Identifying successful features in extended definitions from Chemistry: A corpus study

Contextualized Writing Assessment, IWAC 2016
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Agenda

- Context
  - Problem
  - WID @ CHEM374
- RQ
- Data
- Methodology (corpus analysis top-down/ bottom-up)
  - Extended Def
  - Lexical Bundles
- Preliminary Findings
- Next Steps

Context

- Writing can improve understanding of content *and* the preferred forms of intragroup communication.
- Disciplinary knowledge features specialized forms, methods, and purposes.
- Learning outcomes are not an incentivized focus for many STEM faculty at R1 universities.
- Course providers (discipline-specific profs & TAs) often lack tools to integrate writing into curriculum.
- WID-based courses are often short-lived and tied to individual faculty.

Chem 374 Intro to Physical Chemistry

"complementary approaches to understanding chemical systems" and processes

- Thermodynamic: macroscopic, observation-based (inductive)
- Microscopic: prediction-based on atomic models (deductive)

- Motivation

  "while students score well on exams, they struggle to apply the concepts and models covered in exams in a meaningful way in new situations."

CHEM374 (revised) 2014-2015

Replace 1 midterm with short writing assignments

- 10 weekly writings
  - Hard copy, typed
- Apply conceptualized models to problems in clearly written “plain English” (no symbols or formulae)
- Graded on a 10 point scale
  - 3pts/ea Accuracy, Clarity, Grammar; +1 for format (typed)
  - Hand-written comments.
- Revise and resubmit up to twice per assignment

Data Set

- Student weekly writing, wk 1, 5, & 8
- Assignment Prompts
- Rubric grading bands (A, C, G + f)
- Marginalia & end comments
- Interviews with professor and GTA graders

Research Questions

R1: What co-occurring patterns exist between grades received, grading criteria, and critical writing features of extended definitions?

R2: Which writing issues do graders mark comment upon most frequently?

R3: Do students improve revision process through practice overtime?

R4: L1/L2 comparison in writing lexical bundles, extended definitions, revision practices?

Data: Writing Samples → Corpus

Students: 99 student writers (66 L1; 33 L2)

3 weekly writing samples (weeks 1, 5, & 8)

538 total texts, 51223 tokens

By Week	Total	L1	L2	Comparison
01	205	133	71	65: 35
05	141	86	55	61: 37
08	192	121	72	63 :37
Total	**538**	**340**	**198**	**63: 37**

By Score	Total	L1	L2	Ratio
high_10	183	125	58	68: 32
med_07	212	129	83	61: 39
low_04&01	143	86	57	60: 40
Total	**538**	**340**	**198**	**63: 37**

R1 Analysis: Extended Definitions

(Swales & Feak 2012, pp. 74-76)

Short definition (def) plus one or more of the following parts:

extension	Example: Economic systems
types (t)	*Traditional, command, market, mixed, gift*
components (comp)	*Goods, actors, monetary units, market place, decision making, regulation, etc.*
Application (app)	*production, allocation, exchange, consumption,*
History (h)	*People (smith, ricardo, marx, greenspan)* *Institutions (stock market, exchange market)* *Events (Great Recessions 2008,)*
Examples (ex)	*US economic regulation post wwii,* *French economy under Louis XiVth*
operating principle aka: cause & effect (op)	The mechanism of supply and demand UK's rationale for abandoning the gold standard (1931)

Sample: 10_-_01_f_ll_061

<prompt: How is the velocity of a plane wave related to its wavelength and period, and why does that make sense? >

The velocity of a plane wave is equal to its wavelength divided by its period[1]. The wavelength of a plane wave is equal to the length of a complete wave cycle[2]. The period of a plane wave is equal to the time taken for the wave to complete one complete wave cycle[3]. So, the velocity of the plane wave can be understood as the time taken to complete the length of a complete wave cycle, or length divided by time, which equals to wavelength divided by period[4].

<comment: name is handwritten>

1 = def/comp
2 = def/comp
3 = def/comp
4 = op

Sample: 10_-_01_f_ns_002

The velocity of a plane wave is equal to a ratio of the wave's wavelength and its period[1]. When considering the units of each component, this relationship makes complete sense[2]. Velocity is recorded in meters per second; wavelength is the distance between waves (typically meters or centimeters) and period is the amount of time in seconds for a single wave to form[3]. It is understandable to think that, if the wavelength was increased while the period was held constant, the velocity would increase as well[4]. The wave would have farther to travel in the same amount of time it had when shorter[5]. The same can be said about a velocity change[6]. If the velocity of a wave is increased, it would then be moving faster[7]. With this faster pace must come either a reduction in the period or an increase in the wavelength to account for the change[8]. These three components of a wave are intrinsically linked[9]. One cannot change without affecting a change on the others[10].

