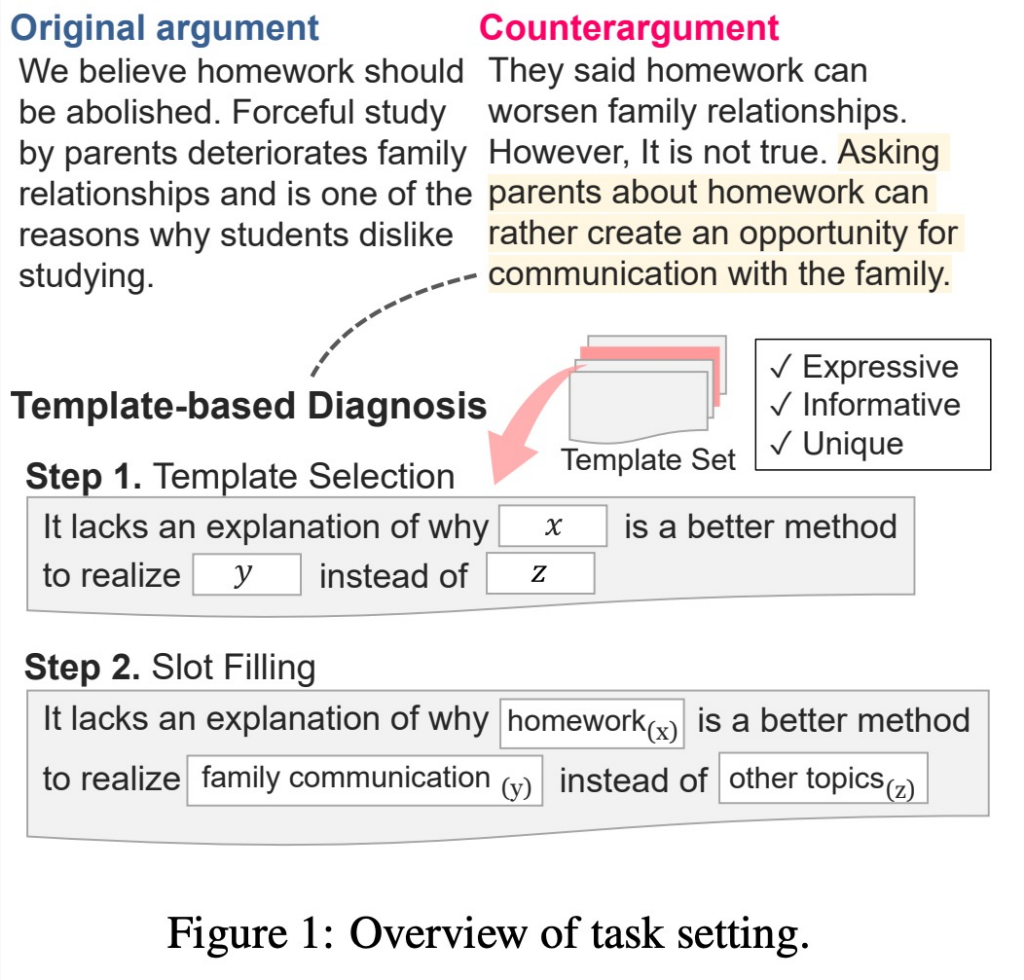
