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# Metacognitive convergences in research writing

across doctoral students in science and engineering

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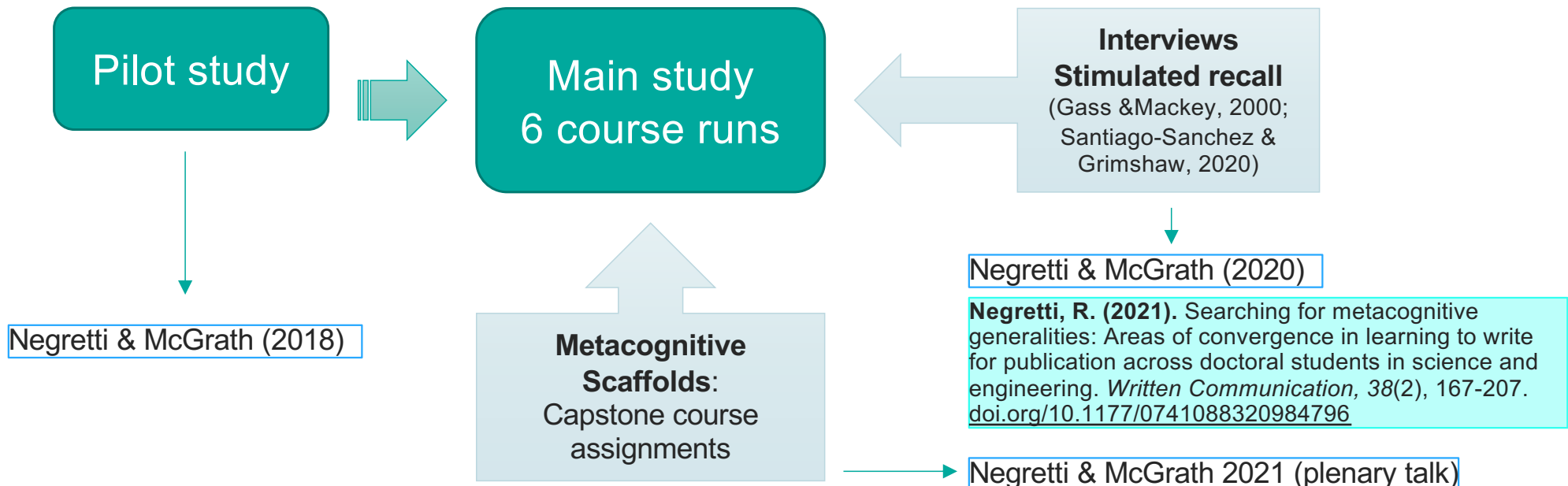
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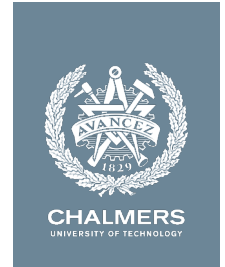


**MAGN. BERGVALLS STIFTELSE**

# Starting point Project - metacognition in scientific writing

Even the best writers with the best intentions can produce words that are meaningful to them but will fail to be meaningful to another.  
*(Hacker et al., 2009)*





## Aim and motivation

# Searching for generalities

- Just like any other learning endeavor, learning to write for publication can be assumed to require metacognition.
- Academic/scientific writing poses unique and varied “rhetorical problems” (Flower & Hayes, 1980) tied to discipline, field of study, and scientific audiences (journals) (Casanave, 2019).



### Bazerman’s (2018) call for an investigation of **generalities**

**Aim:** Across different disciplines, backgrounds, languages, and levels of expertise, this study seeks to identify **what students have in common**, rather than what differentiates them as writers.



**(RQ1):** What common aspects of genre knowledge are doctoral students metacognitive about when writing research articles for publication, across STEM disciplines?