1 = def/comp
2 = app 1
3 = def/comp
4 = op1
5 = op1
6 = ex1
7 = ex1/op2
8 = ex 2
9 = def/comp
10 = op3

R1 Analysis: Lexical Bundles

(Chen & Baker, 2010)

- Referential expressions (framing, quantifying)
- Stance (epistemic/obligatory, ability)
- Discourse organizers (intro, elaboration, inference, focus)

Function	Example Type	Example
Referential expression	Framing,	*In the context of* *the existence of*
Stance	Epistemic	*It can be argued* *the fact that the*
Discourse organizers	Inferential	*as a result* *this is due to*
Recycled Language	Recycled Prompt	*make sense* *an example of*

R1 Analysis: Lexical Bundles

(Biber & Conrad, 1999)

Category		Pattern	Example
NP-based	(1)	noun phrase with post-modifier fragment	*the nature of the*
PP-based	(2)	preposition + noun phrase fragment	*as a result of*
VP-based	(3)	copula *be* + NP/AdjectiveP	*is one of the*
	(4)	VP with active verb	*has a number of*
	(5)	anticipatory *it* + VP/adjectiveP + (complement-clause)	*it is possible to*
	(6)	passive verb + PP fragment	*is based on the*
	(7)	(VP +) *that*-clause fragment	*should be noted that*
	(8)	(verb/adjective +) *to*-clause fragment	*are likely to be*
	(9)	others	*as well as the*

Sample: 10_-_01_f_ll_061

<prompt: How is the velocity of a plane wave related to its wavelength and period, and why does that make sense? >

The velocity of a plane wave is equal to its wavelength divided by its period. The wavelength of a plane wave is equal to the length of a complete wave cycle. The period of a plane wave is equal to the time taken for the wave to complete one complete wave cycle. So, the velocity of the plane wave can be understood as the time taken to complete the length of a complete wave cycle, or length divided by time, which equals wavelength divided by period.

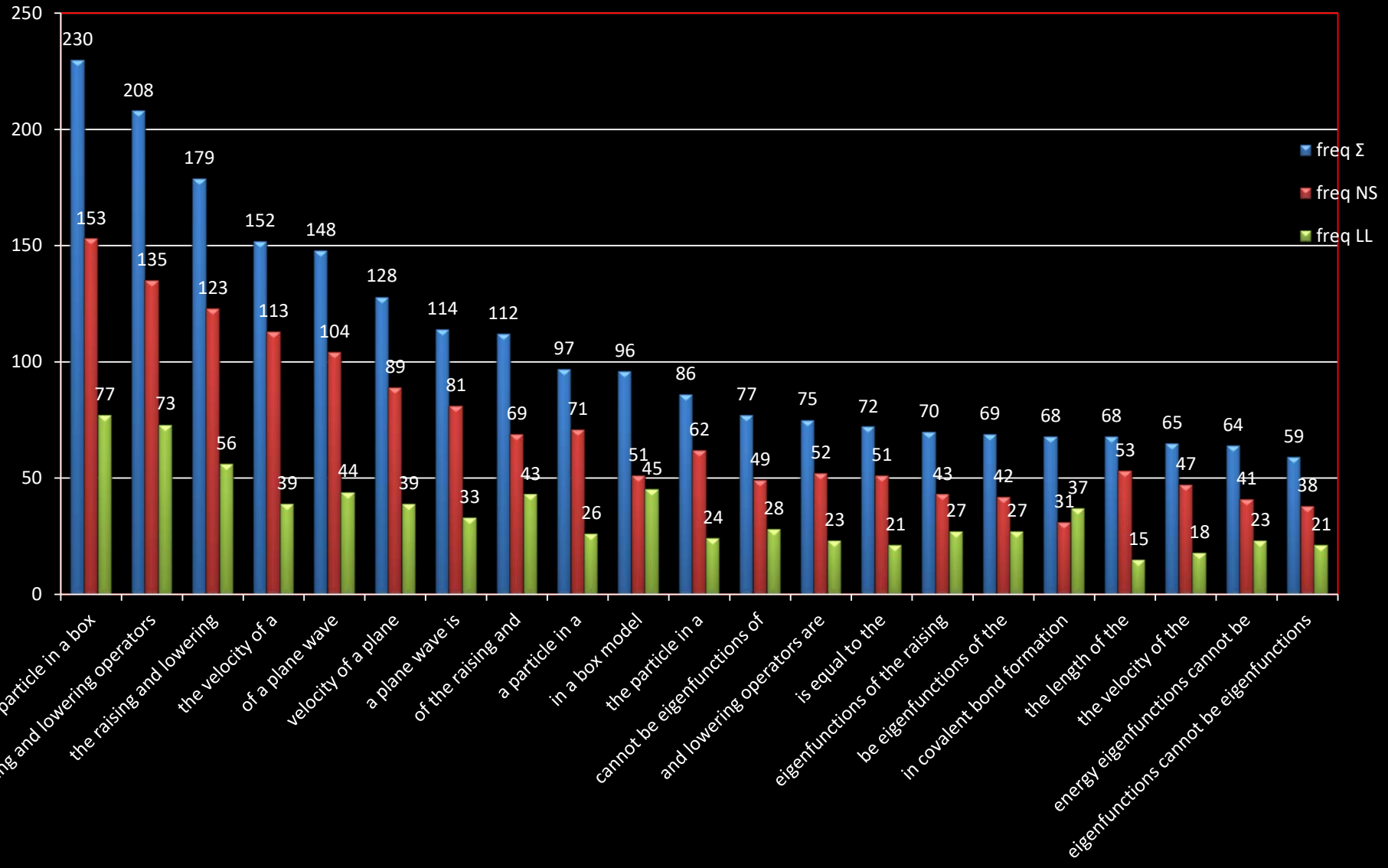
<assessment comments: name is handwritten>

