A quantitative method to evaluate student workload

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Introduction

Academic life may at times be demanding and challenging for university students, due to various external and self-induced pressures, particularly in relation to handling academic assessments. "Heavy workload" is reported as a key factor affecting student engagement in courses they have enrolled in (Wahat, et al. 2012, Rahim, et al. 2016).

Clearly, assessment tasks are critical to student learning, the nature and timing of these tasks being the instructor's responsibility. However, there are few studies on how these assessments should be apportioned across a semester, or even how to quantify their impact on student workload. It is reasonable to assume that the assessment schedule and workload are associated with the student's performance and engagement (Tampakis and Vitoratos 2009). Many students reported that their "inability to manage workload during the semester" undermined their ability to engage with their subjects. It would, therefore, be useful to quantify the relationship between assessment types and submission timings with their associated workload to enable more optimal assessment distribution to reduce student stress within, and across multiple, subjects within a teaching period.

Current methods to manage student workloads typically attempt to measure assessment workload based on qualitative student feedback and questionnaires, which are not always reliable in isolation.

Existing Workload Measurement Methods

Existing workload assessment methods in the literature tend to fall into three groupings.

The first group is related to recognising the amount of time students commit and organise for academic activities. The existing methods that attempt to measure workload are based on qualitative student feedback and questionnaires. There are many ways to understand student workload quantity; accumulating data from the students through **surveys** (Breton, 1999; Neves & Hillman, 2017; Spronken-Smith, 2005; Winer, et al., 2004), **interviews** (Nosair & Hamdy, 2017; Schuman, et al., 1985) **feedback** (Ruiz-Gallardo, et al., 2016; Ruiz-Gallardo, et al., 2011; Ruiz-Gallardo, et al., 2006; Zuriff, 2003) personal **journals** (Bartual Figueras & Poblet Farrés, 2009; Kember, et al., 1996) and **multiple questionnaires forms** across the semester by students (Arana, et al., 2005; Barjola-Valero et al., 2014; Darmody, et al, 2008; Greenwald & Gillmore, 1997; Kržin-Stepišnik & Kolar, 2007).

An online survey is the most common method to collect information, especially if it is necessary to have a large sample of students' feedback. Gerrard and her colleagues (2017) conducted a study to understand the first-year undergraduate engineering students' workload in the first term of studying at University and their expectations and the realities of their new life. Each week a random sample of students submitted details of their weekly workload including perceptions of difficulty for each course qualitatively and quantitively. In addition to this data, general information was gathered from both students and instructors at the beginning of the term. The results showed students were overloaded during major and minor assessments. Whereas in the first three weeks of the term students had fewer tasks to do. Therefore, Gerrard and his colleagues recommended the workload should be distributed more evenly throughout the term. The results confirmed that the students' workloads were more than they had expected before starting the course.

Recently, Souto and Baeza collected **a large detailed dataset of students' feedbacks** from two Spanish universities. The detailed workload measurements have been taken from various universities included of 1400 students. The study introduced the empirical distribution functions of workload indicators (Souto-Iglesias and Baeza_Romero, 2018). One drawback of these study methods is that they are all retrospective and adapting these indicators to new environments is highly labour intensive (they all involve data collection from students).

The second group is focused on correlating students' physiological reactions to reported stress from the workload. "Workload stress" is a typical body response that could induce extreme worry and depression to a set of stimuli. In this highly stressful environment, the student might be prone to anxiety. Gajalakshmi, and his colleagues (2012) and Chraif (2015), studied various stimulus causative to stress, psychologically. Gajalakshmi et al. evaluated study load and correlation to stress by measuring body mass index (BMI) and the "visual analogue scale" (VAS) of anxiety (a validated assessment of exam stress among medical students). Chraif (2015), applied psychometric instruments with a combination of tests and questionaries to understand the relation between student workload and stress. Furthermore, Ernawati and his colleagues (2019), appraised links between student's mental and physical workload during the course. The mental workload was identified by the NASA task load index, and the physical workload was measured by heart rate.

