#P029
Session P1C

The Effect of Note-Taking Style on Quality of Reflection and Memory Retention Following Continuing Medical Education

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:

Emerging research suggests that learners who take electronic notes may not engage in as much content reflection as those who take written notes; yet, many clinicians engage in electronic note-taking behaviors when completing continuing medical education offered through electronic platforms.

Purpose:

E-learning and mobile electronics are increasingly being used to take, secure and store educational notes during CPD. In an effort to reduce cost and/or waste, many CPD providers no longer provide hard-copy, paper handouts, and instead provide learners with electronic copies of handouts, presenter notes, and resources. While these advances in technology mean that learners have more access to original sources of information, the converse is that there are few opportunities to engage in handwritten notes to supplement reflection and functional encoding. There is very little information available in the literature on the implications that this can have on memory retention and quality of reflection within the context of CME. Our team has previously found that participants who take hand-written notes retain more knowledge than those who are instructed to type notes. In this study, we extend these results to explore the effects of voluntary note-taking style on memory retention and quality of reflection, following a typical live CPD program.

Theoretical Background:

- Note-taking has two functions:
  1. Accelerating the encoding of novel information; and
  2. Facilitating later review of content
- Creating notes draws on processes used for the **acquisition**, **processing**, and **recoding** of information from an external source.
  - These processes typically accelerate memory for information
  - With these processes, the learner reconceptualises the instructional content to match their own mental models.
- The encoding process of note-taking can occur through long-hand or typed notes; **however, information is processed differently according to the tools used.**
- The production of writing, speaking, and typewritten language all involve different synaptic mechanisms in the brain (Kellogg, 2004; Kellogg, 2001(a); Kellogg, 2001(b)
  - use the same processing structures but encoding process is associated with different physiological structures in the brain (Cleland & Pickering, 2006).
- The **self-reference effect** refers to the superior memory for words and concepts judged in relation to the self, the optimal way of achieving good retention (Rogers, Kuiper & Kirker, 1977; Klein & Loftus, 1988).
  - **Reflection** also draws on the effects of this encoding process.
- **Typing notes** is associated with a more automatic approach to recording information, drawing less on encoding strategies
  - Typed notes typically offer information verbatim
- **Typing notes** using technology offers more opportunity for distraction (Hembrooke & Gay, 2003).
  - When performing more than one cognitive task simultaneously, performance is impaired in each task (Hembrooke & Gay, 2003).
- **Orthographic** and **motor execution** processes contribute to encoding through handwritten means.
- Planning the content of a handwritten note engages visual working memory, self-reference, planning and translation, in order to identify and record the most appropriate information given the constraints of the motor ability to write (Olive, Kellogg, & Piolat, 2007).

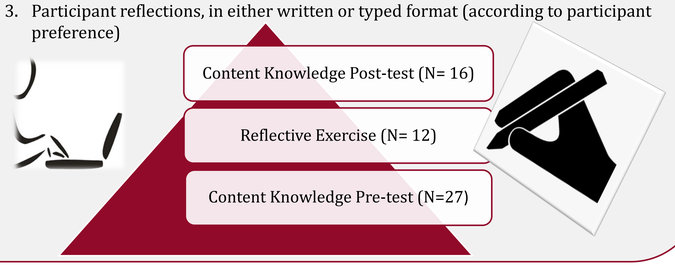
Literature Background:

- Electronic notes are more comprehensive, easy to decipher, and verbatim (Mueller et al., 2015).
  - However, electronic notes associated with **less reflection**, **less understanding** of material.
  - Even when learners are instructed not to type notes verbatim, they continue to do so.
- When compared to undergraduate students instructed to take written notes longhand, students who created comprehensive typewritten notes performed poorly on tests measuring both the recall of content and the conceptual application of content presented during the learning activities.
- There are fragmented clusters of information on the impact of note-taking style of memory retention, found within the areas of :
  - Psychological sciences (Kellogg, 2001a; Kellogg, 2001b; Kellogg, 2004)
  - Linguistics (Cleland & Pickering, 2006)
  - Information technology (Bui, Myerson & Hale, 2013)
  - Education research (Williams & Eggert, 2002)

Methodology:

The pilot of the study employed a mixed methods design including:

1. Survey addressing note-taking preference and demographic;
2. Pre and post-test evaluation of knowledge regarding content of a live CPD event on addictions;
3. Participant reflections, in either written or typed format (according to participant preference)



Research Questions:

1. ***"Is there an effect of preferred note-taking style (written or typed) on the memory retention of information provided through continuing medical education (CME)?"***
2. ***"Is engagement in reflection effected by the participant's preference to type or to write reflective content?"***

Discussion:

Considering the widespread movement toward innovative electronic CPD and the use of electronic technology to provide CPD, it is important that CPD providers and consumers understand the strengths and limitations of handwritten and typed note-taking, including its resultant impact on memory retention and changes to practice. Our preliminary results suggest that:

- Reflection is enhanced by handwriting, with greater depth and insight/quality of thought presented in handwritten reflections.
- Memory for new CPD content is significantly greater in health professionals who prefer to handwrite their notes and do handwrite notes, as compared to those who type notes. Of note is that participants who prefer to type notes, but attempt to handwrite notes, perform significantly lower on post-test knowledge tests.
  - Careful analysis and reflection on these results suggest that judgement and confidence in pre-event knowledge may be compromised by encoding new information without reviewing or reflecting on it, as these participants (n=4) report that they did not review notes, and did not submit reflective exercises.

Considering that 50% of health professionals are unlikely to review notes following a live CPD event, CPD may be more effective when participants are encouraged to engage in handwriting activities within the context of the CPD event, and to engage in reflective exercises in order to obtain CPD credit.

Results:

Q: "Is there an effect of preferred note-taking style (written or typed) on the memory retention of information provided through CME?"

A: YES!

- At 3 months post-intervention a modest effect was noted. Participants who reported that they 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.

Limitations:

- The CPD event that was featured received very poor participant feedback related to the educational content and appropriateness of learning objectives
- Several participants who completed the post-test noted that they had taken written notes, but would have preferred to take typed notes. These participants tended to demonstrate a loss of knowledge related to the subject material.
- **Further investigation will be conducted in order to explore these effects**

	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 1: 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*

Q: "Is engagement in reflection effected by the participant's preference to type or to write reflective content?"

A: YES!

- Typed reflections tended to be short and simple, often very blunt and reflect bias
- Typed reflections echoed pre-test "***perceived*** learning needs"
  e.g. *"My clients lie to me when they do not have their…drug cards"*
  " [Now] I can become more empathetic to my clients…"
  " [I should]use audit tools, pain inventory, ASI in my practice"
- Handwritten reflections tended to build on pre-test perceived learning needs and reflect ***misperceived*** or ***emergent*** learning needs:
  e.g. *"Substance abuse becomes addiction when it represents an all-consuming, meaningful activity – planning how to obtain the substance, implementing the plan, and relying on a social network that is linked to the substance use"*
  "One area that often becomes relevant in regards to social identity; when an individual can become accepted as a part of a community simply based on their substance use, their identity becomes ingrained in the substance use"
  "The most pressing needs and difficulty is helping clients move from pharmacological interventions to cognitive, social, and environmental supports. It seems that when clients are dependant on medication alone we see many client lose focus on complimentary therapies."

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. McGaghi, 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.

Contact Us:

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

Queen's University,
Office of CPD
68 Barrie Street,
Kingston ON K7P2E6

Continuing Professional Development