## Starting point

# Theory - metacognition in scientific writing



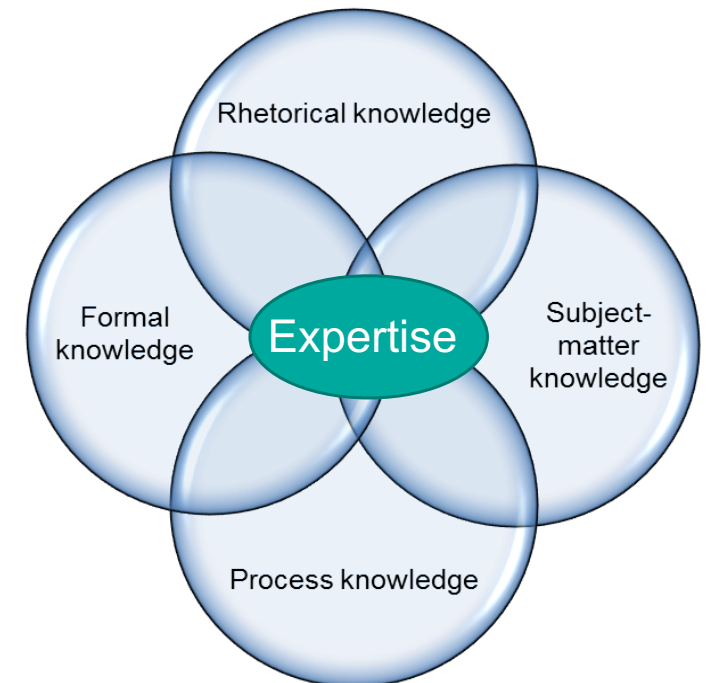
Metacognition theory (Winne & Azevedo, 2014)	Implications for doctoral writing
<b>Metacognitive knowledge</b>	
<ul style="list-style-type: none"><li>• <u>Declarative knowledge</u>: Being aware of possessing a certain type of knowledge, including the self, types of tasks, domain knowledge. It can be verbalized.</li></ul>	<p>PhD writers represent a variety of literacy backgrounds: may hold <b>different and/or inaccurate declarative metacognitive knowledge</b> (Dunning et al., 2003) about the nature of writing or themselves as writers</p>
<ul style="list-style-type: none"><li>• <u>Procedural knowledge</u>: Being aware of processes and actions to tackle a specific task—the “know how.” Often acquired implicitly through experience and automatized, and learners may benefit from making it explicit.</li></ul>	<p>Procedural knowledge—knowing how to write—is often implicit (see Beaufort &amp; Iñesta, 2014). Therefore, <b>learners may not be aware of what they are doing, or whether it is effective</b>: conscious and explicit attention to these processes is needed for learning.</p>
<ul style="list-style-type: none"><li>• <u>Conditional knowledge</u>: Being aware of when and why certain aspects of declarative and procedural knowledge are relevant to a specific task and its conditions. Prerequisite for the effective use of these knowledges.</li></ul>	<p>Academic <b>writing is situated</b> and highly sensitive to contextual dimensions: in authentic situations, <b>strategies that may work for some students may not work for others</b> (Dunlosky &amp; Rawson, 2019)</p>
<b>Metacognitive regulation</b> Metacognitive forms of thinking that power self-regulated learning.	

## Starting point

# Theory - metacognition in scientific writing

## Writing expertise as the development of genre knowledge

- Writing expertise as a **gradual integration of knowledge types**, “orchestrated” skilfully across situations (genre reoccurrences). (Tardy, 2009, 2020; Beaufort & Iñesta, 2014)
- Beaufort (2007, 2012) advocated promoting metacognition to foster the **development of writing expertise** across contexts.
- Metacognition facilitates in **transfer and adaptation** of writing knowledge across situations (**recontextualization**). (Driscoll et al, 2019, Lee & Mak, 2018; Negretti & McGrath, 2018, Tardy et al., 2020)



Tardy, C. (2009). Building genre knowledge. Parlor Press



**(RQ2):** What is the evidence that they metacognitively integrate different facets of genre knowledge in writing research articles for publication?

# Findings: Main themes: metacognitive convergences



Main Themes and Sub-themes	Instances	Participants	Coverage
<b>Genre analysis</b>	188	24	34%
Awareness of what one was already doing	15	9	5,8%
Descriptions of genre conventions	76	23	12,8%
Formal elements - information structure and language	82	23	16%
Genre variation	28	12	9,6%
Reading awareness	25	13	8,6%
<b>Reader awareness</b>	109	22	20%
Audience and audiences	61	21	12,4%
Readers' mind- interest and engagement	51	17	10,6%
<b>Rhetorical strategies</b>	205	24	36%
CARS	12	7	6,4%
Creating an argument, persuasion and positioning	58	13	19,4%
Establishing a narrative	16	10	6,8%
Qualification	27	14	9,1%
Rhetorical strategies based on subject-matter knowledge	71	18	19,2%
<b>Writing process</b>	230	24	43%
Changes in writing approach after course	83	24	15,6%
Co-authoring	11	6	10%
Planning and starting the text	8	5	6%
Supervisor	61	19	12,5%

# Findings (matrix analysis): Metacognitive Integration of Genre Knowledge

Main co-occurrences only (summary of more complex table)

What evidence exists that students metacognitively integrate different facets of genre knowledge in their writing?

