IOWA STATE UNIVERSITY

Corpus and genre-based automated writing evaluation for scientific writing

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International Perspectives on Corpora for Language Learning
University of Queensland
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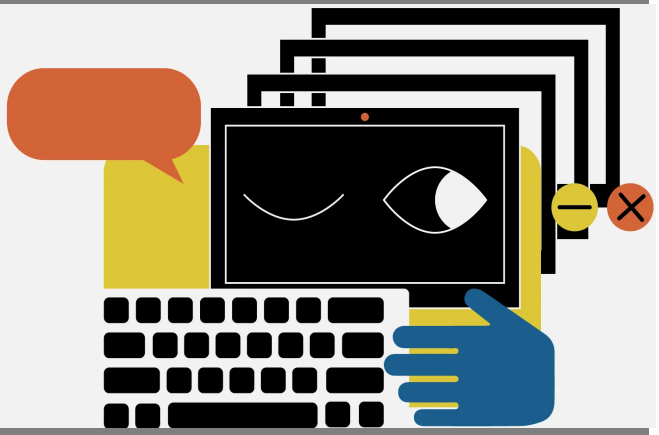

Outline

- Background to genre-based Automated Writing Evaluation
- Research Writing Tutor: Genre-based AWE exemplar for scientific writing
  A. Corpus as data
  B. Corpus for feature design
  C. Corpus for pedagogical implementation
- Learning potential and impact
- Future directions

Automated Writing Evaluation (AWE)

Ability of computer technology to evaluate and score written prose (Shermis & Burstein, 2003)

A "comprehensive history of AWE has yet to be written"
(Hazelton et al., 2021)

- 1st generation – grading of student writing
  - Project Essay Grade

- 2nd generation – individualized feedback on errors

- 3rd generation – analysis of student writing across academic disciplines and writing genres

Genre-based AWE

3rd generation of AWE took a "left turn" (Burstein et al., 2016a, p. 6)

- **From** quantifiable features that, "in the aggregate, embody the meaning of writing for the assessment" (Williamson, 2013, p. 166)

- **To** "the rhetorical ability to integrate an understanding of audience, context, and purpose […]; the ability to effectively employ multiple writing strategies; the ability to learn and use the conventions appropriate to a specific genre of writing" (Perelman, 2012, p. 129)

- Motivated by EAP teaching and learning needs
- Grounded in ESP genre theory
- Focused on the design and pedagogical uses of automated feedback tools for genre writing
  - moves (communicative goals)
  - steps (writing strategies)

Genre-based AWE

- Mover (Anthony & Lashkia, 2003)
  - Move structure of research article abstracts
  - Naïve Bayes classifier

- Intelligent Academic Discourse Evaluator (IADE) (Cotos, 2009)
  - Move feedback on research article Introduction sections
  - Support Vector Machines classifier (Pendar & Cotos, 2008)

IADE

- Research Writing Tutor (RWT) (Cotos, 2014, Cotos et al., 2015, 2016, 2017, 2020)
  - Move/step feedback on IMRD/C sections
  - Support Vector Machines classifier (Cotos & Pendar, 2016)

RESEARCH WRITING TUTOR

- Academic Writing Analytics (AWA); AcaWriter (Knight et al., 2020)
  - Feedback on rhetorically salient sentences
  - Rule-based dependency parser (Sándor, Kaplan, & Rondeau, 2006)

UTS AcaWriter

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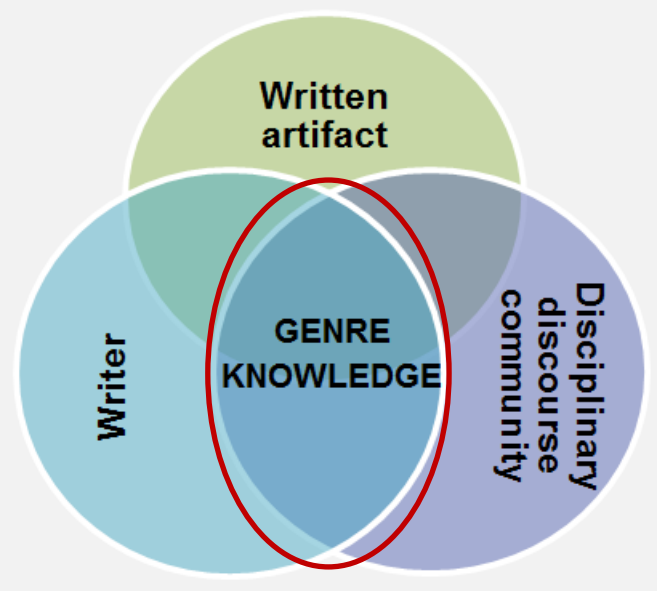
Genre-based AWE for scientific writing



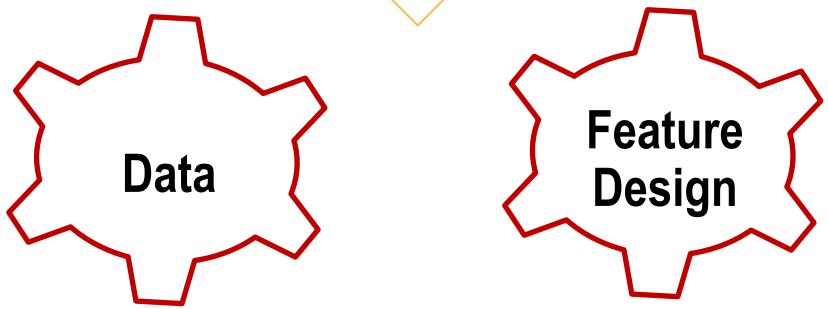
- Writer's self-awareness and metacognitive knowledge of the rhetorical task
- Socio-disciplinary awareness about the discourse community

- Metapragmatic ability to produce a research genre artifact
  - communicative action
  - genre-specific language choices
  - appropriate to the expectations of the disciplinary discourse community

Genre-based AWE for scientific writing

- Invaluable tool for genre analysis (Hyland, 2007, p. 224)
- Powerful methodology-technology for determining how disciplines use language in their major genres (Lee & Swales, 2006, p. 57)

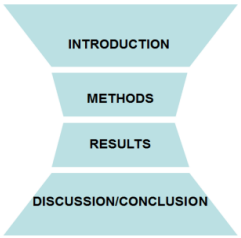
Corpus for RWT development



A. RWT: Corpus as data

Corpus analysis and annotation of research articles in the disciplines

Genre (move/step) conventions in published research articles



- Cotos, Huffman, and Link (2015)
- Cotos, Link, and Huffman (2016)
- Cotos, Huffman, and Link (2017)

Corpus of 30 disciplines

900 articles (30 per discipline)

- Moves/steps used across disciplines, with distinct patterns and variation
- Characteristic functional, rhetorical, content, and linguistic realizations
- Disciplinary writing is multi-functional
- Moves/steps not randomly distributed
- Disciplines cluster based on use of moves/steps

A. RWT: Corpus as data

- Cross-disciplinary conventions

Introduction	Methods	Results	Discussion/Conclusion
Move 1: Establishing the territory Step 1 – Claiming centrality *and/or* Step 2 – Providing general background *and/or* Step 3 – Reviewing previous research	**Move 1: Contextualizing the study methods** Step 1 – Referencing previous works *and/or* Step 2 – Providing general information *and/or* Step 3 – Identifying the methodological approach *and/or* Step 4 – Describing the setting *and/or* Step 5 – Introducing the subjects/participants *and/or* Step 6 – Rationalizing pre-experiment decisions	**Move 1: Approaching the niche** Step 1 – Providing general orientation *and/or* Step 2 – Restating study specifics *and/or* Step 3 – Justifying study specifics	**Move 1: Re-establishing the territory** Step 1 – Drawing ona/theoretical general background *and/or* Step 2 – Drawing on study-specific background *and/or* Step 3 – Highlighting principal findings *and/or* Step 4 – Previewing the discussion 'road map'
Move 2: Identifying a niche Step 1 – Indicating a gap *and/or* Step 2 – Highlighting a problem *and/or* Step 3 – Raising general questions *and/or* Step 4 – Proposing general hypotheses *and/or* Step 5 – Presenting justification	**Move 2: Describing the study** Step 1 – Acquiring the data *and/or* Step 2 – Describing the data *and/or* Step 3 – Identifying variables *and/or* Step 4 – Delineating experimental/study procedures *and/or* Step 5 – Describing tools/instruments/materials/equipment *and/or* Step 6 – Rationalizing experiment decisions *and/or* Step 7 – Reporting incrementals	**Move 2: Occupying the niche** Step 1 – Reporting specific results *and/or* Step 2 – Indicating alternative presentation of results	**Move 2: Framing the new knowledge** Step 1 – Explicating results and/or Step 2 – Accounting for results *and/or* Step 3 – Clarifying expectations *and/or* Step 4 – Addressing limitations
Move 3: Addressing the niche Step 1 – Introducing present research descriptively *and/or* Step 2 – Announcing present research purposefully *and/or* Step 3 – Presenting research questions *and/or* Step 4 – Presenting research hypotheses *and/or* Step 5 – Clarifying definitions *and/or* Step 6 – Summarizing methods *and/or* Step 7 – Announcing principle outcomes *and/or* Step 8 – Stating the value of present research *and/or* Step 9– Outlining the structure of the paper	**Move 3: Establishing credibility** Step 1 – Preparing the data *and/or* Step 2 – Describing the data analysis *and/or* Step 3 – Rationalizing data processing/analysis	**Move 3: Construing the niche** Step 1 – Comparing results *and/or* Step 2 – Accounting for results *and/or* Step 3 – Explicating results *and/or* Step 4 – Clarifying expectations *and/or* Step 5 – Acknowledging limitations	**Move 3: Reshaping the territory** Step 1 – Supporting with evidence *and/or* Step 2 – Countering with evidence
	Move 4: Expanding the niche[a] Step 1 – Generalizing results *and/or* Step 2 – Claiming the value *and/or* Step 3 – Noting implications *and/or* Step 4 – Proposing directions	**Move 4: Establishing additional territory** Step 1 – Generalizing results *and/or* Step 2 – Claiming the value *and/or* Step 3 – Noting implications *and/or* Step 4 – Proposing directions	

(Cotos et al., 2015)

A. RWT: Corpus as data

- Description of moves and steps

Rhetorical Intent *[Why?]*	Content Realizations *[What content?]*
– to give meaning to the results – provide logic behind arguments related to principal findings – to take a position and incline the reader to accept it	Statements that express authors': – interpretations of the results – inferences based on the results – deductions from the results – evaluation of the results – hypotheses based on the results

Linguistic Realizations *[What language choices?]*
– The results indicate that incumbents do indeed react preemptively to Southwest's entry threat. [ECON] – The validation results presented suggest that STEMS-Air can be applied to both short-term and long-term modelling of PM10. [ENVE]