The third group, pertaining to **faculty staff workload,** uses a Workload Calculation Model (WCM) designed by Brooks and Nelson (2018) that collects data from teaching, service and scholarship by using timesheets. Also, for various activities, the nominal numbers of hours per year were used for each activity/position. The preliminary model can be applied for the most work activities to evaluate staff workload. They used Microsoft Excel Sheets for the model calculations. Although this model has not been developed to assess **student workloads**, so far, it is the only method which is similar to our proposed method.

Our presented method is based on using the inputs of the individual marks, nature and timing for each assessment within a teaching period, with the intent to quantify and enable better management of assessment workload to benefit students.

It should be noted that all of the above methods are effective within their local contexts, which will, of course, vary between courses and cultures.

Methodology

According to assessment procedures at Monash University, the nominal full-time student workload is nominally 48 hours per week (including contact and non-contact hours) typically spread across four "units" (subjects). Assessment requirements may vary significantly between units. The weighting of the assessments within a subject is constructed following the "hours" requirements to be completed by average students

We propose a tool to quantitatively estimate the student academic workload across a semester based on (i) assessment marking allocation, (ii) submission timing and (iii) the nature of the assessment (e.g. individual or group-based). It uses data gathered from official "unit guides" (documents outlining unit requirements for students).

Currently, five different factors related to the nature of the coursework are considered in the calculation of "weekly workload" based on the unit guides at Engineering Faculty, Monash University. These are: 1) fundamental knowledge assessed by quizzes, tests, tutorials or exams, 2) application of the knowledge assessed by laboratory reports and assignments, 3) problem-solving ability which is assessed by projects, 4) teamwork assessed in group assignments, reports and presentations, 5) time management (a "procrastination factor") related to the amount of time available to complete assessments.

Our method is based on the aggregation of the assessment marks (per week) weighted by factors related to the assessment types into a weekly "workload indicator", and only considers "in-semester" assessments. This method was then developed into a tool using Microsoft Excel. The percentage of overall marks allocated to in-semester assessment typically ranges from 40-60% and in some units could be 100%. This percentage is the overall workload level that student has to deal with through the semester before the final exam for one unit.

Table 1 shows a possible assessment distribution for a student studying a standard full-time load of four units (A, B, C, D), with a total of 190 (of a possible 400) in-semester marks (which vary between units), over a standard academic semester of 12 weeks.

Table 1: Example of one semester's assessment schedule

Unit	Assessment	Marks	Group factor (G_f)	Procras. Factor (P_f)	Release Weeks	Due Week
Unit A 50%	Test	10	1	0		6
	Test	10	1	0		12
	Laboratory	5	1.05	0.2	2	4
	Laboratory 1	5	1.05	0.2	2	7
	Laboratory 2	5	1.05	0.2	2	11
	Tutorial	5	1	0		5
	Tutorial	5	1	0		12
	Class quiz	3	1	0		5
	Class quiz	2	1	0		12
Unit B 40%	Test	10	1	0		8
	Test	10	1	0		10
	Laboratory	3	1.05	0.1	1	6
	Laboratory	7	1.05	0.2	2	11
	Assignment	10	1.1	0.5	5	10
Unit C 50%	Test	10	1	0		5
	Test	10	1	0		10
	Laboratory	5	1.05	0.2	2	7
	Laboratory	10	1.1	0.2	2	12
	Tutorials (3)	15	1	0		6-9
Unit D 50%	Class quiz (2)	1	1	0		3-4
	Class quiz (4)	2	1	0		6-9
	Laboratory	10	1.1	0.2	2	5
	Laboratory	15	1.15	0.5	5	10
	Assignment	3	1	0		5
	Assignment	4	1	0		11
	Tutorial	5	1.05	0.1	1	5
	Tutorial	5	1.05	0.1	1	7
	Presentation	5	1.05	0.2	2	12