Are students who are metacognitive about audience also aware of how this knowledge informs their own rhetorical strategies?

How frequent is this combination across all students?

	Genre analysis (GA)			Reader Awareness (RA)			Rhetorical Strategies (RS)		
	N	Participants	Coverage	N	Participants	Coverage	N	Participants	Coverage
GA									
RA	25	12	7,3%						
RS	63	21	10%	61	20	11,8%			
WP	91	24	15,8%	36	17	7,6%	94	22	14,4%

# Findings (matrix analysis): Metacognitive Integration of Genre Knowledge

Matrix analysis to “zoom in” on specific co-occurrences

	GA		Awareness of already doing		Genre conventions		Formal elements		Genre variation		Reading awareness	
	N	P	N	P	N	P	N	P	N	P	N	P
<b>RA</b>	25	12	2	2	13	9	6					
Audience(s)	17	10	1	1	9	7	3					
Reader's mind	8	5	1	1	4	2	3					
<b>RS</b>	63	21	3	3	35	16	20					
CARS	5	5	1	1	1	1	2					
Creating an argument	8	6	1	1	5	4	11					
Establishing a narrative	2	2	1	1	2	2	0					
Qualification	10	9	0	0	1	1	6					
RS (subject-matter)	21	12	0	0	15	9	7					
<b>WP</b>	91	24	4	3	25	11	50					
Changes	38	17	4	3	3	2	28					
Co-authoring	4	2	0	0	1	1	0					
Planning/starting	5	4	0	0	0	0	5					
Supervisor	15	10	0	0	9	6	3					

	RA		Audience(s)		Reader's mind	
	N	P	N	P	N	P
<b>GA</b>	25	12	17	10	8	5
Awareness already doing	2	2	1	1	1	1
Genre conventions	13	9	9	7	4	2
Formal elements						
Genre variation						
Reading awareness						
<b>RS</b>	63	21	35	16	20	10
CARS	5	5	1	1	1	1
Creating an argument	8	6	1	1	5	4
Establishing a narrative	2	2	1	1	2	2
Qualification	10	9	0	0	1	1
RS (subject-matter)	21	12	0	0	15	9
<b>WP</b>	91	24	4	3	25	11
Changes	38	17	4	3	3	2
Co-authoring	4	2	0	0	1	1
Planning/starting	5	4	0	0	0	0
Supervisor	15	10	0	0	9	6

“It’s good to get the tools and to get the name of what you are actually trying to do. Like, for example, when you structure, what are the techniques that you can think about?”

(P21, Electrical Engineering) GA+WP

“Most things were stuff that I kind of used already, just that I didn’t know about it. It helped me realize which way I was writing papers. I just saw that wow, this really fits very well.”

(P10, Astrophysics) GA +WP

“One thing that really improved ... was clarifying why we do this, this is what we contribute. Makes it easier for the readers to see whether this is of interest for their particular work.”

(P18, Energy and environment) RA+RS

“We expect that this paper will be controversial in the field, so we payed attention to state the main message repeatedly: in the overview paragraph which is obligatory for (Journal), as a conclusion of commentary on figures, and in the conclusion”

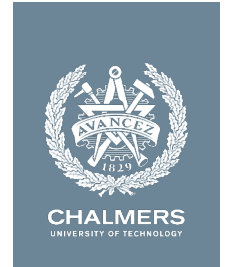
(P22, Physics) RA+GA+RS

“To get this big picture, the structure of your text. Before I didn’t really think about it; I would just sit down and just start typing, and afterwards I had to go back and rewrite everything, because it was a mess ... now it’s clearer to structure a text, it becomes a lot easier to write.”

(P12, Physics) GA+WP



# Findings: Metacognition and writing expertise



- Students metacognitive knowledge converges on 4 the themes/subthemes in their writing:
  - Evidence of writing expertise as integration of knowledge types
  - Evidence of writing expertise as deliberate, metacognitive orchestration of these knowledges  
(Beaufort, 2007, 2012; Tardy, 2009, 2016)
- Genre analysis as **cognitive apprenticeship**? (Kellogg and Whiteford; 2009)
- Making writing knowledge available for introspection (Schraw & Moshman, 1995) →
- Interventions could investigate metacognitive scaffolds focused on these themes and sub-themes



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