Example

- Characteristic functional, rhetorical, content, and linguistic realizations

Discussion section

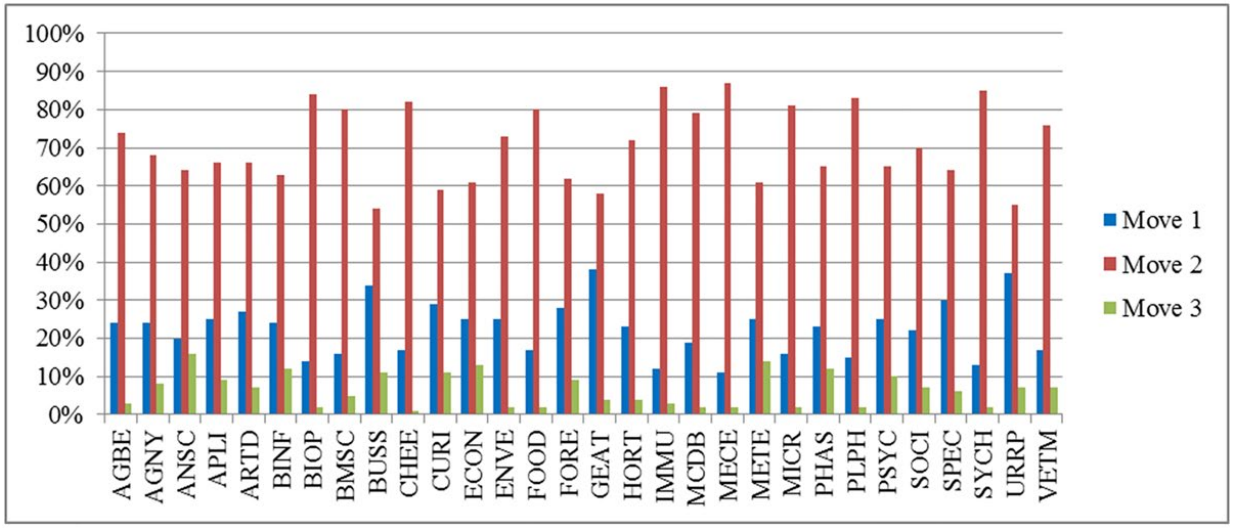
Move 2: Framing new knowledge

Step 1: Explicating findings

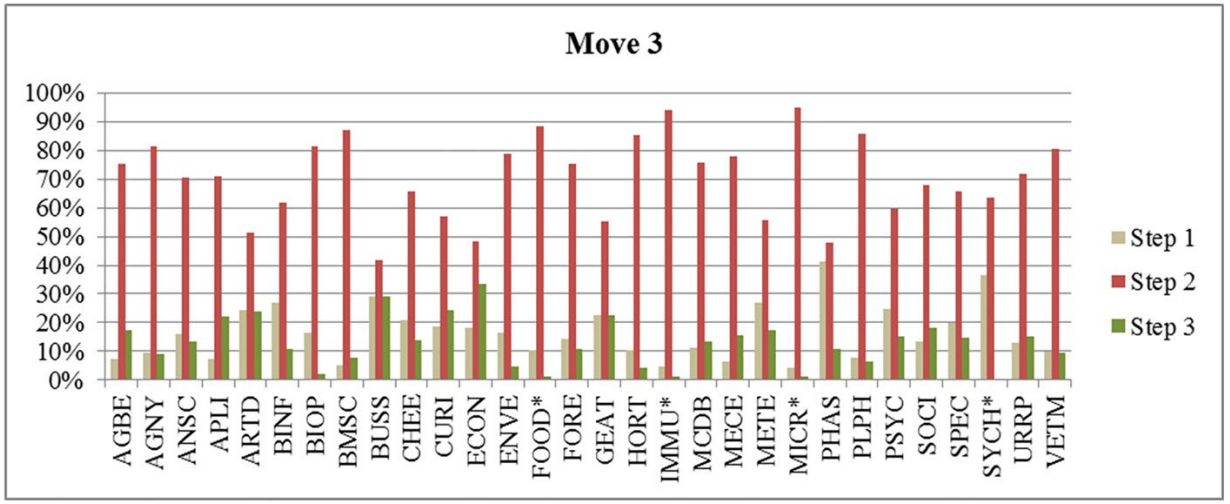
(Cotos et al., 2016)

A. RWT: Corpus as data

- Frequency of moves and steps in the disciplines



Methods section



(Cotos et al., 2017)

A. RWT: Corpus as data

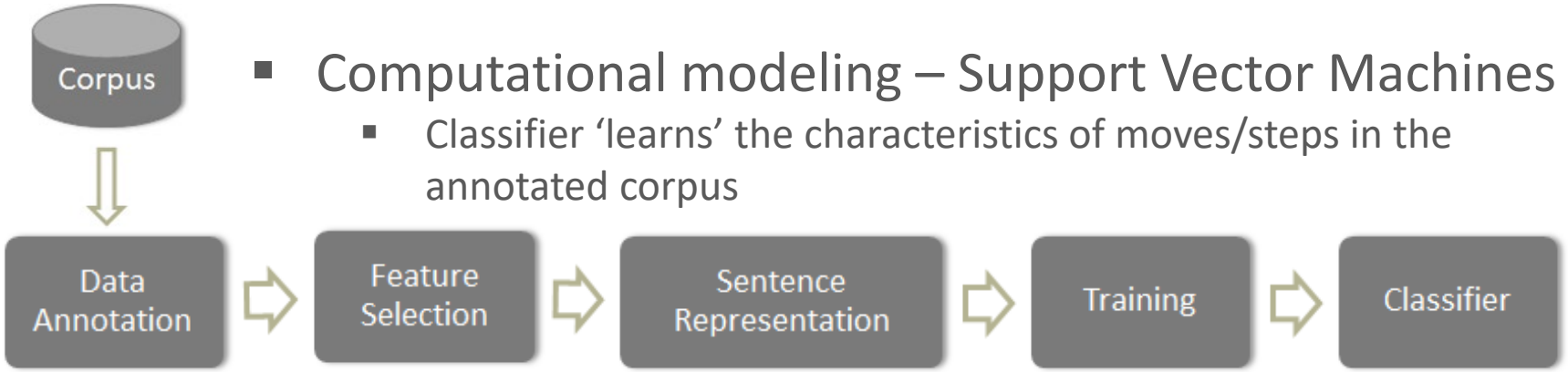
- Linguistic features for computational modeling

Move 1 *Step 1-Claiming Centrality*		*Move 2* *Step 2-Highlighting a problem*		*Move 3* *Step 7-Announcing principal outcomes*	
n-gram	OR	n-gram	OR	n-gram	OR
recent year	20.01	as a result	6.24	found that	22.18
the past	19.53	due to the	3.52	show that	9.81
wide us	16.52	becaus of the	3.50	we also	8.41
interest in	15.50	the fact that	3.23	that in	5.96
the last	14.13	have not been	3.22	demonstr that	5.86
import in	11.51	larg number of	3.09	the averag	5.84
bodi of	8.43	there i a	2.44	the result	5.56
been studi	7.40	the major of	2.29	demonstr the	5.25
an import	7.28	to be a	2.28	consist with	5.07
of interest	6.95	a result of	2.24	reveal that	4.72
plai an	6.88	the number of	2.23	here we	4.70
ar import	6.70	lead to the	2.05	the membran	4.26
research have	6.43	a rang of	1.99	evid of	4.22
most import	6.40	on the other	1.92	correspond to	4.08
over the	5.92	of the most	1.89	evid that	3.96

[OR - probability that *n*-gram will occur in a given step versus the probability that it will not]

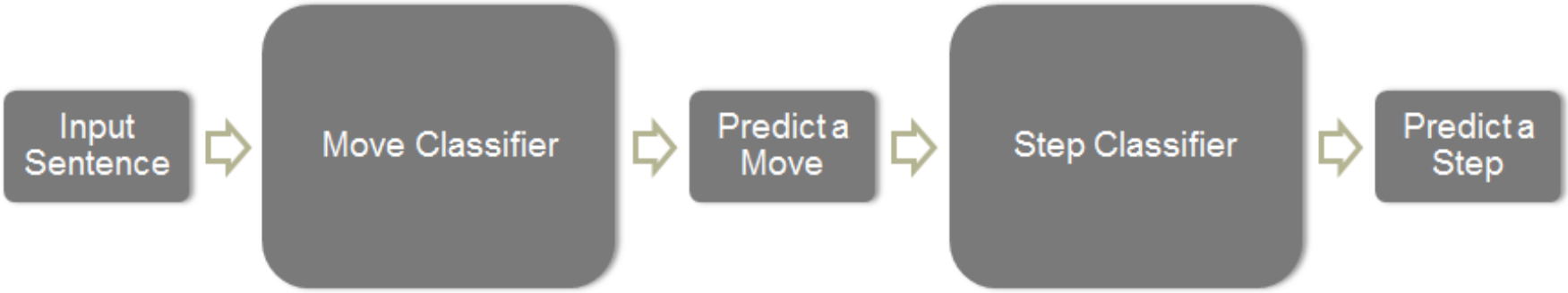
(Cotos & Pendar, 2016)

A. RWT: Corpus as data



- Computational modeling – Support Vector Machines
  - Classifier 'learns' the characteristics of moves/steps in the annotated corpus

- Classifier predicts the moves/steps that new texts should have in order to be classified similarly to human annotation

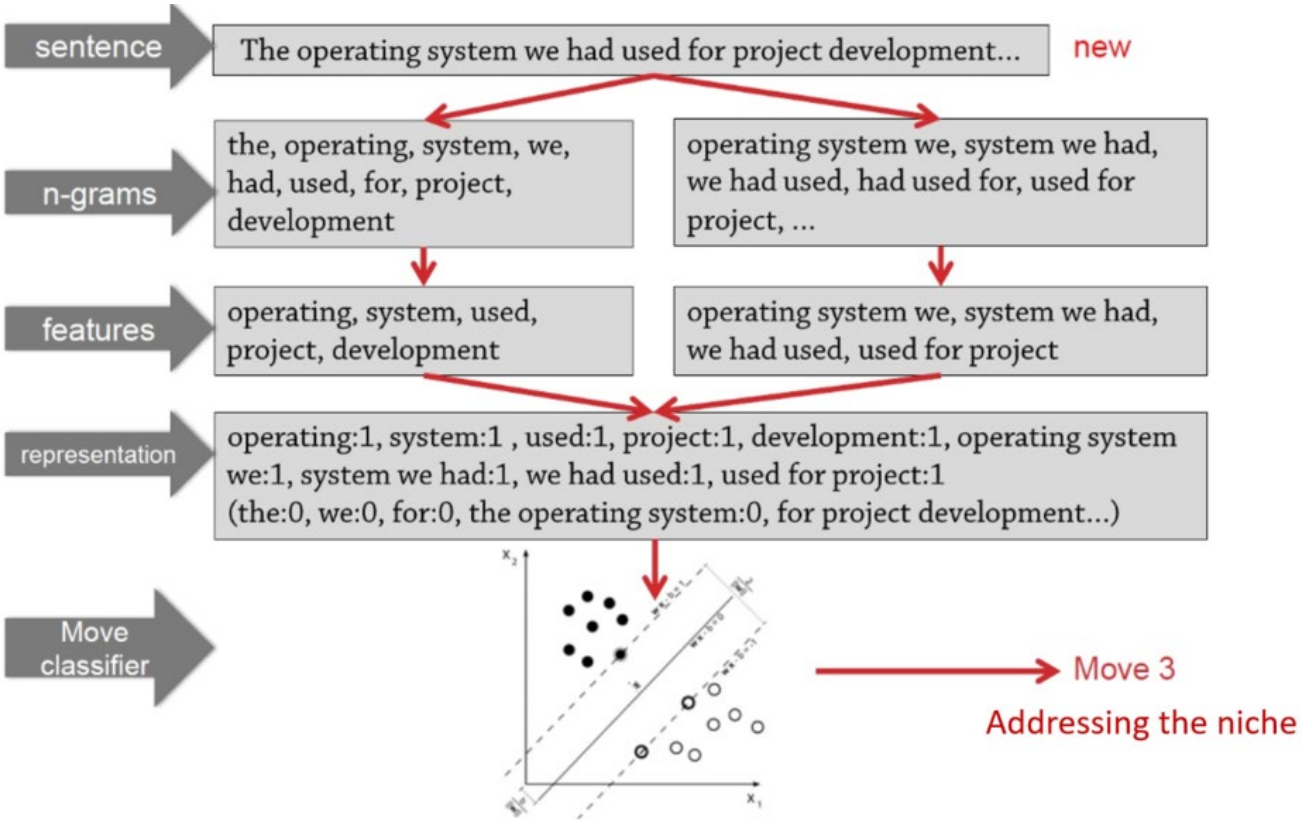


- Identified moves/steps passed on for generation of different types of feedback

(Cotos & Pendar, 2016)

