

Individual Grading in Groups: A Capstone Project Practice

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The ICT industry requires professionals with heterogeneous skills such as technical expertise, business management capabilities, innovative thinking and artistic creativity to work together in order to solve complex problems. To meet this industry demand, Western Sydney University (WSU) in Australia has a final-year capstone program aimed at training students with a range of skills to work together, in a software development project, that would enhance their employability. One of the challenges in this program is awarding a fair grade, that accurately reflects each individual student's potential. As a solution, WSU has developed a System for Individual Grading in Capstone Projects (SIG-CP). SIG-CP calculates individual marks in a group setting, utilizing: peer, supervisor/mentor, client/sponsor and an academic-panel feedback factors. The approach assesses both the product and process aspect of the capstone work, as well as the quality and quantity of contribution of individual students. Further, the paper presents an analysis on how the average mark varies depending on how and which feedback factors are used in the grading process.

Keywords: Capstone, Grading, Group, Individual, Fairness, Feedback, Peer, Supervisor, Academic, Client

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Introduction

Computing capstone programs are designed to reflect the industry practices, such as working with people from different backgrounds and varying skill sets in achieving a common outcome⁽¹⁾. In this view, Western Sydney University (WSU) offers a final-year capstone program that brings together students from three different undergraduate courses to complete medium-sized industry-based projects.

One of the challenges of running a capstone program is awarding a fair grade in a group setting. Specifically, when student contributions differ from quality and quantity perspective, and students in the same group have heterogeneous skills. Academics managing capstone programs have highlighted the importance of using feedback from various sources in assessing the outcome, and not just rely on the final product for the assessment of individual students^(1, 2). Academic practices show the use of input from peer and self-assessments⁽²⁻⁴⁾, supervisor/mentor evaluations⁽⁴⁾, client/sponsor feedback⁽⁴⁾ and academic panel grading⁽⁵⁾ employed in calculating individual marks in a group setting. This paper presents the experiences over the last eight-years at WSU, in assessing individual students, from various study backgrounds in ICT, based on feedback factors received from peers, supervisors/mentors, clients/sponsors and academic panel.

The paper first presents the background of the capstone program at WSU, followed by a detailed explanation on the System for Individual Grading in Capstone Projects

(SIG-CP) used for calculation of individual marks in a group setting. Further, the paper provides an analysis on how the average mark has fluctuated based on how and which feedback factors are used.

Background of PX

Within the School of Computing, Engineering and Mathematics (SCEM), at WSU, there is a well-established capstone program that has been running over 18 years. This capstone program serves three undergraduate degrees, namely Computer Science (CS), Information Technology (IT), and Information Systems (IS).

These three degrees are designed with different levels of emphasis on technical and business analytical skills. The CS degree is more focused towards the development of hard-core technical skills such as programming, database, networking, data structures, firmware and algorithms, with a low emphasis on business analysis and management. On the other end of the spectrum, IS degree gives a heavy prominence to business analysis and management, with comparatively low focus on hard-core technical skills. The IT degree roughly gives same level of attention on technical skills and business analytical skills. Between these three degrees, there is 30% of overlap of content, with the other 70% focusing on the developing graduate attributes specific to that degree.

The SCEM's capstone program, named Professional eXperience (PX) is common to all three degrees. In PX, students from CS, IT and IS are grouped together to work in a 'real-life' project. Students are grouped by the

PX coordinator, based on their previous academic performances, in a manner that all skills needed in the project are covered.

Similar to most computing capstone programs, students are expected to complete a software development activity in one semester. In addition to the software outcome, there are few other deliverables in PX. These deliverables cover both the process and product aspect of the capstone projects. PX deliverables and how these cover varying skills are as outlined in table 1.

Table 1: Assessment Tasks in PX

Assessment Task	Weight	process or product	(G) Group or (I) Individual	Skill Area
Plan	5%	process	G	Management
Proposal	5%	product	G	Innovation
Porotype	10%	product	G	Creativity
Systems Design	15%	product	G	Business Analytics
Final Software	40%	product	G	Technical, Innovation and Creativity
Handover report	5%	product	G	Management
Presentation	10%	both	G	All
Abstract and video	5%	product	G	Technical, Innovation and Creativity
Diary and reflections report	5%	process	I	Self-management

In PX, all projects are real and defined by external client/sponsors⁽⁴⁾ from the industry, or by researchers. PX does not use ‘artificial’ projects defined by academics. Clients/sponsors specify the project requirements, as in the IT industry. They are interested in getting all the requirements met in the final product.

Each PX group has a supervisor/mentor who guides and monitors the students throughout the semester. The supervisor meets the group every week and grades the assessment tasks, except for the final presentation (10%). This regular contact with students, gives the academic-supervisor insights into the group dynamics.

At the end of the session, a panel of academics (5-8 members), marks the final presentations of all student groups. This panel includes academic-supervisors, and other academics, who are not supervising students in that semester. The academic-panel has the opportunity to see all the projects on ‘one stage’. This gives them the ability to objectively evaluate the outcome of a project in comparison to other projects.