(1) NP based = 5 *the __ of a __*

(6) Passive vp + pp frag = 4 *is ___ to ___*

#	lexical bundle	freq Σ	freq NS	freq LL	%NS	%LL
1	particle in a box	230	153	77	0.665	0.335
2	raising and lowering operators	208	135	73	0.649	0.351
3	the raising and lowering	179	123	56	0.687	0.313
4	the velocity of a	152	113	39	0.743	0.257
5	of a plane wave	148	104	44	0.703	0.297
6	velocity of a plane	128	89	39	0.695	0.305
7	a plane wave is	114	81	33	0.711	0.289
8	of the raising and	112	69	43	0.616	0.384
9	a particle in a	97	71	26	0.732	0.268
10	in a box model	96	51	45	0.531	0.469
11	the particle in a	86	62	24	0.721	0.279
12	cannot be eigenfunctions of	77	49	28	0.636	0.364
13	and lowering operators are	75	52	23	0.693	0.307
14	is equal to the	72	51	21	0.708	0.292
15	eigenfunctions of the raising	70	43	27	0.614	0.386
16	be eigenfunctions of the	69	42	27	0.609	0.391
17	in covalent bond formation	68	31	37	0.456	0.544
18	the length of the	68	53	15	0.779	0.221
19	the velocity of the	65	47	18	0.723	0.277
20	energy eigenfunctions cannot be	64	41	23	0.641	0.359
21	eigenfunctions cannot be eigenfunctions	59	38	21	0.644	0.356
22	length of the box	50	38	12	0.760	0.240
23	the energy eigenfunctions cannot	47	30	17	0.638	0.362
24	lowering operators are well	44	31	13	0.705	0.295

Ngram distribution



R2: Which writing issues do graders most commonly mark /comment on ?

Taxonomy	types	tokens
Review marks	code	a, c, g
	accolades	Good! Yes! Better!
Grading Comments	accuracy,	incorrect, review reading
	clarity,	Explain, unclear, plain language Why? What is ___
	grammar	Spelling, language, grammar
General	assignment-based	No symbol, no formula

R2: Which writing issues do graders most commonly mark /comment on ?