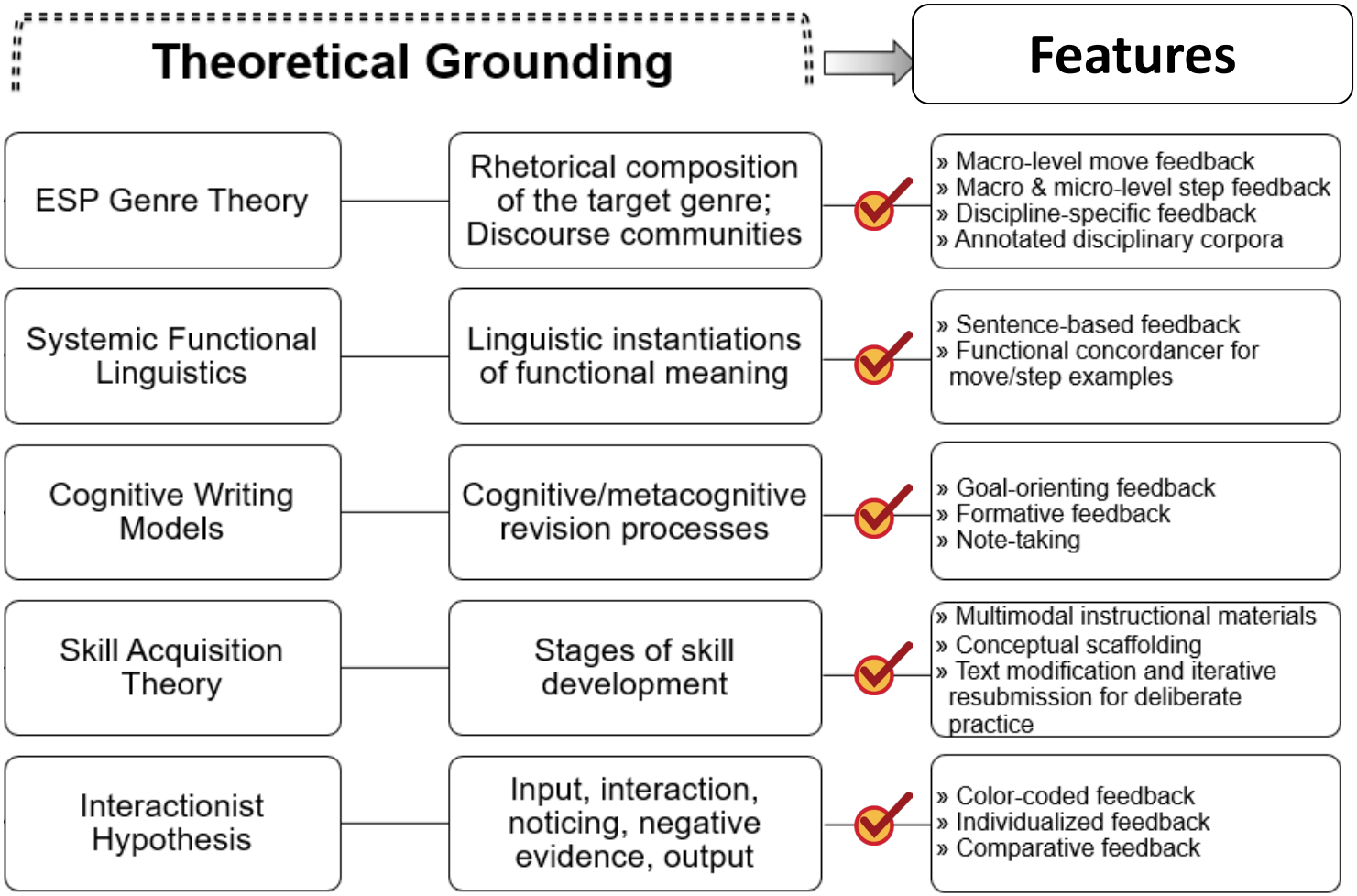
A. RWT: Corpus as language data

- Computational modeling



(Cotos & Pendar, 2016)

B. RWT: Corpus for feature design



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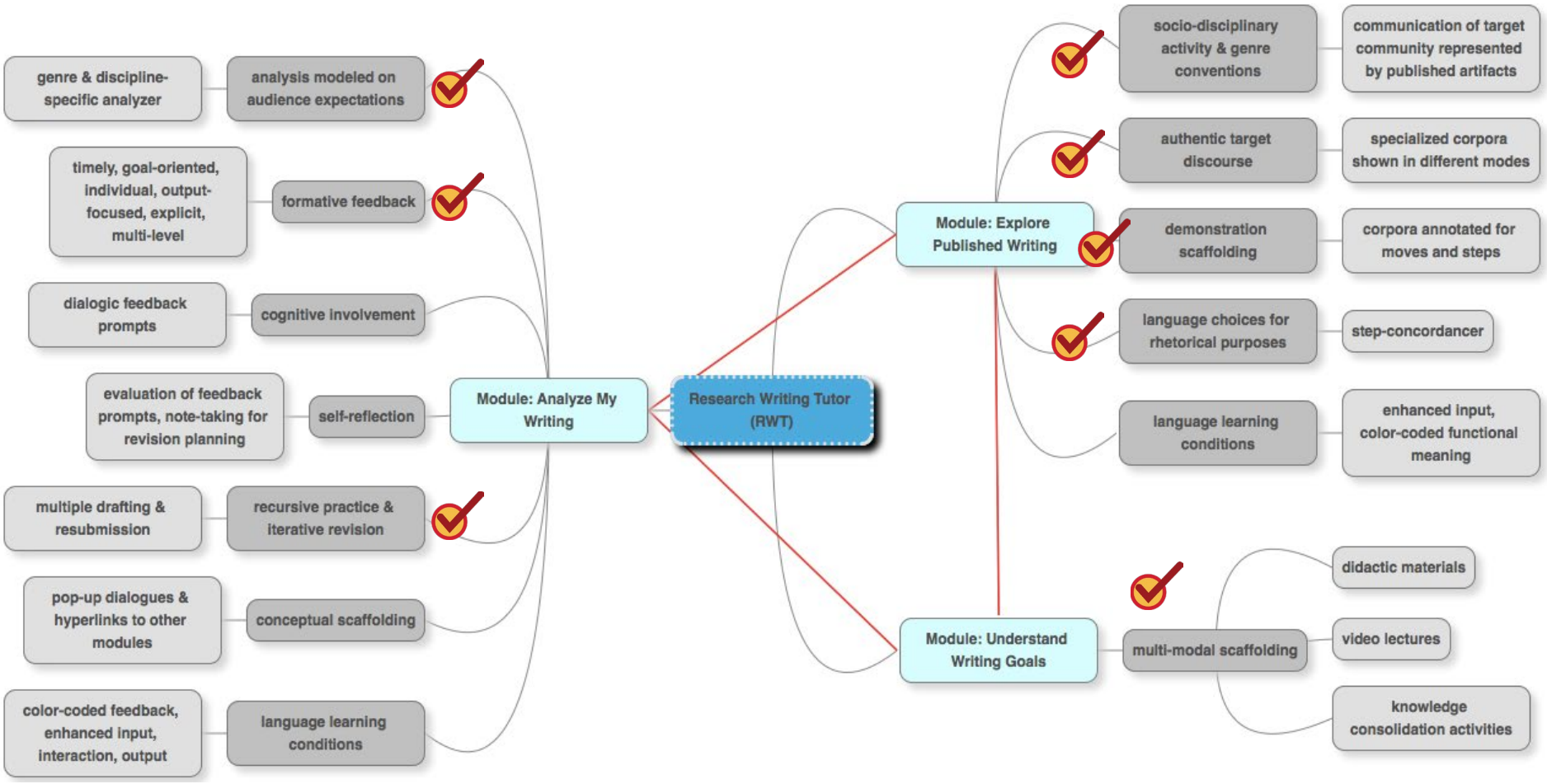
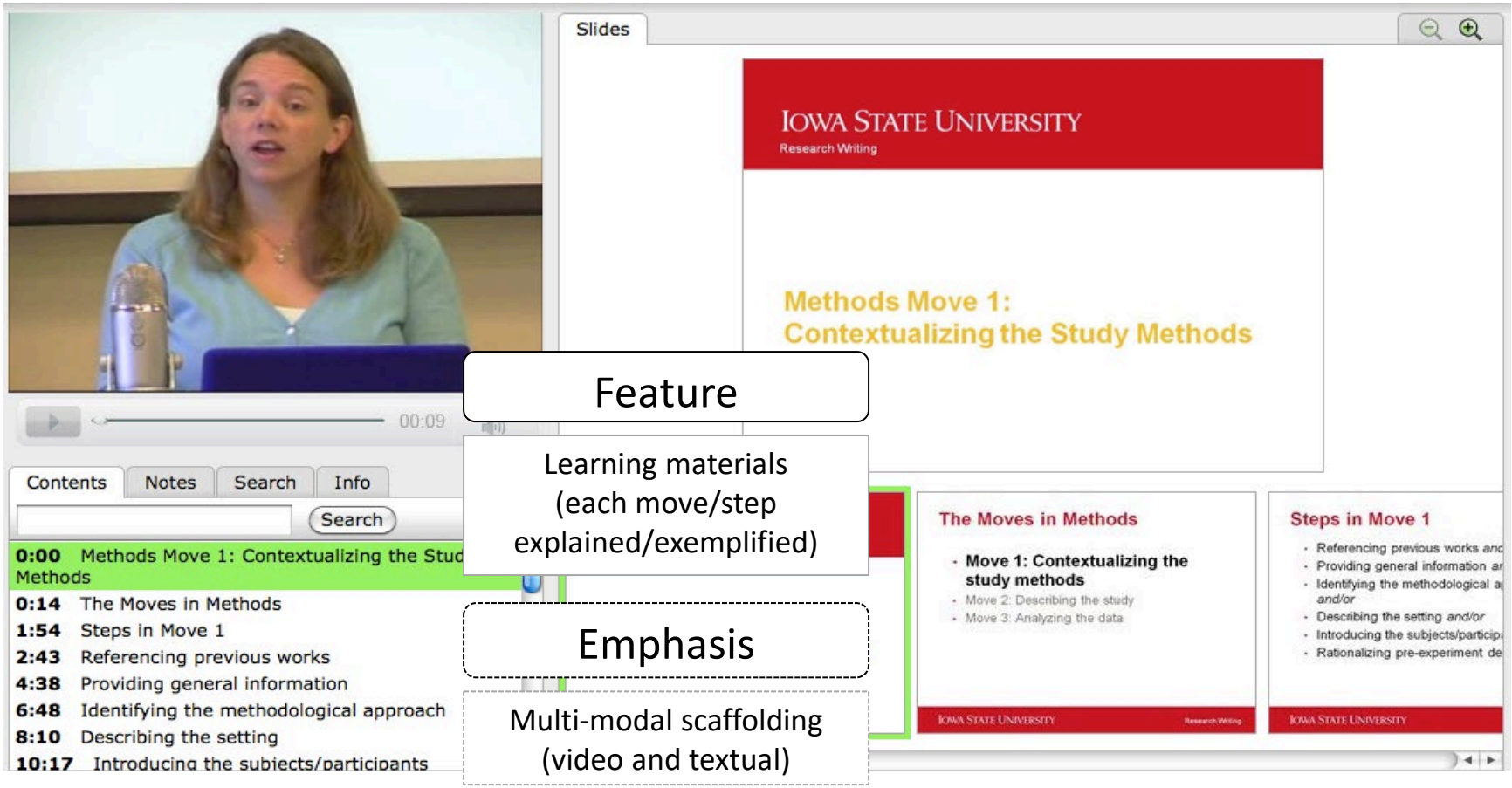


(Cotos, 2015)

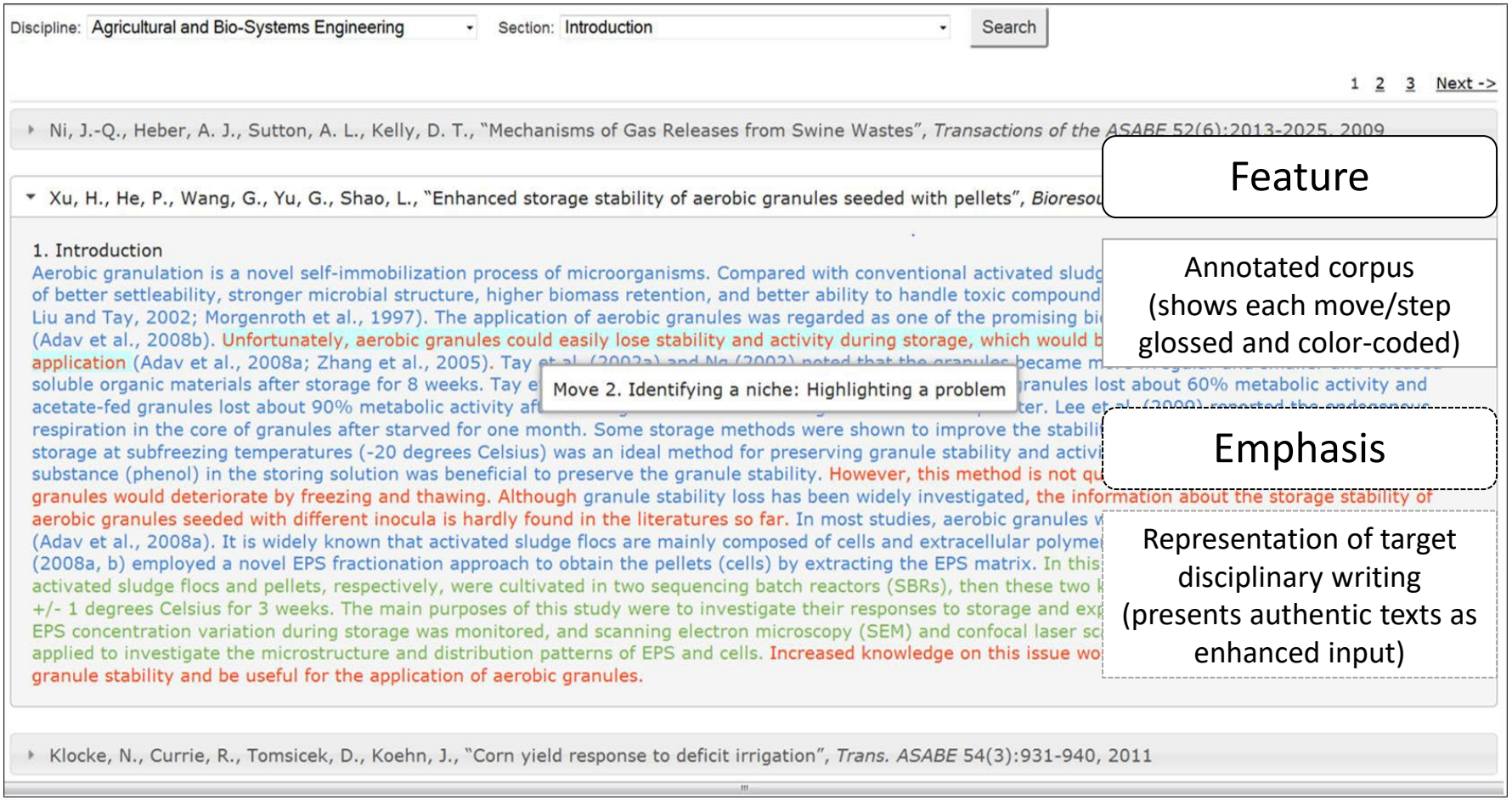
B. RWT: Corpus for feature design

- Instruction: 'Understand Writing Goals' module



B. RWT: Corpus for feature design

- Pedagogical mediation: 'Explore Published Writing' module



B. RWT: Corpus for feature design

- Pedagogical mediation: 'Explore Published Writing' module

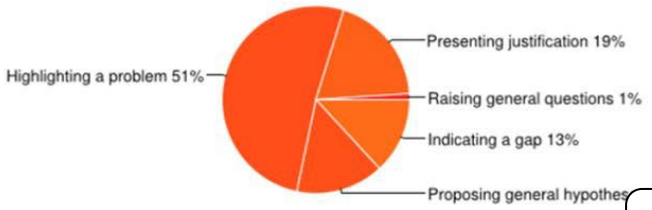
Discipline: Agricultural and Bio-Systems Engineering