PX is run in Autumn (March-May) and Spring (August-October) sessions over 14 weeks. Project sourcing and grouping tasks are done before the start of the semester by the PX coordinator. In week 15, students give a presentation to the academic-panel. During week 16-17 grading is carried out by the PX coordinator in consultation with the supervisors.

System for Individual Grading in Capstone Projects (SIG-CP)

Due to heavy group activity nature in PX (95%, see table 1), awarding a fair individual mark based on true contributions is important. Hence, the System for Individual Grading in Capstone Projects (SIG-CP) was developed and used by the PX coordinator, for individual marks calculation (figure 1).

System for Individual Grading in Capstone Projects (SIG-CP)					
Group number	PS1010				
Group Assessment Marks out of 85%	80				
Student numbers -->	Student 1	Student 2	Student 3	Student 4	
A1	Student 1	23	23	24	30
A2	Student 2	12	28	25	35
A3	Student 3	12	20	33	35
A4	Student 4	12	20	28	40
A5	Average Contribution	14.75	22.75	27.5	35
A6	Ideal average contribution --> 25				
A7	Average Weighting Factor	0.59	0.91	1.1	1.4
A8	Eligible Group Mark	47.2	72.8	88	112
A9	Ceiling value 1 --> 112				
A10	Group Mark Component	47.2	72.8	66.7857	85
B1	Individual Marks For Diary & Reflections Report (5%)	2	5	4.3	5
B2	Individual Mark Out of 90%	49.2	77.8	71.0857	90
B3	Non - Completion Penalty 10%	8.00%	0.00%	0.00%	0.00%
B4	Marks after non completion penalty (Out of 90%)	45.264	77.8	71.0857	90
C1	Supervisor Factor (-10 to +10)	-10	-5	5	0
C2	Marks after supervisor factor out of 90%	35.264	72.8	76.0857	90
C3	Ceiling value 2 --> 90				
C4	Final Marks Submitted by Supervisor (Out of 90%)	35.264	72.8	76.0857	90
C5	Supervisor Comments for individual Students	Lacks skills and professionalism		Best performer in the group. Contributed well to all areas.	Comments
D1	Presentation Marks (Out of 100) 70				
D2	Presentation Marks Calculated (Out of 10%) 7				
D3	Raw Mark (Out of 100%)	42.264	79.8	83.0857	97
D4	Corresponding Possible	F	D	D	HD
D5	Panel Grade for the overall submission of the group work. C				
D6	Marks updated After Panel Grade	52.264	74.8	78.0857	87
E1	Client Assessment on individual students	0	5	-3	5
E2	Marks updated after Individual client assessment factor	52.264	79.8	75.0857	92
E4	Ceiling value 3 --> 92				
E5	Adjusted Marks After Implementing Client	52.264	79.8	75.0857	92
E6	Client Mark Assessment of the project OUTCOME 95				
E7	Marks Awarded to Individual Students After Client Assessment	49.6508	75.81	71.33143	87.4
E8	Ceiling value 4 --> 88				
Final Mark Awarded to Individual Students in PX	49.6508	75.81	71.33143	87.4	

Figure 1: Example use of SIG-CP

SIG-CP combines four feedback factors in calculation of individual marks: peers (rows A1-A10), supervisor (rows C1-C5), academic-panel (rows D1-D6) and client (rows E1-E8). The current implementation of SIG-CP uses Excel Sheets. At the end of the semester, a SIG-CP Excel sheet is created for each group. The example

given in figure 1, indicates that even though the group mark component at the start of the grading process is 80/85, student 1 is likely to fail (≤ 50), and students 2, 3 and 4 will get a distinction ($75 \geq 85$), a credit ($65 \geq 75$) and a higher-distinction ($85 \geq 100$) respectively.

Peer and Self Assessments in SIG-CP

Use of peer and self assessments based weighting factor method for individual marks calculation is a popular practice in capstone programs^(2, 3). In week 14, all students submit confidential peer assessments using a standard form (MSWord). There are three sections under which students provide feedback on peers and themselves.

1. **Quantity of Contributions:** Numerical % value of contribution on various project activities.
2. **Quality of Contributions:** Categorical values (six steps ranging from poor to excellent) representing the standard of the contributions.
3. **Account of events:** Explanations highlighting major contributions of the each member and any other comments.

Academic supervisors analyze these forms and enter marks in rows A1 to A4 in SIG-CP. There are arguments for and against the use of confidential or open peer assessments⁽⁶⁾. Irrespective of whether the peer assessments are confidential or open, there are some issues associated with only using the peer assessments for individual marks calculations. These issues include:

- students providing biased assessments towards themselves or to a specific group member.
- strong personalities within the group coaxing the other students by providing a dishonest picture of contributions.

