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Supporting Information for the Student Workload Quick Guides for Instructors and Students[1]

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Academic workload is recognized as an important factor in the teaching and learning environment that influences the quality of learning; thoughtful and accurate workload planning is not just a technical issue but is central to responsible course design [1, 2]. This document provides key points from literature and findings from a recent FASE Student Survey about engineering undergraduates' perspectives on transition to remote learning in spring 2020. The purpose is to provide instructors with a deeper understanding of academic workload and related issues. This knowledge supported the development of two quick guides for instructors and students on workload.

Understanding Academic Workload. Literature shows the following insights.

- Academic workload is a complex and multidimensional construct. Students experience a heavy workload as a feeling of pressure or stress [3] that may at times feel overwhelming regardless of actual course expectations. Thus, there is an important distinction between "objective workload" (e.g. the actual hours spent in class or independent study) and the "perceived workload" that a student experiences [4]. In a study, the actual or objective workload only constituted 4% of the variance of perceived workload explained [5].
- Students' perceived workload is influenced not only by objective workload but also by other factors, such as: (a) teaching and learning practices [6, 7]; (b) task characteristics, such as difficulty and value of the task [8, 9]; (c) characteristics of individual learners, such as self-efficacy [10] and self-regulation capacity [11]; and (d) students' off-campus commitments [10].
- Students' perceived workload is a factor that affects their levels of stress and mental health [11]. Further, the perception of an excessive workload can detract from learning, or simply encourage surface learning [8, 12].
- The perceived workload can vary by student groups. Female students tend to be more likely than males to feel academic stress [11]; academic stress tends to decline as students progressed through their program of study [13].
- Academic workload can be understood from the perspective of cognitive load in educational psychology and instructional design literature. The Cognitive Load Theory [14, 15] argues that cognitive load arises from three main sources: intrinsic, extraneous, and germane cognitive load.[3] As such, efforts need to be made to reduce extraneous cognitive workload for students.

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[3] *Intrinsic cognitive load* refers to the number of cognitive elements and the degree of interactivity required by the learning materials that are inherent to learning outcomes. In contrast, *extraneous cognitive load* is one imposed purely by the design and organization of the learning materials rather than the intrinsic nature of the task; it occurs when learners are required to engage in irrelevant cognitive activities not directed toward to the schema construction for learning. *Germane cognitive load* comes from the effort that contributes to schema construction for learning. Increasing germane cognitive load only works within the limits of total available cognitive capability [15].

- Online learning places more cognitive load on learners than does face-to-face learning. This is because online learners often engage in activities that do not directly facilitate their schema[4] acquisition and automation for learning (see literature review in [16]; and students often feel information overload in online learning via computer-mediated communication [17]. The cognitive overload can interfere with students' motivation to learn by inhibiting their attention to the instructional material [18] and result in student disengagement in learning [19].

Academic Workload in Remote Learning. The recent FASE Student Survey on Transition to Remote Learning provided the following findings.

- Approximately half the students felt that their academic workload increased as a result of the transition to remote learning. There seemed to be cognitive overload for some students.
- The perceived increase of workload was attributed to various factors, including (a) decreased access to the appropriate technologies, (b) decreased motivation for learning, (c) difficulties communicating for group projects, (d) declining general mental health, (e) changed ways of teaching and learning, and (f) increased responsibilities at home. There appeared to be various sources of extraneous cognitive load during the pandemic. Notably, the perceived increase of workload was a factor that negatively influenced students' mental health after the online transition.
- Recording live class sessions and using pre-prepared recordings were found to be the most popular online teaching techniques among engineering students. Using recorded lectures is an online teaching approach; however, a main issue with this approach is that students often experience cognitive overload [20]. Therefore, the frequent use of lecture recordings can increase students' perceived workload.
- Students reported that some instructors under-estimated their completion time for final assessments. There were some instances where exams published as taking three hours to complete actually took some students 10-15 hours to finish. Lack of necessary study space or equipment was a reason for the prolonged completion time for some students. Thus, there was extraneous cognitive load associated with the completion of assessments.
- In line with the literature, perceived increase of academic workload varied among student groups. Specifically, *Year 5 (with PEY) students* were less likely than Years 1 to 3 students to perceive an increased workload as a result of the online transition; students in some programs were more likely to perceive an increased workload (e.g., Civil Engineering > Mechanical Engineering and Electrical Engineering); and *Women* were slightly more likely than men to perceive an increased workload.