Section: Introduction

Moves: Move 2-Identifying a niche

Step: Indicating a gap

SEARCH



Examples of "Indicating a gap"

Dufault, N., Isard, S., "A portable rainfall simulator for evaluating the wet deposition of plant pathogens", *Applied Engineering in Agriculture* 26(1):71-78, 2010

Ecological and environmental factors that influence organisms during each stage of the dispersal process are important for understanding the mov development of plant disease epidemics (Aylor, 1986; Madden, 1992) . However, there is limited information about some of these processes, especially for the deposition of plant pathogen propagules from the atmosphere onto susceptible host plant tissues. Rainfall has been identified as an important mechanism in the spread of plant pathogen propagules (Aylor, 1986; Madden, 1992; Isard and Gage, 2001; Isard et al., 2005).

Wong, K., Sugumaran, M., Lee, D., Zahid, M., "Ecological aspects of endemic plant populations on Klang Gates quartz ridge, a habitat island in Peninsular Malaysia", *Biodiversity and Cons*

This ridge is the most prominent of a series of such ridges in this part of Peninsular Malaysia. Current collecting indicates that inventory of the pla the earlier listings by Ridley (1922) (21 species) and Henderson (1928) (265 species), and a later enumeration by Kiew (1982) (175 species). Many records do not distinguish between an occurrence on the quartz ridge proper and one on the abutting (non-quartz) slopes.

Line, D., Shaffer, M., Blackwell, J., "SEDIMENT EXPORT FROM A HIGHWAY CONSTRUCTION SITE IN CENTRAL NORTH CAROLINA", *Transactions of the ASABE* 54(1):105-111, 2011

Historically, construction-related activities were cited by the state as a major source of degradation to lakes (NC DENR, 1992), and the perception highways typically make up a significant proportion of urban construction, it is unknown what the contribution of highway construction is to the ov development. In fact, few studies have documented the effects of highway construction on the water quality of receiving streams.

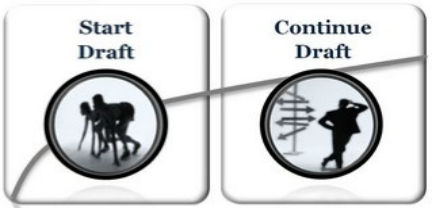
Feature

Functional concordancer (move/step search engine)

Emphasis

Language choices for rhetorical purposes (all examples extracted from the corpus)

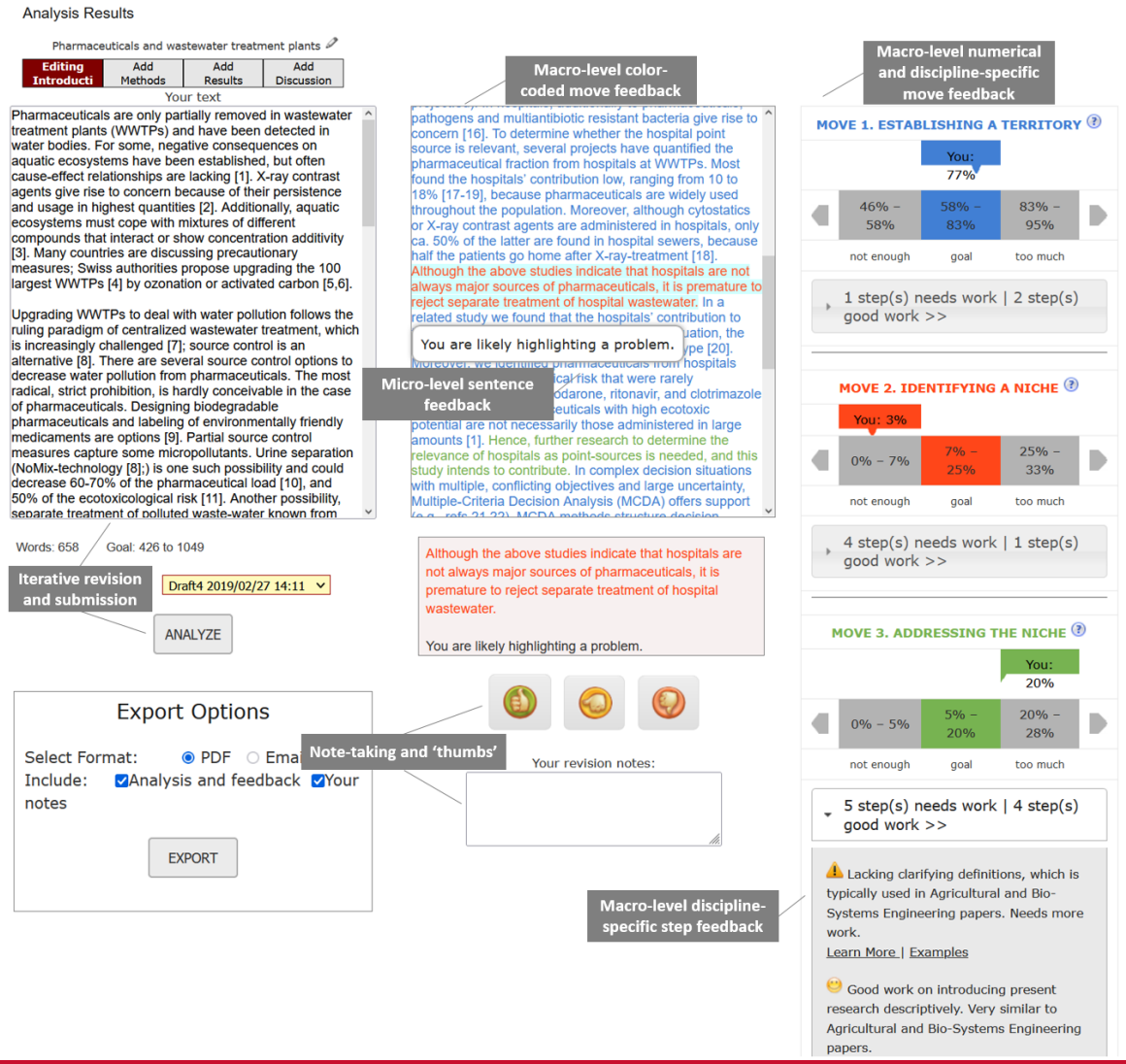
B. RWT: Corpus for feature design



- Feedback: ‘Analyze My Writing’ module

Emphasis

multiple drafting and continued revision



B. RWT: Corpus for feature design

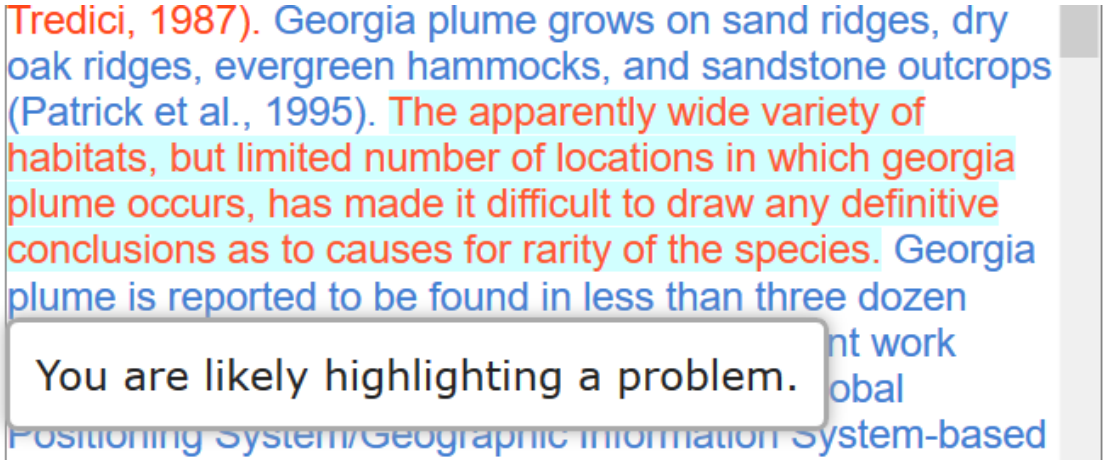
- Feedback: 'Analyze My Writing' module

Feature

Color-coded feedback
(entire text is shown in colors representing particular moves)

Emphasis

Textual context
(to depict the move structure of the draft)

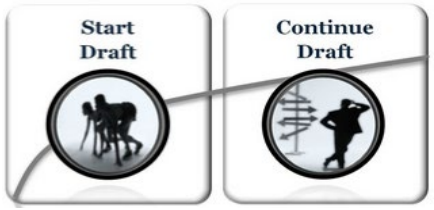


Feature

Functional feedback
(comments or clarifying questions about the step function of individual sentences)

Emphasis

Monitoring of rhetorical intent
(to draw attention to functional meaning)



B. RWT: Corpus for feature design

- Feedback: 'Analyze My Writing' module

Feature

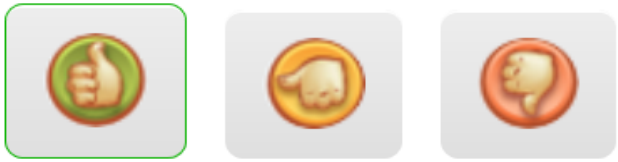
Note-taking (comments or clarifying questions about the step function of individual sentences)

Emphasis

Intra-personal interaction (to foster cognitive processing)

Critical information on fundamental aspects of floral development are needed to develop an understanding of what factors are causing lack of sexual reproduction in native habitats.

You are likely presenting justification.

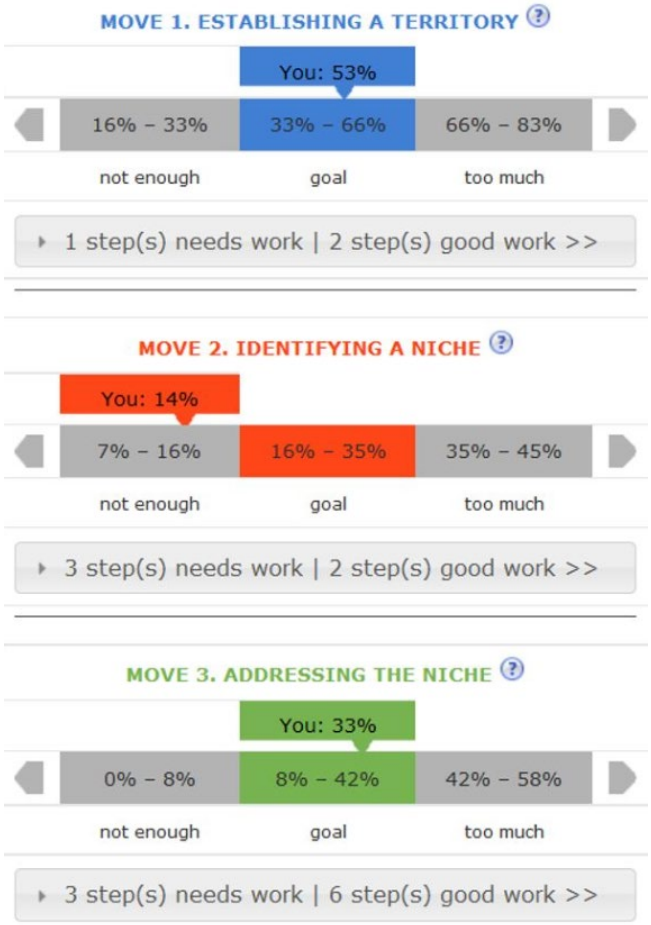


Your revision notes:

Yes, but maybe I should say that new research is needed because it's the research that would provide the critical information needed.

