P050
Session P2A

Taking a Step Back from Technology:

Electronic Note-Taking and Its Implications on Continuing Professional Development

Danielle N Naumann[1,2], Colin Mascaro[3], Karen M Smith[1,3], Kate Kittner,[1] Lindsay Cameron[1]

[1]Continuing Professional Development, Queen's University; [2] Queen's University, School of Rehabilitation Therapy; [3] Physical Medicine and Rehabilitation, Queen's University

Problem Statement: Opportunities for reflection following continuing professional development are reduced when learners engage in electronic note-taking practices.

Background:

•There is limited research on the relationship between note-taking behaviors and memory retention, with only a small amount of evidence describing the relationship between working memory and writing, and even less evidence comparing the effects of typing on memory.
•Research emerging from Princeton University (Mueller & Oppenheimer, 2015) looks at this relationship in undergraduates; report that typing notes is inferior to longhand
•Electronic note-taking is associated with less learner reflection on the content, less understanding of the material.
•The production of writing, speaking, and typewritten language all involve different synaptic mechanisms, where they use the same processing structures but the encoding process is associated with different physiological structures in the brain.
•Note-taking has two functions: facilitating the encoding of information and the later review of that content from a learners notes. The encoding process of note-taking can occur through long-hand or typed notes; however, research indicates that it is processed differently according to the tools used
•There are fragmented clusters of information on about the effects of note-taking behavior on subsequent application of new information in specific disciplines, but no comprehensive descriptions of the implications these effects could have on professional application of new information.
•Most of the information discussing the impact of technology on learning is anecdotal.
•The little research that has been featured on the topic in medical disciplines has focused on patient documentation practices, and using hand-held technology as a practice tool.

Implications for Continuing Professional Development:

- Note-taking preference can have an effect on memory for novel educational content, in the absence of reviewing notes or applying content to patients in clinical practice. **This effect is seen in both the long-term and short-term.**
- Hand writing notes can have an effect on memory retention when paired with guided reflection activities in all participants. CPD providers should consider embedding guided reflective activities and handwritten activities into CPD programming (i.e. use of flip charts, post-test guided reflection).
- Participants who prefer to type notes and are required to write them (due to circumstance –i.e. "forgot my laptop"), and do NOT participate in guided reflection, demonstrate very poor memory retention. In fact, confidence in prior knowledge on the subject is reduced.
- Less than 50% of CPD participants note report reviewing their notes from the CPD event
- Only 10% of participants report a preference for typing notes (as compared to not taking notes, or hand-writing notes)
- Guided reflection is effective in either written or typed formats, but the quality of reflection is higher in participants who engage in written reflections OR written notetaking followed by online, typed reflections.
- CPD providers should continue to provide participants with hard-copy, printed conference materials for reference and note-taking purposes.
- Handwritten reflections tend to build on pre-test perceived learning needs and reflect ***misperceived*** or ***emergent*** learning needs
- In the absence of guided reflection, typed reflections are often very blunt and reflect bias; and to echo pre-test "perceived learning needs"

What does this mean for CPD?

Future Direction:

Further research needs to examine the effects of note-taking style during electronic CME events on information retention and application, in order to inform our recommendations for physician participants in our CME events.

Our research group will continue to explore the finer nuances of memory retention and note-taking practices.

Key References:

1. Kellogg, R. T. (2004). Working memory components in written sentence generation. American Journal of Psychology, 117, 341–361.
2. Kellogg, R. T. (2001a). Competition for working memory among writing processes. *American Journal of Psychology, 114*, 175–191.
3. Kellogg, R. T. (2001b). Long-term working memory in text production. *Memory & Cognition, 29*, 43–52.
4. Rogers, T. B., Kuiper, N. A., & Kirker, W. S. (1977). Self-reference and the encoding of personal information. Journal of Personality and Social Psychology, 35, 677-688.
5. Klein, S. B., & Loftus, J. (1988). The nature of self-referent encoding: The contributions of elaborative and organizational processes. *Journal of Personality and Social Psychology, 55*(1), 5.
6. Bui, D. C., Myerson, J., & Hale, S. (2013). Note-taking with computers: Exploring alternative strategies for improved recall. *Journal of Educational Psychology, 105*(2), 299.
7. Royal College of Physicians and Surgeons of Canada (2014). Continuing Professional Development and Life Long Learning.
8. McGaghil, WC, Siddal, VJ, Mazmanian, PE & Myers, J. (2009). Lessons for Continuing Medical Education From Simulation Research in Undergraduate and Graduate Medical Education: Effectiveness of Continuing Medical Education: American College of Chest Physicians Evidence-Based Educational Guidelines. Chest. 2009;135(3_suppl):62S-68S.
9. Barnes, B. E. (1998). Creating the practice-learning environment: using information technology to support a new model of continuing medical education. Academic Medicine, 73(3), 278-81.
10. Mamary, E. M., & Charles, P. (2000). On-site to on-line: Barriers to the use of computers for continuing education. Journal of Continuing Education in the Health Professions, 20(3), 171-175.
11. Hersh, W. (2004). Health care information technology: progress and barriers. Jama, 292(18), 2273-2274.
12. Hembrooke, H & Gay, G. (2003). The Laptop and the Lecture. The Effects of Multitasking in Learning Environments.
13. Van Meter, Peggy, Linda Yokoi, and Michael Pressley. "College Students' Theory of Note-Taking Derived From Their Perceptions of Note-Taking." Journal of Educational Psychology 96 (1994): 323-338
14. Williams, Robert L., and Alan C. Eggert. "Notetaking in College Classes: Student Patterns and Instructional Strategies." The Journal of General Education 51 (2002): 173-199.
15. Mueller, P. A., & Oppenheimer, D. M. (2015). The pen is mightier than the keyboard: Advantages of longhand over laptop note-taking. Psychological Science.