[4] A schema is "a collection of basic knowledge about a concept or entity that serves as a guide to perception, interpretation, imagination, or problem solving." (https://dictionary.apa.org/schema)

Strategies for Reducing Perceived Workload

Two main strategies can help stressed students: (a) decreasing the number of stressors; and (b) increasing student abilities to cope with stress [21]. For these purposes, instructors are recommended to take the following actions:

- Take care to estimate and keep the objective workload expected for a typical course under 10 hours per week this fall. A list of literature-based calculator values [22] (see the appendix) has provided a basis for estimating student workload in online learning. In particular, it was suggested that student workload should be twice the media duration when students watch a video. This suggestion was verified by an empirical study that measured the duration of pre-lab videos and the time students spent watching the videos and answering the follow-up questions in a chemical engineering laboratory course [23].
- Create opportunities to help students build rapport from the start of a course. These efforts can not only help students actively participate in breakout group discussion and group assignments but also help alleviate perceived workload. Literature shows that perceptions of workload can be lowered by increasing interaction within the peer group and between lecturers and students [7, 24].

Further, instructors are encouraged to use more effective teaching approaches as literature suggests that effective instructional and learning design help reduce students' perceived workload [3, 14]. Greater efforts should be made to help students alleviate cognitive overload in online learning. These practices include general teaching principles, such as teaching with enthusiasm and passion, telling a coherent story with examples from practice, making linkages with the actuality, and using project-based approach (rather than memorization) [6]. The literature [14, 25] and the FASE Student Survey findings also suggest that the following strategies can be helpful:

- Teach students to use relevant technology at the beginning of a course so that they can focus their time on learning materials during the course.
- Create and use quality, shorter lecture videos that include speed functions
- Scaffold learning materials to build towards increasing complexity
- Provide cues for how to process the materials to reduce processing of extraneous material
- Present learning materials in an integrated way (i.e., use audiovisual presentations and avoid getting students to learn from audio or visual presentations alone)
- Use a more examinee-friendly exam format, such as allowing students to be able to see all the questions before the start of the exam, move backwards to previous questions during the exam, and submit their work easily (e.g., using a pdf file to show diagrams etc.)

Appendix: Student Workload Calculator Values in Online Courses[5] [22]

Learning activity type	Task	Description	Estimated time
Acquisition	Reading: Survey	Reading to grasp main ideas	300 words per minute (divide total word count by 300 to get time in minutes)
	Reading: Understand	Reading to understand the meaning of each sentence	130 words per minute (divide total word count by 130 to get time in minutes)
	Reading: Engage	Reading to critically analyse	70 words per minute (divide total word count by 70 to get time in minutes)
	Watching/listening	Watching a video or listening to a podcast/audio file.	2x length of media
Discussion	Discussion	Engaging in question peers or responding to questions from peers, usually in a forum.	Time to be decided by learning designer and included in the learning materials, using writing: opinion or thought as a guideline.
Investigation	Search: verificative	Locating a fact or a known resource.	4 mins per search
	Search: topical	Searching for information on a topic.	Time to be decided by learning designer and included in the learning materials.
	Experimenting/collecting data	Engaging in activity to test a hypothesis.	Time to be decided by learning designer and included in the learning materials.
Practice	Quiz (Multiple choice)	Choosing the correct answer from a range of options.	60 seconds per question + any additional reading time to be allocated as per Read: Engage.
	Writing	Formative writing	500 words : 10 hours
	Writing	Opinion/discussion/reflection	100 words : 20 minutes
Production	Writing	Writing essays, reports, or other writing to be checked by a tutor.	500 words : 11 hrs 1500 words : 36 hours 2000 words : 48 hours
	Other	Including artefacts, media, or performance/presentation.	Time to be decided by learning designer and included in the learning materials.
Collaboration	Collaboration	Working with one or more peers to produce an output.	As production x 2
Synchronous	Synchronous	Any synchronous learning activities e.g. webinars	The specified length of the event.

[5] Available at http://bit.ly/postgradworkload. The table is cited here with the permission of the author.

References:

[1] E. Chambers, "Workload and the quality of student learning," *Studies in Higher Education,* vol. 17, pp. 141–153, 1992.

[2] L. Giles, "An investigation of the relationship between students' perception of workload and their approaches to learning at a regional polytechnic," Doctoral disseration at Massey University, New Zealand, 2009.

[3] D. Kember, "Interpreting student workload and the factors which shape students' perceptions of their workload.," *Studies in Higher Education,* vol. 29, no. 2, pp. 165–184, 2004.

[4] K. Bowyer, "A model of student workload," *Journal of Higher Education Policy and Management,* vol. 34, no. 2, pp. 239-258, 2012.

[5] D. Kember and D. Y. P. Leung, "Influences upon students' perceptions of workload," *Educational Psychology* vol. 31, no. 2, pp. 185-198, 1998.