Many studies showed that group assessments have positive outcomes for students (Goldfinch, et al., 1999; Lejk, et al., 1999; Lopez-Real and Chan, 1999; Bourner, et al., 2001), that can be highlighted by developing experience in mimicking work within a real organisation, the opportunity for working in a team and knowing group members well. However, difficulties of negotiating internal group dynamics, time management and unequal workloads are identified as having adverse effects on student engagement in group assignments. Bourner and his colleagues (2001) declared "time-consuming", "not enough time" and "dependency on others” in group work as factors that contribute to increased workload. Garvin and his colleagues (1995) reported addressing two issues; lack of skills teamwork to run a project and be part of a team by students. To account for this, we introduced the “group factor” (G_f) (shown in Table 1). Individual assessments have a group factor of 1, while group assessments incur a baseline overhead of 0.05 (for assessments worth up to 5 marks) and an additional 0.05 for every extra five marks that the assessment is worth.

The tool also accounts for the fact that people (students in particular) frequently procrastinate in undertaking assignments and this is captured via a “procrastination factor” (P_f), which skews the weighting of the assessment load towards the submission deadline throughout the semester. In the current tool presented, a linear skewing was adopted. This skewing tool divides the total marks of the associated assignment following a positive linear gradient across the release and submission week of the task. A procrastination factor of 1 gives the maximum possible gradient with zero ‘marks’ contribution in the first week of the assignment and a factor of 0 means that there is no procrastination. From our experience, we selected 0.1/week for laboratory-based assignments and long report-based assignments (P_f = Number of workload weeks*0.1). Based on the P_f, the skew coefficient (S_{CO}) was implemented, and the overload procrastination factor has been calculated for each assessment, and then the summative workload level was accumulated in each week. “Release week” is the week that the assessment announces during the semester. “Active week” is the number of weeks that the assessment runs during the semester and “Due week” is the week that the assessment has to be submitted by students. Note that the weeks with non-zero P_f have workloads spread over multiple weeks.

We acknowledge that further research needs to be conducted to validate and refine the models and values associated with the factors G_f and P_f. We present this work as a preliminary proposal to be further explored.

The weekly workload for each assessment (Wa_n) for each week is calculated as:

$$Wa_n = (P_f * \text{Maximum Coefficient}) + S_{CO}$$

$$\text{Maximum Coefficient} = (2 * \text{Mark} * \text{Group factor}) / (\text{Number of active weeks})^2$$

All the weekly workload contributions from each assessment are then aggregated by week, either for a single unit or across all units within a single semester. These can then be simply visualised in a graphical format, as discussed in the next section.

Results and discussions

Using the tool, it can be observed how the assessment loadings are typically distributed across the semester. These weekly student workload distributions can be computed directly from the unit guides for any given semester. Figure 1 shows workload distribution for Unit A in Table 1. Figure 2 shows the combined workload distribution from all of the units in Table 1 (Units A to D).