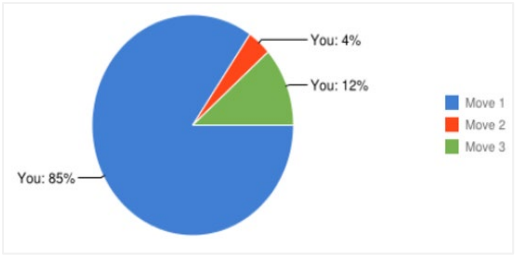
B. RWT: Corpus for feature design

- Feedback: 'Analyze My Writing' module



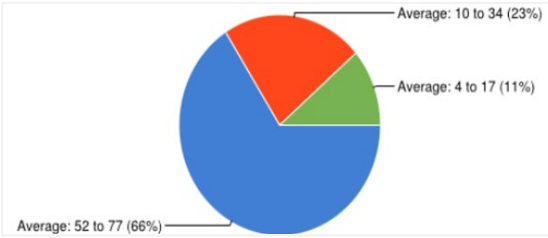
Feature

Numerical, comparative feedback
(range bars and pie charts summarize the distribution of moves in the draft compared with disciplinary corpus)



Emphasis

Socio-disciplinary context
(to compare the draft with the target discipline)



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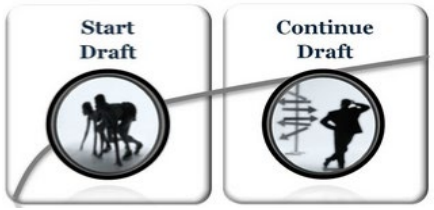


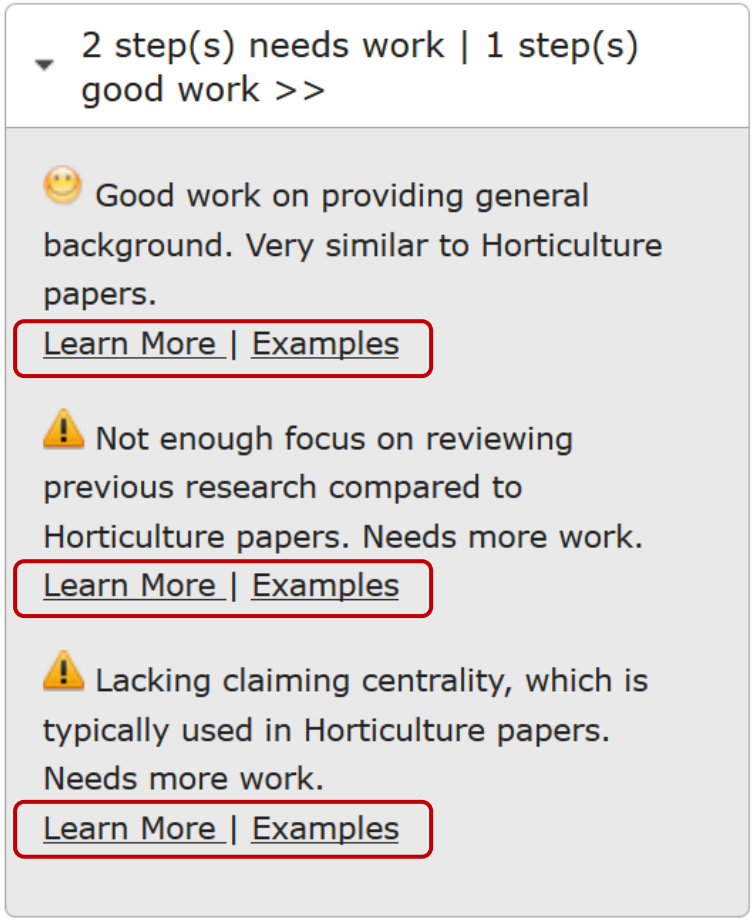
- Feedback: 'Analyze My Writing' module

Feature

Goal-orienting feedback
(range bars for moves expand to show which step/s are addressed well and which may be lacking or needing more work)

Emphasis

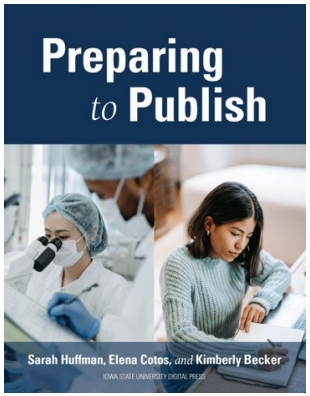
Planning and revision
(to set goals based on textual and socio-disciplinary patterns)

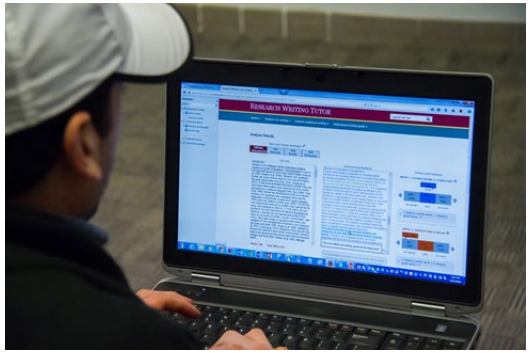


C. RWT: Corpus for pedagogical implementation

Course: Preparing Publishable Thesis Chapters

- Knowledge and comprehension
  - Instructional videos (RWT)
  - Readings - genre writing conventions (RWT) (Huffman, Cotos, & Becker, 2021; open access https://iastate.pressbooks.pub/preparingtopublish)
  - Knowledge consolidation activity
- Corpus exploration
  - Rhetorical composition (RWT)
  - Language use (RWT)
- Analysis and application
  - Drafting and revision (RWT)
  - Peer review
  - Final draft submission

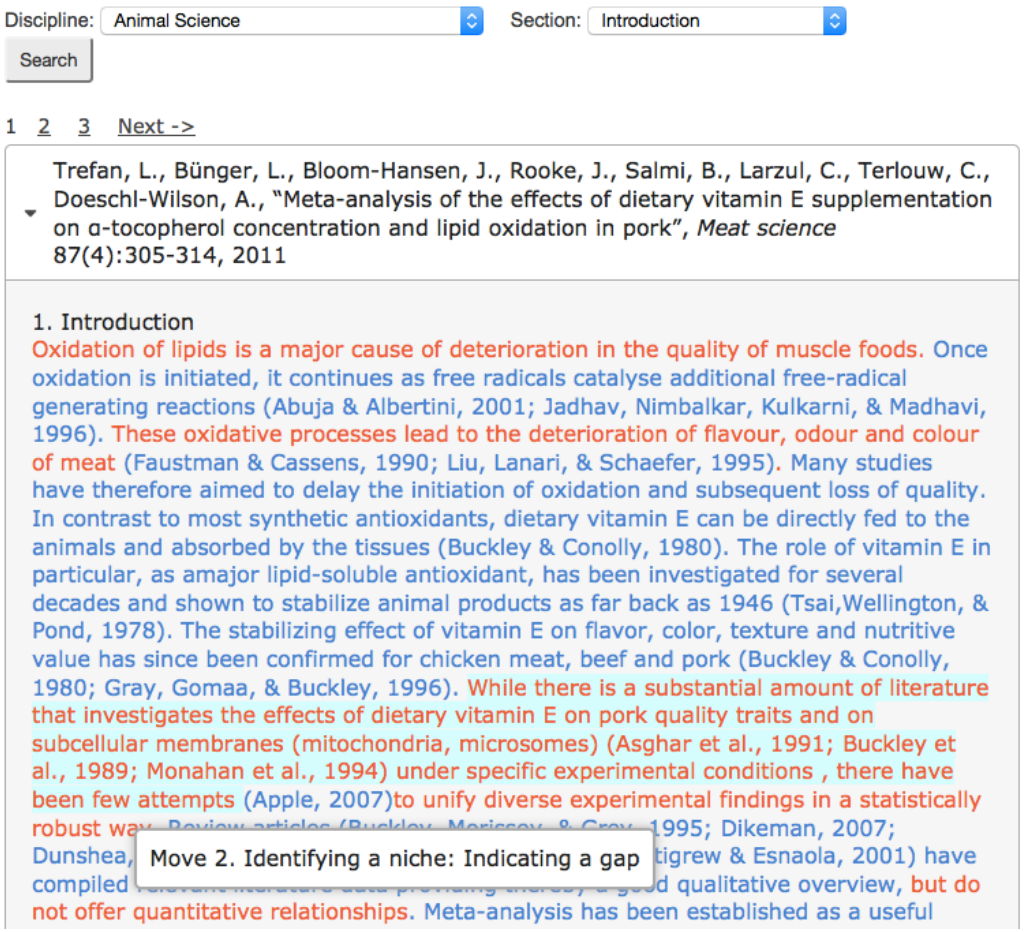




RWT: Corpus for pedagogical implementation

- Corpus exploration: Top-town analysis of rhetorical composition

- How is [Move] distributed in the Introduction?
- Do all the three steps appear in [Move]? If yes, in what order? Does the order matter?
- Are there any steps in [Move] that are not used or are very rare? Why do you think they are not typical of the research articles from your discipline?
- Is there any communicative overlap? That is, are there sentences that represent more than one step in a given move or more than one move?



RWT: Corpus exploration

- Corpus exploration : Bottom-up analysis of language use

- Identify the linguistic choices indicative of certain step functions
- Compile findings into a list of move/step examples of functional language use

* Note grammatical features (e.g., present vs past, active vs passive, modals, etc.)

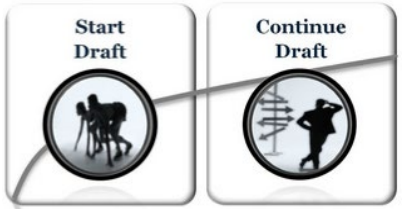
Claiming centrality

These vegetables are widely accepted by consumers because they are easy to prepare for eating. In addition, there is an increasing demand by consumers for safe and nutritious foods that improve physical performance, reduce risks of diseases, and increase the life span. Enhancing the nutritional levels of vegetables would improve nutrient intake without requiring an increase in consumption.

However, in some cases the terms QTL and gene will be used interchangeably for ease in explanation. Because of the wide use of PI 88788 as a resistance source, it has been the focus of a number of studies. These mapping studies have revealed the presence of only two resistance QTL that can be traced to this source (Concibido et al., 1997; Glover et al., 2004).

Since a major role of transpiration is leaf cooling, canopy temperature (Tc) and its reduction relative to ambient temperature is an indication of the role of transpiration in cooling the leaves. Thus, interest is increasing in using canopy temperature when breeding for drought tolerance. This involves selection of genotypes that maintain lower canopy temperature as compared with other genotypes under the same field conditions.