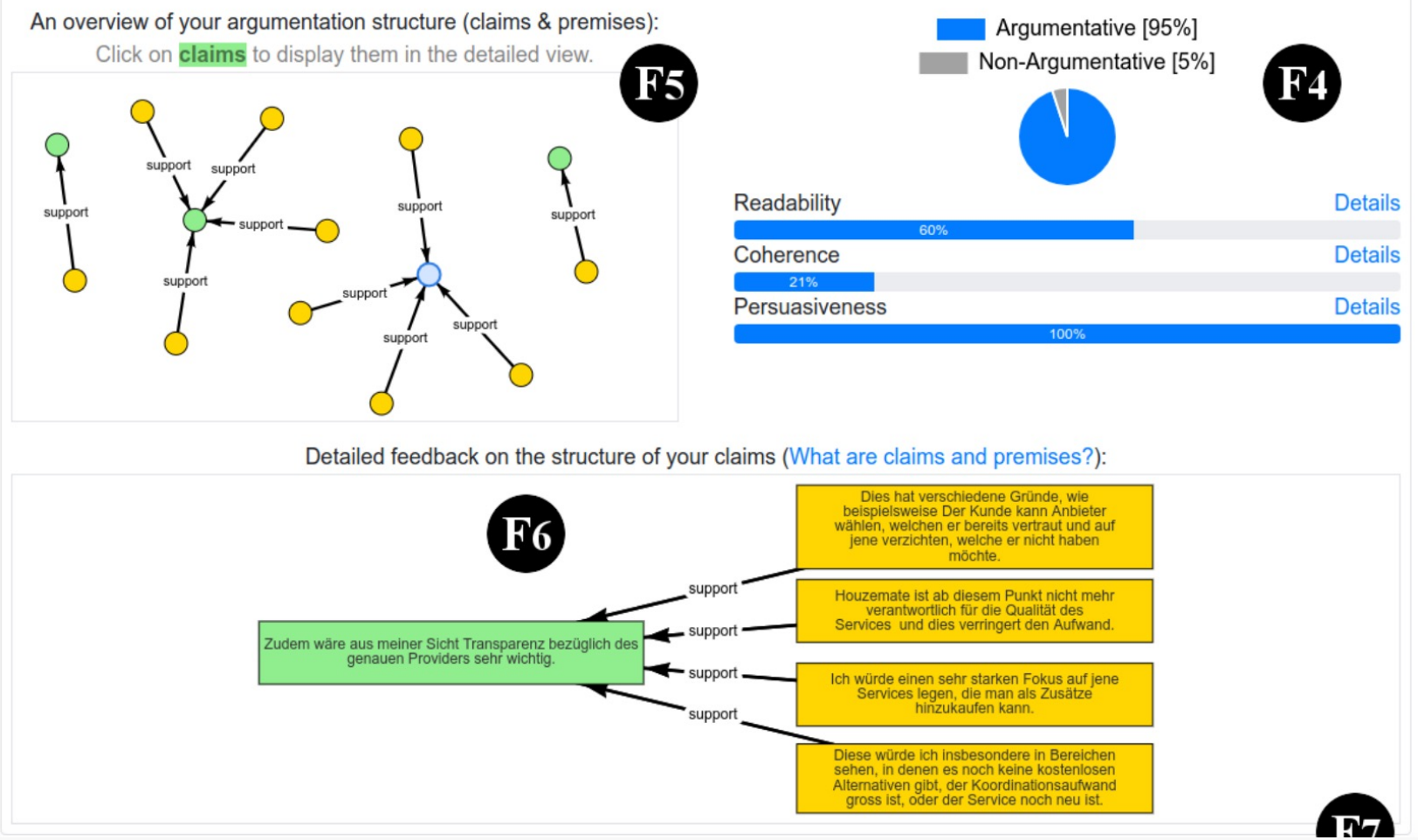