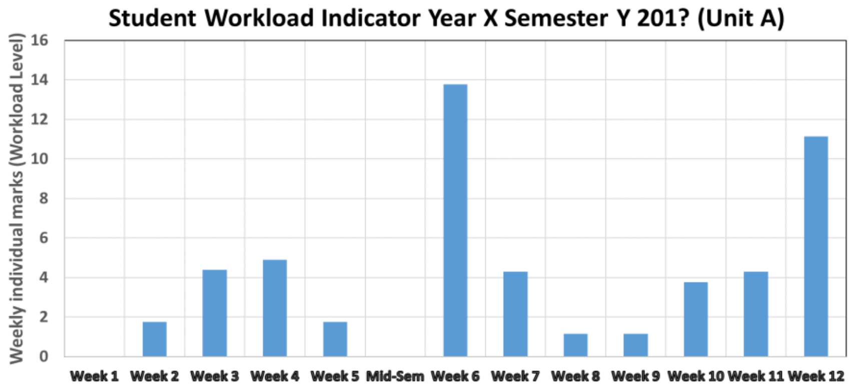
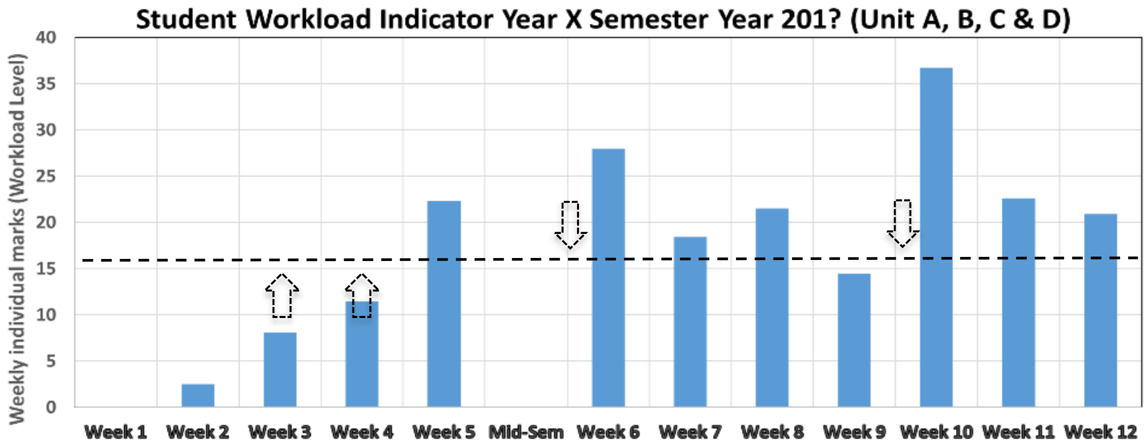


Figure 1: Example of one unidentified unit spreadsheet data to show assignments spreading and workload level (total mark across the semester, 50% and final exam, 50%).



Week	W1	W2	W3	W4	W5	M	W6	W7	W8	W9	W10	W11	W12
Workload Level	0	2.7	8.3	11.5	22.3	0	27.8	18.2	21.4	14.3	36.4	22.3	20.7

Figure 2: Example of one unidentified semester spreadsheet data to show assignments spreading and workload level for Unit A-D

Typically, each unit's assessment types and timings are determined by different unit co-ordinators independently without any cross-consultation. These assessments can be class tests, preliminary quizzes before or after lectures/workshops or practical classes, assignment, laboratory reports or individual or group projects. Each assessment is assigned marks based on the amount of work required and the importance of the tasks. While this tool can illustrate the student workload to students and unit co-ordinators for single units (Figure 1), since students typically study more than one unit each semester, each unit's assessment timetable is likely to have overlapping deadlines with other units, as these timetables are independent of one another. Our tool can quantify the effect of these independently determined assessment deadlines on student workload, as shown in Figure 2.

Figure 2 illustrates that for this combination of units, there are likely to be particularly high workloads in two weeks 6 and 10. This information can be of use to both students (to plan their time accordingly) and unit coordinators to better understand their students' workload across the semester. It would be beneficial if the units' coordinators could use the tool to inform their assessment timings, before finalising their unit guides, since a small change in the assessment design and schedules can make a significant difference in the student workload level. A case in point: course coordinators can perhaps work together to cap the maximum weekly individual marks (workload) experienced by the students. If we sum up the total in-semester marks from Unit A-D above and further dividing the total by 12 weeks, the theoretical ideal workload distribution would then be 16 marks per week. While it may not be feasible to achieve such an ideal distribution, this can serve as a benchmark particularly in reducing the workload in Week 6 and 10 in Figure 2 or in shifting some of the workloads from the second half of the semester to Week 3 and 4.

Conclusions

The conventional method for evaluating academic assessment load is student feedback, which is not always reliable in isolation. This paper proposes a quantitative unit workload evaluation method for academics, course planners and students. With further research, development and refinement, it could be used to develop a system to help instructors to manage the assessment timing and weighting in their units, possibly with the goal of reducing workload peaks to minimise student stress due to excessive workload. Students could use the system to evaluate workloads for single, or more holistically, multiple combinations of units to better plan their time over a semester.

The tool considers two sufficient “overload” parameters - group workload and procrastination factors. These parameters were estimated based on the authors’ teaching experience; however, future investigations are necessary to validate and refine the group workload and skew coefficients.

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