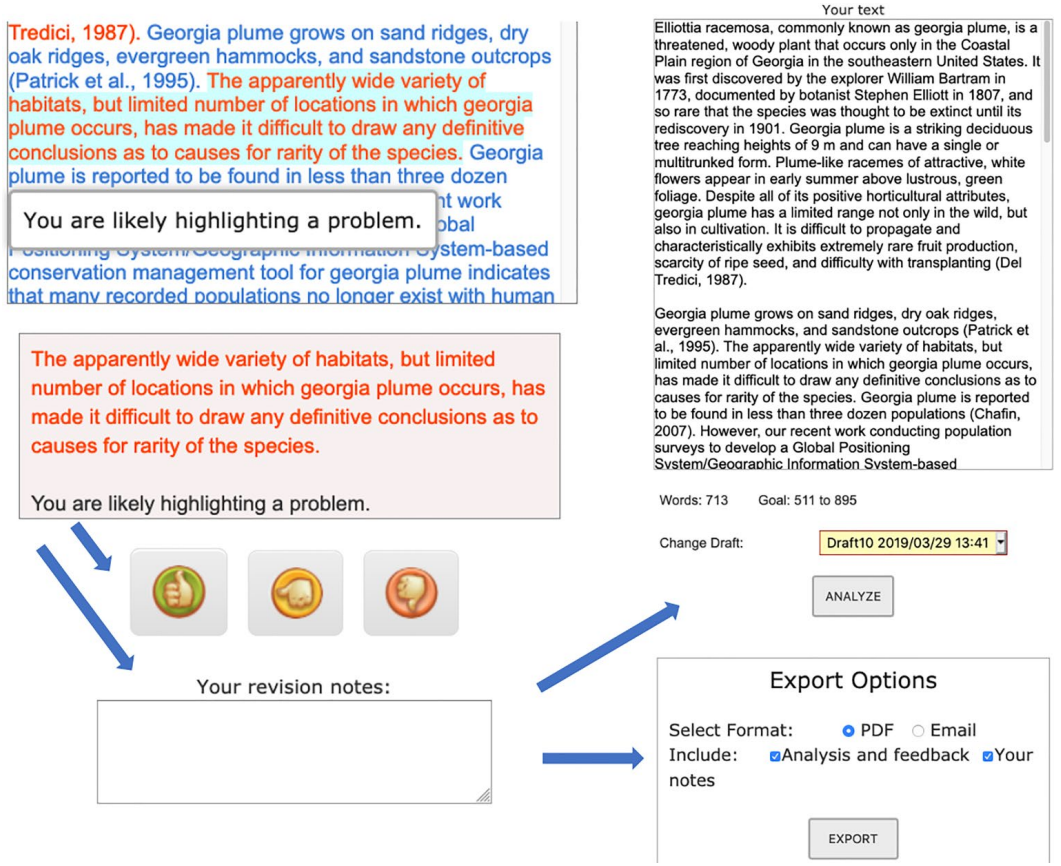
The effects were particularly large in the arils. Considering the increasing demand for intensely red pomegranates , further understanding of climate effects on the fruit coloration is needed, especially in face of "global warming" that already affects the climate in traditional cultivation regions of pomegranates. Knowledge of the factors and processes involved in anthocyanin



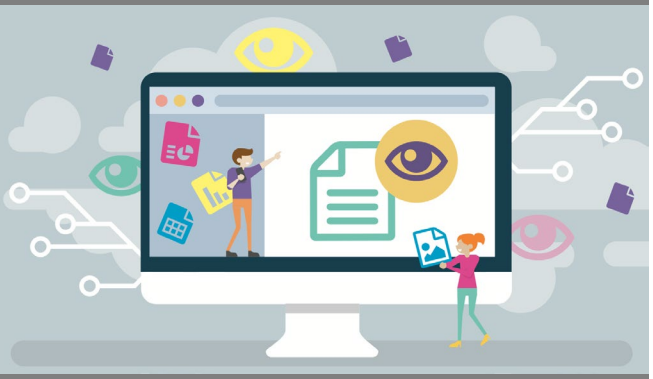
RWT: Effects of corpus & genre-based AWE

- Writing task: Self-analysis and revision

- When you receive your color-coded text in the "Sentence-level feedback" text box, click on each sentence and check if you agree with the feedback prompt. Analyze all your sentences and take clarification/revision notes as follows:
  - If you agree, click on "thumbs up";
  - If you don't agree, click on "thumbs down" and write the step/strategy you think the sentence represents;
  - If you partially agree (e.g., the move is colored as you intended, but the step meaning you are trying to convey is different; or, your sentence caries two or more step functions, but the feedback prompt contains only one), click on "neutral thumbs" and take a note of what you agree and what you disagree with in "Your revision notes" box below.
  - If the feedback prompt is "The function of this sentence is not clear", clarify it with a revision note as well.
- Make revisions based on your notes in the textbox called "Your text".
  - You can make revisions concurrently with your analysis of individual color-coded sentences. Make the changes you want and then re-submit your modified draft for automated analysis and feedback by clicking on ANALYZE.
  - After you identify the parts of your draft that might need to be improved, export your notes as PDF and begin revising in the textbox called "Your text".
- Revise and resubmit your revised draft for sentence-level feedback as many times as you need.
- If your discipline is represented in RWT, consider the section-level feedback in the form of bar-graphs as well.
  - See whether or not each of your moves is within the "goal" range compared to your discipline.
  - Under each move, click to expand the feedback on steps and see which steps may be lacking or may need more work.
  - Determine which step to address first, second, next, etc. If you need a reminder of what a step means, hover over or click on "Learn More" to see its definition, or click on "Examples" to see sentences from the RWT corpus representing that particular step.
- Revise and resubmit your revised draft for section-level feedback as many times as you need.
- When you finish revising with RWT, export your draft as PDF and save it as "Your name_RWT Introduction revised draft".



Outline



- Background to genre-based Automated Writing Evaluation
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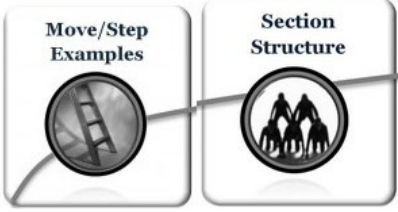
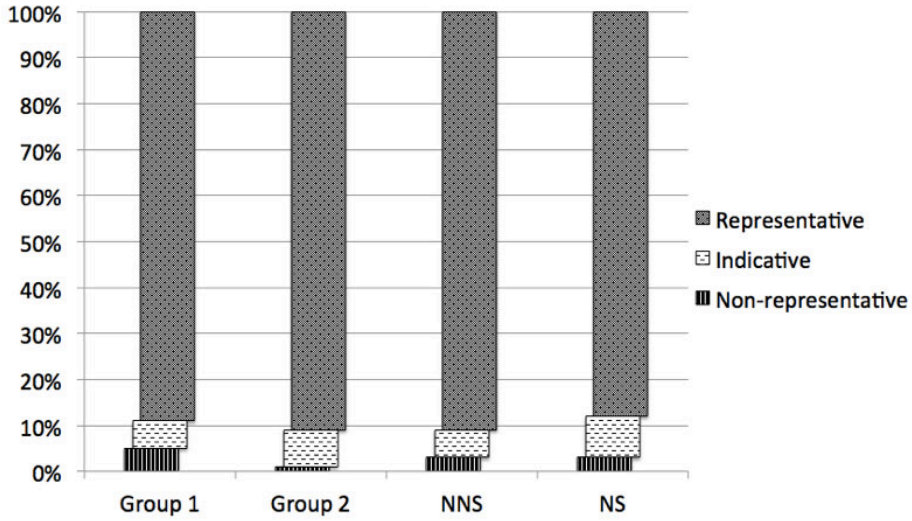
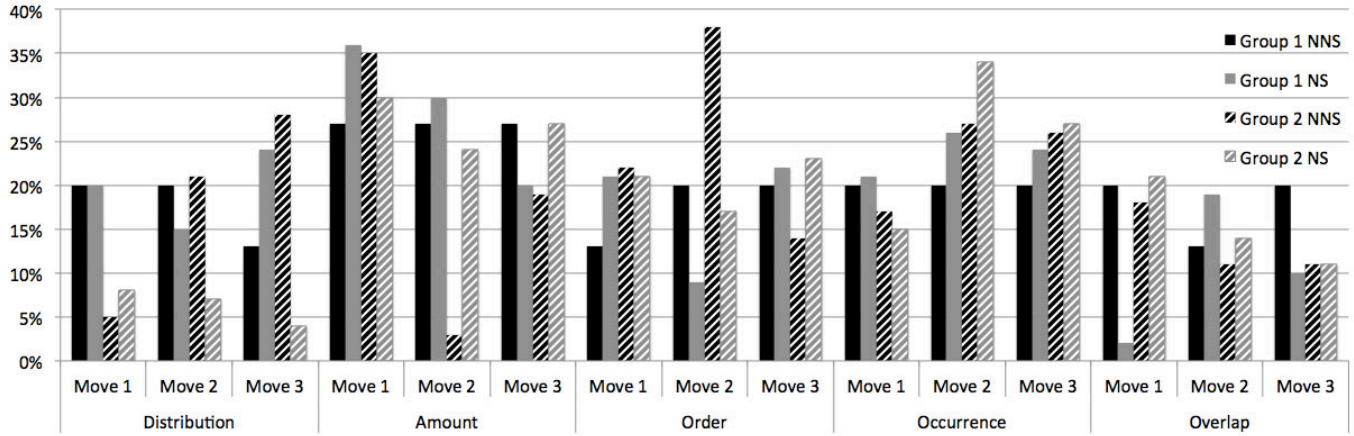
  B. Corpus for feature design
  C. Corpus for pedagogical implementation
- Learning potential and impact
- Future directions



RWT: Effects of corpus exploration

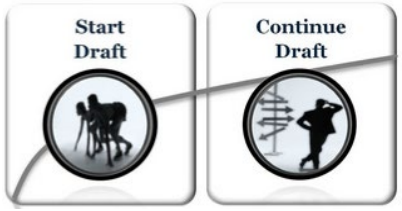
- Corpus-based features can
  - raise genre awareness
  - increase understanding of disciplinary conventions
  - foster noticing of
    - discipline-specific patterns in rhetorical composition
    - functional language expressing specific rhetorical intent





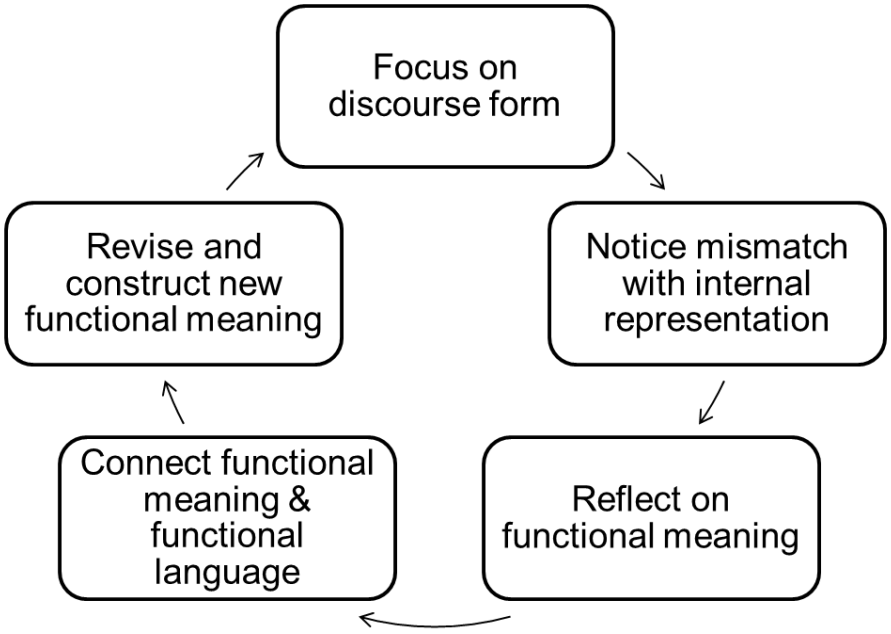
(Cotos, Link, & Huffman, 2017)

- Distribution [move placement]
- Amount [step extent, quantity]
- Order [step succession]
- Occurrence [step presence, absence]
- Overlap [multiple step functions in the same stretch of text]



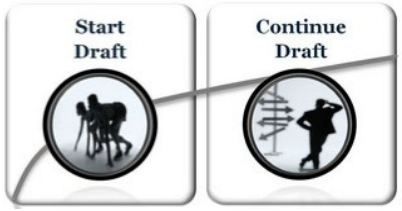
RWT: Effects of corpus & genre-based AWE

- Corpus-based automated feedback can
  - foster intra-personal interaction
  - enable learning-revision cycle
  - develop a meaning-oriented internal representation



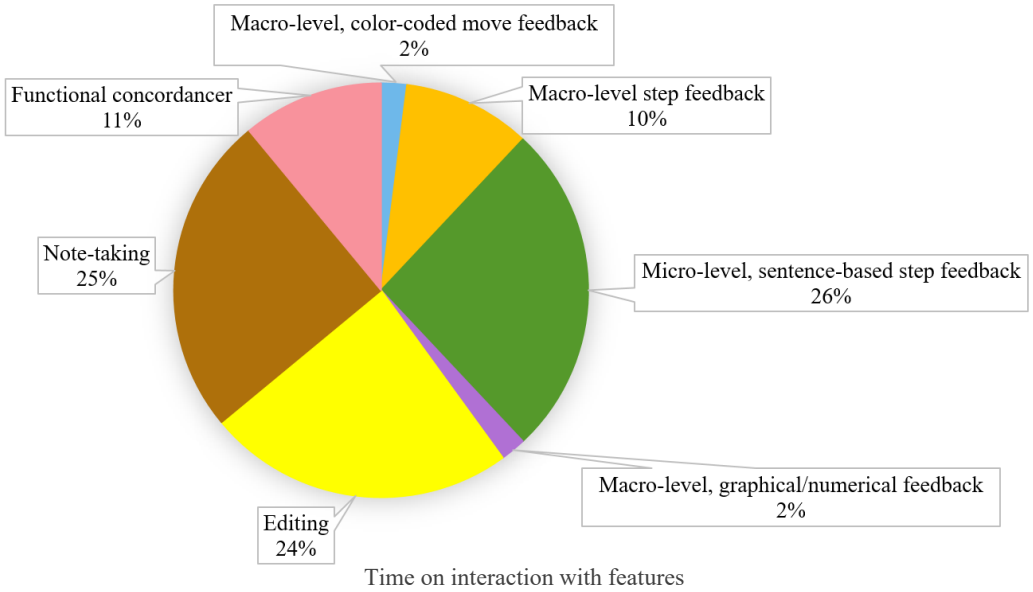
(Cotos, 2011, 2014)