Figure 1: Overview of task setting.

Visualization of Explanations = How? - Example

AL: An Adaptive Learning Support System for Argumentation Skills,
T. Wambsganss et al. CHI 2020



Interaction = Who is interacting with whom? - Example

ArgueTutor: An Adaptive Dialog-Based Learning System for Argumentation Skills, T. Wambsganss et al. CHI 2021

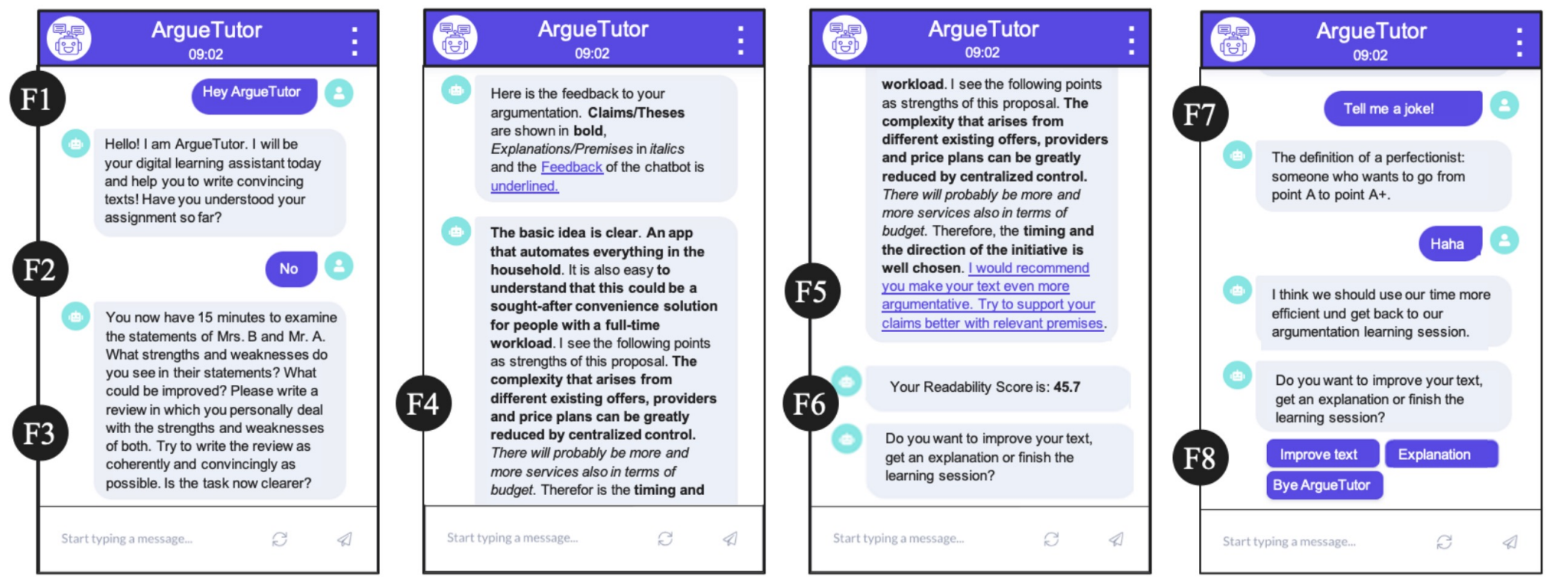


Figure 1: Screenshot of our adaptive dialog-based learning system: a user conducts a certain writing exercise and receives adaptive tutoring and feedback on the argumentation quality of her text

Personalization of the Explanations = To Whom? - Example

"Mama Always Had a Way of Explaining Things So I Could Understand": A Dialogue Corpus for Learning to Construct Explanations, H. Wachsmuth et al. COLING 2022