	Sur		~~L1/L2/2~~ D1 - score	A	C	G	+	D2	A	C	G	+	D3	A	C	G	+	Written Feedback	relate
(wa1) How is the velocity of a plane wave related to its wavelength and period, and why does this make sense? [velocity, wavelength, period, ratio, frequency, wavenumber...]																			
	001	2n	4	1		1	1	10										1 no equations	
	002	1	10																
	003	1	4	1	1		1	10										1 what about the velocity of the wave	
	004	1	7	1				10										1 no symbols & write about any plane wave (not light)	
	005	1	4		1	1		7		1		1	10					2 not needed & why does it make sense?	n
	006	1	10																
	007	1	4		1	1	1	7		1		1						1 good & ? 2 read the question! & why does your answer make sense?	n
	008	1	4	1	1		1	10										1 could start here and explain why it makes sense	n
	009	1	1	1	1	1		10				1						3 why did you need to say his?	
	010	1	4	1	1		1	10				1						1Like the surfer images, but it is not clear how they address the question. 2keep it simple!	
	011	2n	7		1			7		1		1	10					2 clarity/accuracy 3 bue why does it make sense that v = x/lam?	n
	012	2y	4	1	1			10											
	013	1	10																
	014	1	4	1	1		1	7	1			1	10					1a underlined(x3) 2 why does it make sense?	n
	015	2y	7		1		1	10				1						1 no symbols 2 why does it make sense?	n
	016	1	4	1	1			10				1						2 you still have not clearly explained why it makes sense	n
	017	2n	4	1	1			7			1		10				1	3 could be more clear use the words velocity, period and wavelength	

R2: scores & mark up

	Avg score	D1 Comments			Mark up	Avg score	D2 Comments			Mark up	Avg score	D3 Comments			Mark up
	D1	A	C	G	+	D2	A	C	G	+	D3	A	C	G	+
W01	5.36	63	81	24	58	9.3	18	15	3	61	8.5	9	2	0	18
W05	7.54	31	42	2	68	7.9	13	13	1	28					
W08	6.15	49	66	4	81	7.7	16	28	0	38	9.3	4	0	0	14
Total	6.1	112	147	28	207	8.2	34	43	3	127	8.9	13	2	0	32
mark up	/283	51%	67%	11%	66%	/189	25%	30%	2%	67%	/53	25%	4%	0%	10%

R3: Do students improve revision process through practice over time?

Sur		D1 - score	A	C	G	+	D2	A	C	G	+	D3	A	C	G	+	Written Feedback	relate
(wa1) How is the velocity of a plane wave related to its wavelength and period, and why does this make sense? [velocity, wavelength, period, ratio, frequency, wavenumber...]																		
001	2n	4	1		1	1	10										1 no equations	
002	1	10																
003	1	4	1	1		1	10										1 what about the velocity of the wave	
004	1	7	1				10										1 no symbols & write about any plane wave (not light)	
005	1	4		1	1		7		1		1	10					2 not needed & why does it make sense?	n
006	1	10																
007	1	4		1	1	1	7		1		1						1 good & ? 2 read the question! & why does your answer make sense?	n
008	1	4	1	1		1	10										1 could start here and explain why it makes sense	n
009	1	1	1	1	1		10				1						3 why did you need to say his?	
010	1	4	1	1		1	10				1						1Like the surfer images, but it is not clear how they address the question. 2keep it simple!	
011	2n	7		1			7		1		1	10					2 clarity/accuracy 3 bue why does it make sense that v = x/lam?	n
012	2y	4	1	1			10											
013	1	10																
014	1	4	1	1		1	7	1			1	10					1a underlined(x3) 2 why does it make sense?	n
015	2y	7		1		1	10				1						1 no symbols 2 why does it make sense?	n
016	1	4	1	1			10				1						2 you still have not clearly explained why it makes sense	n
017	2n	4	1	1			7			1		10				1	3 could be more clear use the words velocity, period and wavelength	

R3: Do students improve revision process through practice over time?