[6] E. Kyndt, I. Berghmans, F. Dochy, and L. Bulckens, "'"Time is not enough.' Workload in higher education: A student perspective," *Higher Education Research & Development,* vol. 33, no. 4, pp. 684-698, 2014.

[7] D. Kember and D. Y. P. Leung, "Characterising a teaching and learning environment conducive to making demands on students while not making their workload excessive," *Studies in Higher Education,* vol. 31, no. 2, pp. 185–198, 2006.

[8] S. Kolari, C. Savander-Ranne, and E.-L. Viskari, "Do our engineering students spend enough time studying?," *European Journal of Engineering Education,* vol. 31, no. 5, pp. 499-508, 2006.

[9] D. Gerrard and C. Variawa, "Bridges and barriers: A multi-year study of workload-related learning experiences from diverse student and instructor perspectives in first-year engineering education," presented at the American Society for Engineering Education Annual Conference and Exposition, Columbus, Ohio, 2018, June 24-27.

[10] L. Bachman and C. Bachman, "Student perceptions of academic workload in architectural education," *Journal of Architectural and Planning Research,* vol. 23, no. 4, pp. 271-304, 2006.

[11] N. Durand-Bush, K. McNeill, M. Harding, and J. Dobransky, "Investigating stress, psychological well-being, mental health functioning, and self-regulation capacity among university undergraduate students: Is this population optimally functioning?," *Canadian Journal of Counselling and Psychotherapy,* vol. 49, no. 3, pp. 253-274, 2015.

[12] G. Scully and R. Kerr, "Student workload and assessment: Strategies to manage expectations and inform curriculum development," *Accounting Education: An International Journal,* vol. 23, no. 5, pp. 443-466, 2014.

[13] E. M. Adlaf, A. Demers, and L. Gliksman, "Canadian campus survey 2004," Toronto, ON: Centre for Addiction and Mental Health2005, Available: https://collections.ola.org/mon/25005/309709.pdf.

[14] J. Sweller, J. J. G. van Merriënboer, and F. Paas, "Cognitive architecture and instructional design: 20 years later," *Educational Psychology Review,* vol. 31, no. 2, pp. 261 - 292, 2019.

[15] J. Sweller, J. J. G. van Merriënboer, and F. Paas, "Cognitive architecture and instructional design," *Educational Psychology Review,* vol. 10, pp. 251–296, 1998.

[16] S. L. Chang and K. Ley, "A learning strategy to compensate for cognitive overload in online learning: Learning: Learner use of printed online materials " *Journal of Interactive Online Learning,* vol. 5, no. 1, pp. 104-117, 2006.

[17] C.-Y. Chen, S. Pedersen, and K. L. Murphy, "Learners'perceived information overload in online learning via computer-mediated communication," *Research in Learning Technology,* vol. 19, no. 2, pp. 101–116, 2011.

[18] K. W. Hartley, "Media overload in instructional Web pages and the impact on learning," *Educational Media International,* vol. 36, no. 2, pp. 145-150, 1999.

[19] C. P. Lim, "Engaging learners in online learning environments " *TechTrends,* vol. 48, no. 4, pp. 16-23, 2004.

[20] T. Bates, "The ten fundamentals of teaching online for faculty and instructors," teachonline.ca2016, Available: https://teachonline.ca/sites/default/files/pdfs/the_10_fundamentals_of_teaching_online_for_faculty_and_instructors_-_september_2016.pdf.

[21] A. M. Alzahem, H. T. Van der Molen, A. H. Alaujan, and B. J. De Boer, "Stress management in dental students: A systematic review," *Advances in Medical Education and Practice,* vol. 5, no. 167–176, 2014.

[22] N. Beer, "Estimating student workload during the learning design of online courses: Creating a student workload calculator," presented at the 18th European Conference on e-Learning, Copenhagen, Denmark 2019, November 7-8. Available: https://doi.org/10.34190/EEL.19.118

[23] K. Moozeh, J. Farmer, D. Tihanyi, T. Nadar, and G. J. Evans, "A prelaboratory framework toward integrating theory and utility value with laboratories: Student perceptions on learning and motivation," *Journal of Chemical Education,* vol. 96, no. 8, pp. 1548–1557, 2019.

[24] M. Segers, J. Nijhuis, and W. Gijselaers, "Redesigning a learning and assessment environment: The influence on students' perceptions of assessment demands and their learning strategies," *Studies in Educational Evaluation,* vol. 32, no. 3, pp. 223–242, 2006.

[25] R. E. Mayer and R. Moreno, "Nine ways to reduce cognitive load in multimedia learning," *Educational Psycologist* vol. 38, no. 1, pp. 43-52, 2003.