Research on Note-Taking and Memory Retention: Results Summary

Pilot Study 1

Scoping Review of Evidence

Disciplinary Focus	# Publications	Key Concepts
Psychology	28	Writing skills; executive functioning; load; cognition; working memory; learning; planning; encoding
Education	16	Fluency; generative learning; recall; encoding
Cognitive Science	13	Levels of processing; transfer; long-term retention
Memory	12	Directed forgetting; information suppression; rehearsal
Computers/ Technology	11	Multi-tasking; distraction; typing speed; divided attention; limited capacity
Writing Research	6	Fluency; linguistic encoding; verbal/visual working memory
Behavioral Science	2	Verbal working memory; syntactic processing; conscious controlled processing
Medicine	1	Distraction; documentation; computer use

Pilot Study 2

Evaluating Short-Term Memory Retention

- Participants included17 health sciences students and professionals from interprofessional backgrounds.
- Participants completed an online module and were tested 1 week post-intervention

Results:
- Controlling for pre-test scores, participants who wrote their notes achieved higher 1-week post-test scores (M=0.962, SD=.167), than did participants who typed their notes (M=0.747, SD= .229),t (15) = 2.22, p = .02.
- Taking written notes results in a significant increase in memory retention for the material, t(14) = 1.82 , p = .045 (one-tailed).

Table 2: Regressing post-1 week scores on pre-test, post-test and typewritten:

Regressing Post-1-week Scores	Pretest Scores	Post-Test Scores	Note-taking Style	Cons.
Coefficient	.133	1.068*	-1.009**	-.599
Std. Error	.189	.234	.365	.796
t	0.70	4.57*	-2.76**	-.75
P>|t|	0.494	0.001	0.016	0.465
95% CI	(-0.27)-(0.54)	(0.56)-(1.57)	(-1.79)-(-0.21)	(-2.32)-(1.12)

* p<.001 significance level
**p<.05 significance level

Pilot Study 3

Evaluating Long-Term Retention and Reflection

- 27 participants completing a live CPD event (interdisciplinary audience)
- Knowledge tested pre-intervention and 3 months post-intervention
- Guided reflection at 1.5 months post-intervention, analyzed for content and quality

Results:
- Participants who preferred to write notes, and took notes by writing, recalled significantly more information then they knew prior to the CPD event.
- At 3 months post-intervention, this effect was stronger in participants who wrote their notes, as compared to those who typed notes.
- Engagement in reflection was affected by the participant's preference to type or to write reflective content
  - Typed reflections tended to be short and simple, often blunt and reflected bias
  - Typed reflections echoed pre-test "***perceived*** learning needs"
  - Handwritten reflections tended to build on pre-test perceived learning needs and reflect ***misperceived*** or ***emergent*** learning needs:

	Mean (post-Pre)	n	Std Dev	SE	t	p-val (>0)
Typed	0.0463	6	0.0761	0.0311	1.4906	0.0981
Written	0.0567	10	0.1384	0.0438	1.2953	0.1137
Written* (Controlled)	0.1407	6	0.1052	0.0430	3.2749	0.0110**

Table 3: Statistical Analysis of values and data, paired t-tests.
*These values represent participants who preferred to handwrite, and handwrote their notes, controlling for those who preferred to type but handwrote notes.
** Result is significant

Contact the Authors:
Danielle Naumann: Danielle.Naumann@queensu.ca
Dr. Karen Smith: SmithK2@ProvidenceCare.ca
Dr. Colin Mascaro: ColinMarcaro@gmail.com

Continuing Professional Development
FACULTY OF HEALTH SCIENCES