(wa5) Explain why the names of the raising and lowering operators are well chosen, and why the energy eigenfunctions cannot be eigenfunctions of the raising and lowering operators. [keywords: harmonic oscillator, quantum number, raise, lower, energy, eigenfunction (change)...]	Sur		t1/t2/t3 D1 - score	A	C	G	+	D2	A	C	G	+	D3	A	C	G	+	Written Feedback	relate
	079	1	7		1		1	10										1 no equations / no symbols	
	080	1	7				1	7	1			1						1 [underline lower the ground state] + a, more general, & [underline eigenvalue] 2 [underline eigenvalue] + a & not on eigenvalue	
	081	1	10																
	082	1	7	1			1	10										1 [circle because] + a, & didn't answer why not eigenfunctions	
	083	1																	
	084	2n	10				1											1 [underline Appling]	
	085	2y	4	1		1	1											1 [bracket 2 sentences] + g, [underline 2 phrases] + a	
	086	2n	7		1		1	10										1 [underline sentence] + c & [underline ask] 2 [circle times] [the only change is altering "eigenfunction into another function" to "function will change its equation"	
	087	2n	4				1											1 [underline could] (*2) + a & [underline sub clause] + c	
	088	2y	10																
	089	1	10																
	090	1	7		1		1	10										1 no equations / symbols [removal is the only change]	
	091	1	10																
	092	2n	4	1	1		1	10										1 [underline first part of assignment] + you didn't do this, [underline last sentence of response] + c & no symbols /equations	
	093	2n	7		1		1	7		1		1						1 [underline phrase] + c 2 [underline same phrase but longer] + c	
	094	2n	7	1			1	7	1			1						1 [underline] + a & [underline] + a 2 [underline] + c, [underline sub clause] + a + not relevent	
	095	2y	4	1	1		1	7		1		1						1 [underline] + c(*3), [bracket] + c, [underline] + a, explain if you choose to keep this, does not answer q needlessly complicated & refer to the textbook and discussions in class for your answer 2 [bracket] + relevance	

Preliminary Findings:

L1s

- Wider range of scores *all* 1s and *more* 10s.
- Greater use of non-prompt lexical bundles
- Frequently provide more developed definitions

L2s

- Heavier reliance on prompt-based chunks
- Slightly higher rates of revision; many low scoring L2s do not revise

All

- Revision/persistence rates not tied directly to L1
- Grammar is not *the* issue.
- Successful definitions:
  - employ more lexical bundles prompt and otherwise.
  - incorporate components; better ones offer examples, too.
  - Reoccurring end comment: more explanation/ justification needed.

Next steps

- Finish collecting and interpreting data.
- Drill down into the meaning of the grading rubric (A, C, G) .
- Have professor track time spent on grading writing and exams.
- Grammar was more of an issue in wk 01; not again; investigate.
- Can we use successful examples to improve extended definitions?

"What ESL students need – multiple opportunities to use language and write-to-learn, coursework which draws on and values that students already know, classroom exchanges and assignments that promote the acquisition of unfamiliar language, concepts, and approaches to inquiry, evaluation that allows students to demonstrate genuine understanding – is good pedagogy for everyone."

– Vivian Zamel (1995, p. 519)

Abbreviated Bib

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Thank you

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Appendix: Writing Prompts

(wa1) How is the velocity of a plane wave related to its wavelength and period, and why does this make sense? [velocity, wavelength, period, ratio, frequency, wavenumber…]

(wa5) Explain why the names of the raising and lowering operators are well chosen, and why the energy *eigenfunctions* cannot be *eigenfunctions* of the raising and lowering operators. [keywords: harmonic oscillator, quantum number, raise, lower, energy, *s*(change)...]

(wa8) Explain the role of kinetic energy quantization in covalent bond formation. (by thinking about the results you obtained in problem 1 of chapter 9). Note that this is essentially the same as writing a paragraph that answers problem 1(b). [keywords: particle-in-a-box, length, quantum state, energy, kinetic, hydrogen atom, hydrogen molecule, covalent bond energy...]

Week		tot	L1	L2
	w01d1	99	66	33
	w01d2	83	54	29
	w01d3	23	13	10
	01 total	205	133	72
	w05d1	94	61	33
	w05d2	47	25	22
	w05d3	0	0	0
	05 total	141	86	55
	w08d1	95	62	33
	w08d2	64	40	24
	w08d3	33	19	14
	08 total	192	121	71
	TOTALS	**538**	**340**	**198**
			62.8%	36.8%

Score Range	tot	L1	L2
high(10)	69	50	19
med(07)	70	40	30
low(04 01)	66	43	23
01 total	205	133	72
high(10)	54	40	14
med(07)	60	35	25
low(04 01)	27	11	16
05 total	141	86	55
high(10)	60	35	25
med(07)	82	54	28
low(04 01)	50	32	18
08 total	192	121	71

	tot	L1	L2
high_10	183	125	58
med_07	212	129	83
low_04&01	143	86	57
TOTALS	**538**	**340**	**198**