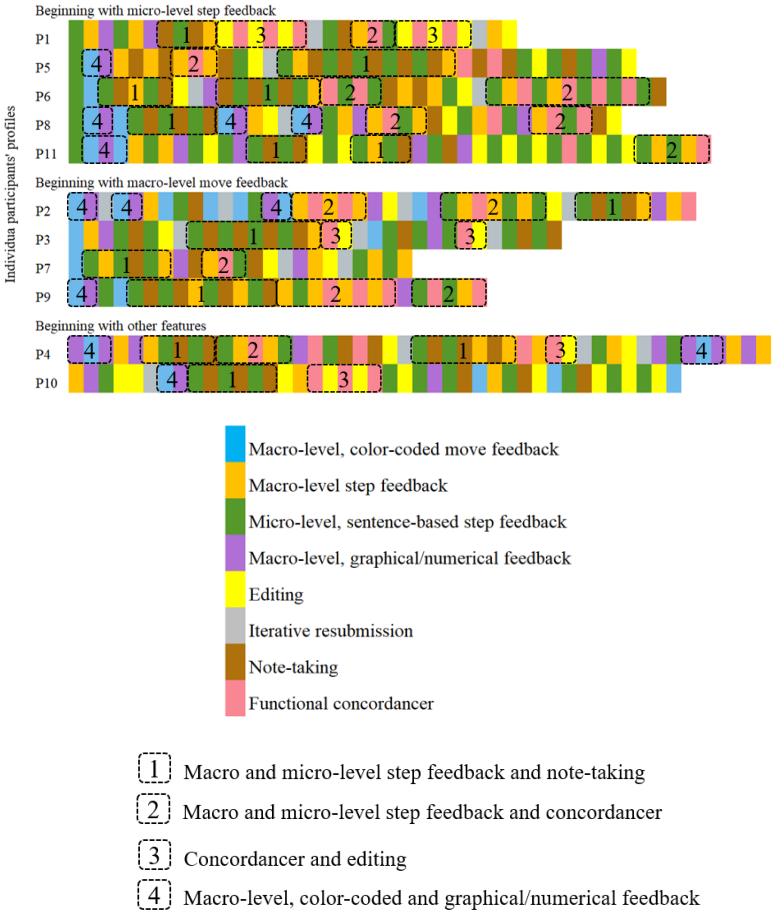
Noticing meaning mismatch
So this part I want it to be shortly describe my research, but uh it displays in **m1.**
Reflecting on functional meaning
See here, this part. [highlights a blue part of the text] in my mind I wanted to write about method. So I think I describe the method, but it's m1. I don't know why. So, see... [highlights a blue sentence] this sentence may be purpose and reason, but in this model ... [highlights a blue sentence] this sentence I think I want to describe the model, how it works. So this, uh, some parameters and ... the method. Actually I don't know which move it will be. I just want to first ... in my mind, I think first I describe the field, uh, the technology in this field. Second, I do some reviews, and later I um... from the review I find some um... maybe not perfect in the previous research, so I can do something more. And in this part... so I describe what I want to do in this paper, and briefly, briefly introduce my method.
Connecting function and lexical choice
Let me see some examples [opens AC in the HO. looks at green sentences and their steps. highlights some.] Hmmm. Let me find some more examples to describe the model. [opens the AC, scrolls down to the green text in an annotated introduction, checks the steps by clicking, highlights parts of the green text. opens another annotated text and does the same] maybe I can write it as description. [speaks aloud and emphasizes] "our work", "of our proposed system"... Let's try this first.
Constructing new functional meaning
[reads his text, then makes changes: "In this model, tungsten cones with different sizes are used to enhance the optical field." --> In our model, several tungsten cones with different sizes were chosen to enhance the optical field." [submits] (Student 40, think-aloud/Camtasia transcript)



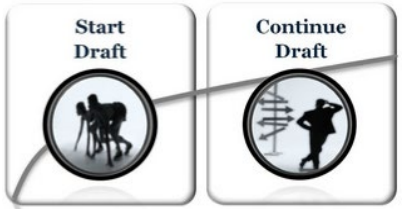
RWT: Effects of corpus & genre-based AWE

- Corpus-based automated feedback and features can
  - enable students to tailor their own interaction strategies
  - allow the necessary degree of learner control



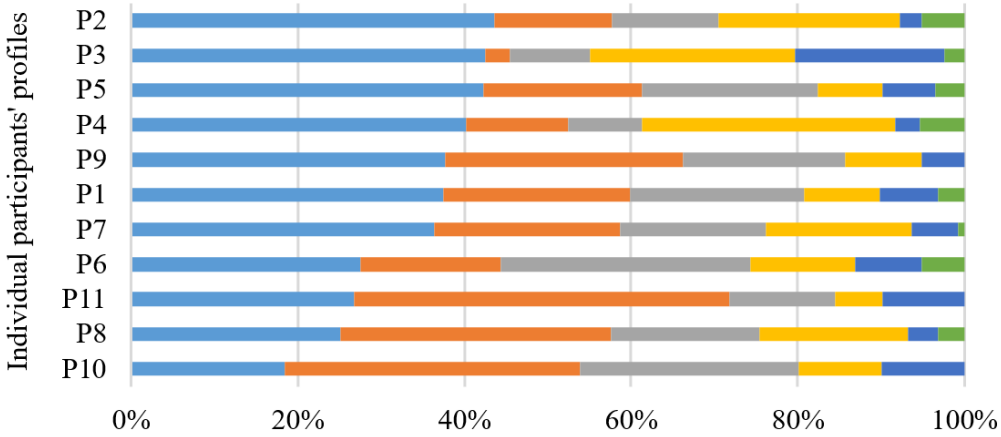


(Cotos et al, 2020)



RWT: Effects of corpus & genre-based AWE

- Corpus-based automated feedback can
  - foster metacognition
  - enhance revision processes



Reflection	Problem solving	Text production
Self-verification Self-evaluation Drawing on knowledge	Comparing representations Detecting dissonance Diagnosing	Paraphrasing Re-writing/adding Revising Resubmitting modifications
Text processing	**Strategizing**	**Environment (RWT)**
Critical reading Selecting input Noticing characteristics/ patterns	Taking local strategic actions Changing approach to writing	Motivation Affect Awareness of system affordances Perception of helpfulness System personification

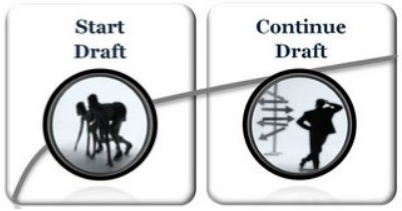
"I agreed with the feedback of the system because I could also see that, yes, my sentence has this function but not as a primary goal."
Process: Reflection (self-verification)

"I didn't have this in mind."
Process: Problem solving (detecting dissonance)

"And maybe those, if I figure out those, maybe that's the blind point that I have in my writing."
Process: Problem solving (diagnosing)

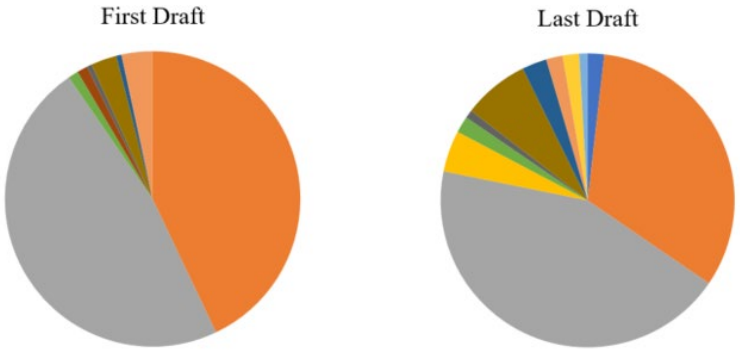
"I focused on the ones actually that needed more work."
Strategizing: Reflection (sequencing actions)

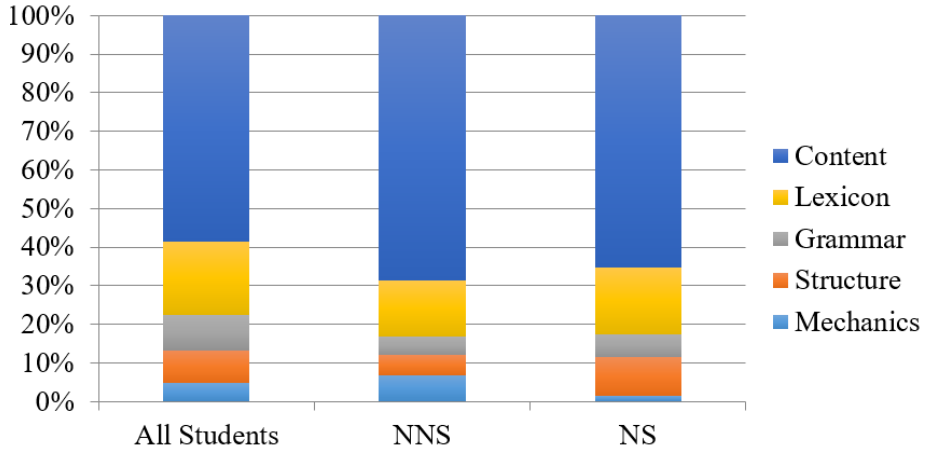
(Cotos et al., 2020)

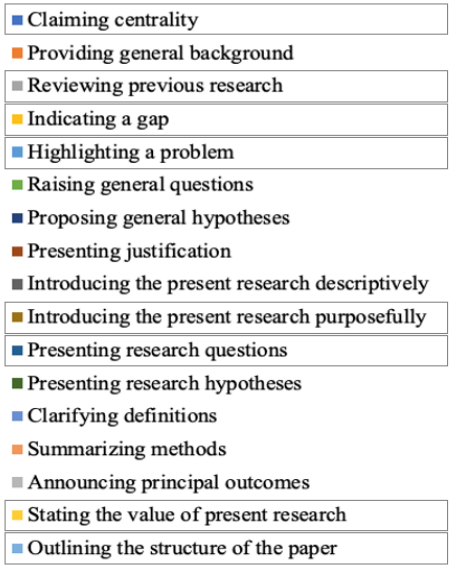


RWT: Effects of corpus & genre-based AWE

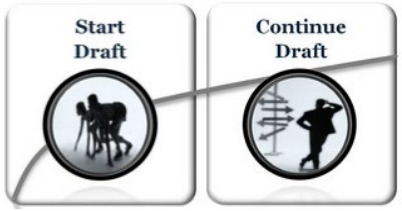
- Corpus-based automated feedback can
  - help transfer knowledge from corpus exploration to drafting and revising
  - contribute to improving genre writing quality





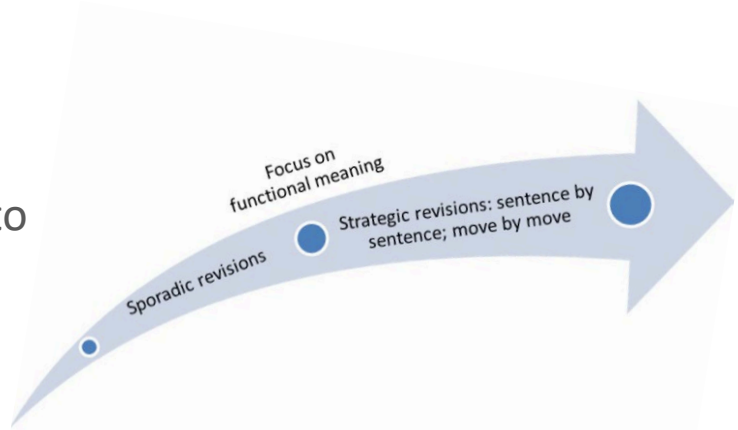


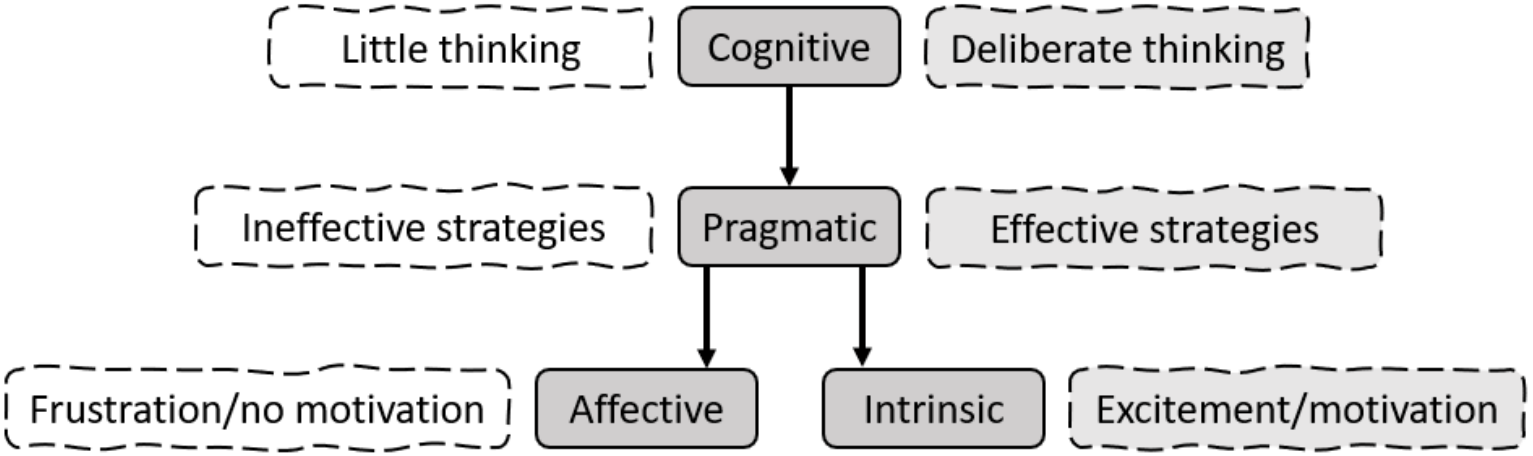
(Cotos et al., 2017, 2020)