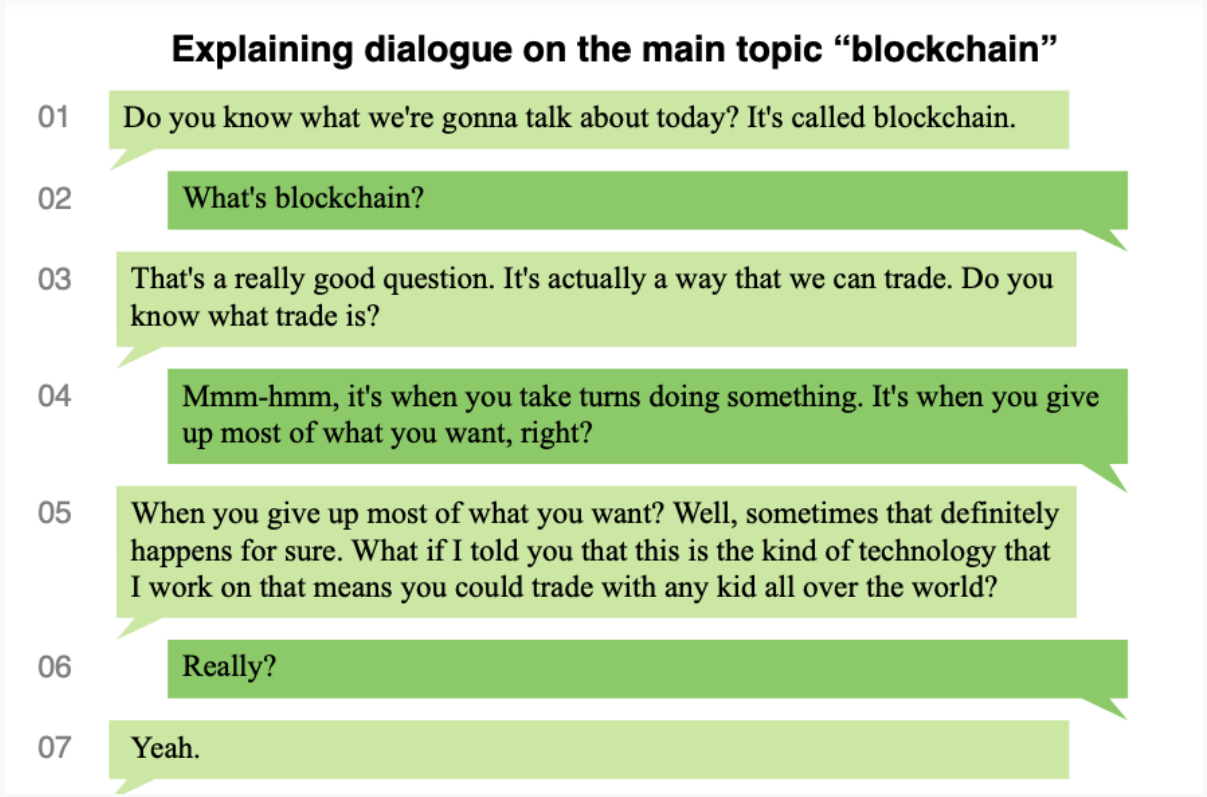


Figure 1: A short explaining dialogue from the video series *5 Levels*, included in the corpus presented in Section 3. Here, an expert explains blockchain to a child.

Related surveys in argumentation

- Automated Writing Evaluation (Ke and Ng, 2019; Beigman Klebanov and Madnani, 2020; Wang et al., 2022)
  - Mainly about essay scoring → Shallow feedback
  - Not deeply covering the different argumentative feedback

- Argumentation Mining (Habernal and Gurevych, 2016; Lawrence and Reed, 2020)
  - Point of view of the coder
  - Not the point of view of the user (not feedback-oriented)

- Explainability (Vassiliades et al. 2021; Čyras et al. 2021)
  - Show the potential of argumentation to explain a model output
  - But don’t explain how to explain an argument

References

All references can be found at https://kmilia.github.io/teach_me_how_to_argue/

- *Teaching Critical Thinking Skills In Higher Education: A Review Of The Literature*, Behar-Horenstein et al, 2011
- *Argument maps improve critical thinkin*g. Twardy. Teaching Philosophy, Vol. 27, , 06 2004
- *Computer-supported argumentation: A review of the state of the art*. Scheuer et al., 2010
- *LPAttack: A Feasible Annotation Scheme for Capturing Logic Pattern of Attacks in Arguments*, Mim et al. EMNLP 2022
- *TYPIC: A Corpus of Template-Based Diagnostic Comments on Argumentation*, Naito et al. EMNLP 2022
- *AL: An Adaptive Learning Support System for Argumentation Skills*, Wambsganss et al. CHI 2020
- *Arguetutor: An adaptive dialog-based learning system for argumentation skills.* Wambsganß, et al., 2021
- *“Mama Always Had a Way of Explaining Things So I Could Understand”: A Dialogue Corpus for Learning to Construct Explanations*, Wachsmuth et al. COLING 2022