RWT: Effects of corpus & genre-based AWE

- Corpus-based automated feedback can
  - exert impact at multiple levels
    - focus on functional meaning is key to positive impact





(Cotos, 2012, 2014; Cotos & Huffman 2013; Cotos et al, 2017, 2020)

Outline

- Background to genre-based Automated Writing Evaluation
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  A. Corpus as discourse data
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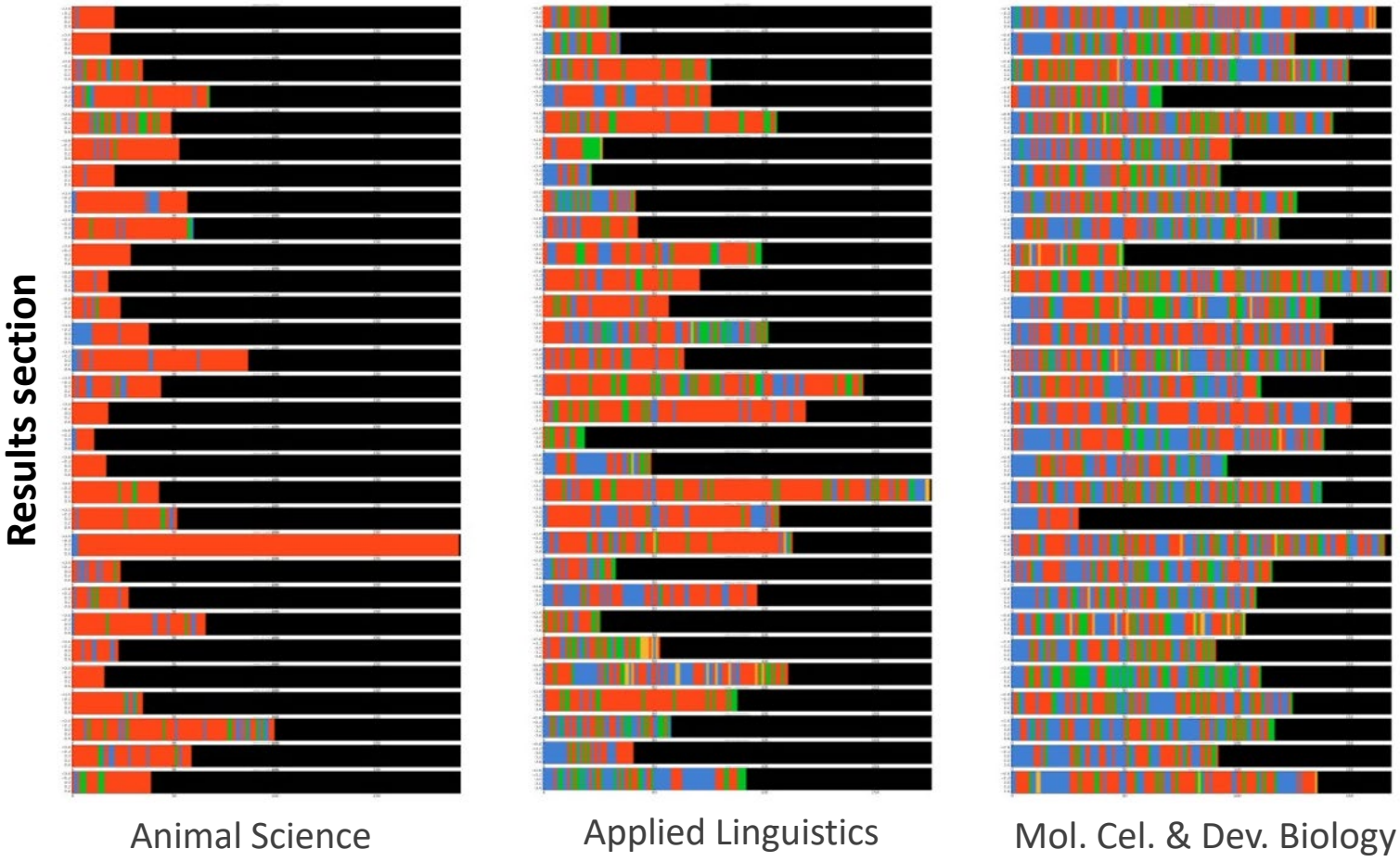
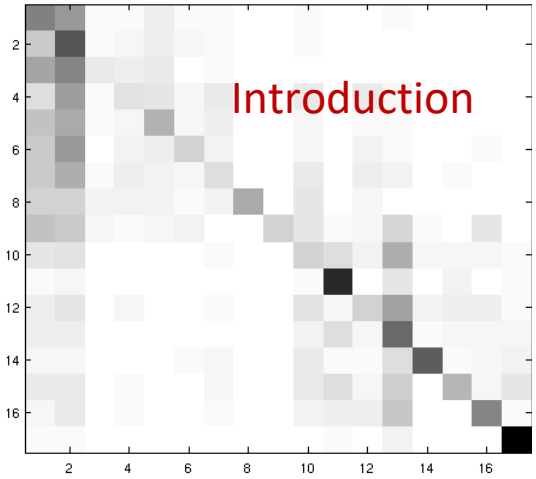
Future directions: Development

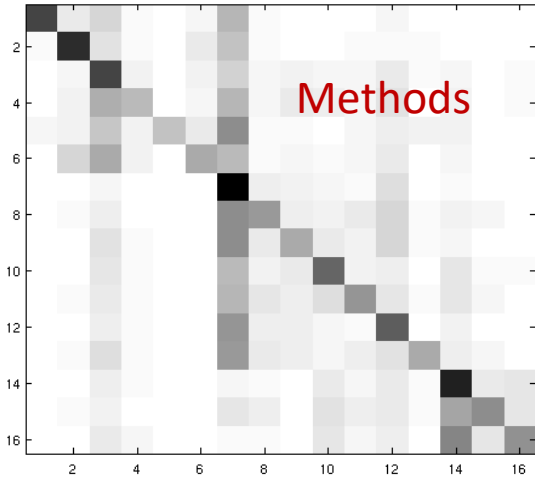
- New feedback on move sequencing

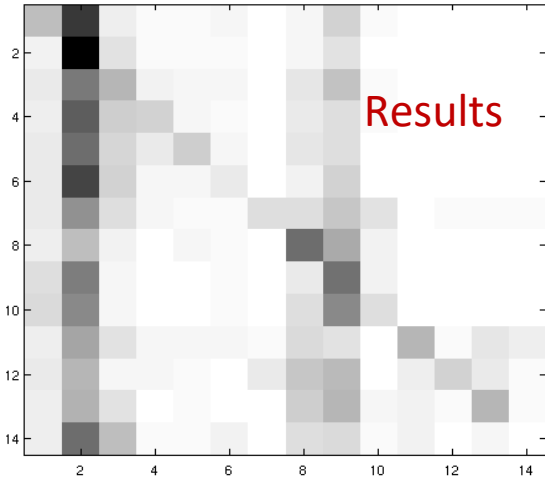


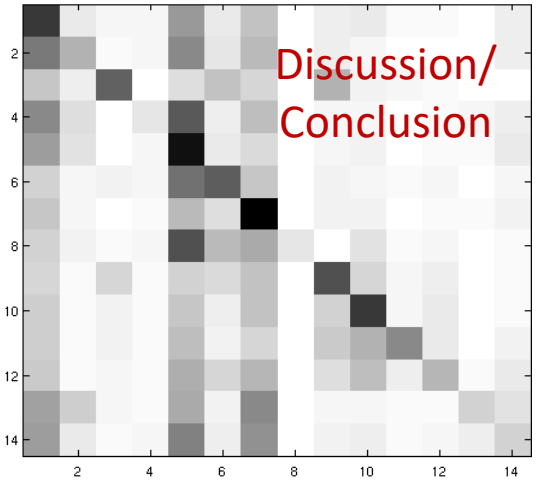
(Cotos et al., 2015)

Future directions: Development









- New feedback on step sequencing

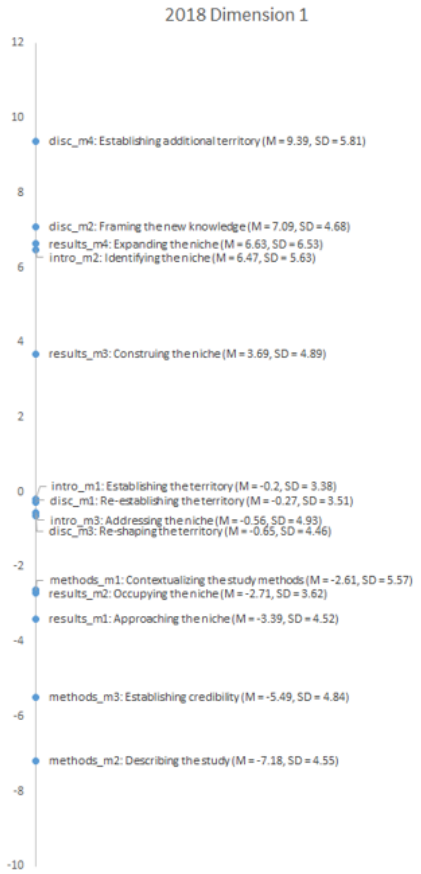
Matrices represent the probability of transitioning from one step to another: black -->high probability; white --> low probability

(Cotos et al., 2015)

Future directions: Development

- Future feedback on linguistic features
  - (Multi-Dimensional Analysis of moves)

Dimension 1	Interpretation and Expansion vs. Simple Reportage
Dimension 2	Abstraction / Overt Empiricism
Dimension 3	Procedural Narration
Dimension 4	Interpreting Results vs. Informational Density



Interpretation & Expansion

Positive Features

Verbs: verb be (.59), present tense (.33)

Modals: possibility (.64), prediction (.41) and necessity (.35) modals

Adverbs: linking adverbials (.48), adverbs (.47)

Stance: adjective-based stance (lexical and grammatical) (.49)

Adjectives: predicative adjectives (.47), attributive adjectives (.36)

Other: pronoun it (.45)

(Gray, Cotos, & Smith, 2020)

Future directions: Evaluation research

- Optimize teachers' understanding of automated feedback
- Improve feedback generation

Student: ***Why?***

Teacher: ***How*** *do I explain why? I can't just say that it makes errors!*

RWT: *"You are **likely** highlighting a problem" [but I'm not entirely sure]*

Me: *What is going on in the "black box"?*

(Cotos, in press)

Future directions: Evaluation research

- To what extent can GBAWE feedback accurately reflect students' genre writing competence?
- How helpful is GBAWE for revision practice and genre writing improvement?
- How do students use GBAWE, and what strategies are most effective?
- What kind of and how much training do students and teachers need to use GBAWE effectively?
- How can teachers assess the effectiveness of GBAWE implementations in their classrooms?
- What are the strengths and limitations of GBAWE compared to other digital writing technologies, and how can different strands of research on feedback, usefulness, and impact address limitations and further inform the advancement of GBAWE?
- How can we most appropriately operationalize genre constructs to design 'actionable' GBAWE feedback; i.e., feedback that provides the guidance needed to improve?
- How can the functionality and output of GBAWE engines be evaluated and interpreted in meaningful ways for teachers and students?
- How can different theories, research results, and practical needs be best integrated in the design of new GBAWE for a range of target contexts?
- What principles should be developed to scale GBAWE from individual genres to genre systems spanning different contexts and discourse communities?

(Cotos, 2022)

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Thank you!

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