Therefore, in PX, we have found peer assessments alone are not sufficient for fair assessment of individuals in a group.

Supervisor/Mentor Evaluation in SIG-CP

In SIG-CP, supervisors have the right to adjust the mark by +/- 10 acting as a judicator fixing any biases that may have occurred in peer assessment process. Supervisors can make this decision based on the free text explanations provided in peer assessments and insights into the group through their involvement throughout the semester.

In some situations, the supervisor's close involvement with the project may develop a subjective view towards the project outcomes. Also, inexperienced supervisors tend to mark at extremes either being too harsh or lenient. Further, supervisors are not aware of the outcomes of similar projects in that session. Therefore, in PX we have found that inclusion of the supervisor

feedback with peer assessments alone is not sufficient for fairer mark calculations.

Client/Sponsor Feedback in SIG-CP

Clients who provide the projects can indicate whether they got the outcome they expected or not. In PX, at the end of the semester, clients provide feedback on individual student's professionalism and overall outcome of the project using a form (MSWord). Clients email the form to the PX coordinator. Based on the client feedback individual students get +/-5 adjustment. In addition, the overall project outcome is scaled based on the client's satisfaction with the end product. The PX, coordinator enters the marks into rows E1 and E6 based on the client feedback.

In PX, we have found that some clients can be overly courteous giving high marks, even when the students have not performed well. Also, we have encountered clients who were savvy and pushing students unreasonably to achieve their own target. This means that there is a certain level of subjectivity associated with client's feedback as well.

Academic-panel Assessment in SIG-CP

In week 15, when the academic-panel marks the final presentations, individual panel members record marks for the presentation (10%) and an overall grade for the end-product. The academic panel may consist of current supervisors and non-supervisors. Therefore, the academic-panel feedback is an important factor in adjusting any subjectivity that may have been injected into the marks by students, supervisors and clients. The PX coordinator enters the panel marks into rows D1 and D5 in SIG-CP.

Impact of Applying Multiple Feedback Factors

Table 2 shows the progression of the SIG-CP through five stages since the PX coordinator created it in 2010.

Table 2: Various Stages of Applying Feedback Factors in PX

Method	Feedback factors used in formula	Feedback factors used as reference	No. Sessions	projects (students)
1	Raw marks for assessments	Supervisor and Panel	1 (2010 Aut)	10 (40)
2	Raw marks for assessments	Supervisor, Panel and Peer	4 (2010 Spr -2012 Aut)	75 (326)
3	Raw marks for assessments + peer	Supervisor, and Panel	2 (2012 Spr -2013 Aut)	36 (151)
4	Raw marks for assessments + peer and supervisor	Panel and client evaluations	7 (2013 Spr - 2016 Spr)	204 (717)
5	Raw assessment marks + peer, supervisor, panel and client	-	2 (2017 Aut -2017 Aut)	74 (242)

As presented in table 2, each feedback factor (peer, supervisor, client and panel) was introduced to assist the decision making of the PX coordinator and academic supervisors. Eventually, these feedback factors were included in the calculation process in a quantitative manner, that gives us the current SIG-CP (figure 1).

Since 2010, there have been 1,476 students (399 groups) completing the PX program. Using the individual final grades of these 1,476 students, we have analyzed how the average marks have varied for the five methods shown in table 2. The variation of the average mark is presented in a graph in figure 2.

When analyzing the figure 2, a few important conclusions can be drawn. In method 1, when just referencing feedback without including it in calculations, has led to low average marks. This could be due to supervisors and coordinator reading the comments accentuating on the negative comments, that led to giving lower marks.

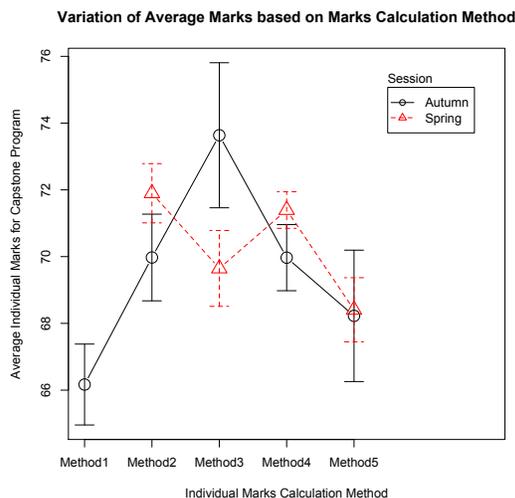


Figure 2: Variation of Average Marks based on Methods given in table 2.

Also, in method 3, when including only peer assessments in calculations, average marks are artificially high. This could be due to students providing high marks themselves or to certain peers, and quantification of those into calculations leading to a high average mark. Similarly, there is a change in average marks between semesters (red-dotted-line vs black-solid-line), even when the same methods (2-4) are used. This is specifically a worrying for the PX coordinator, as the program uses more experienced tenured staff in Autumn and a high percentage of casual staff in Spring, due to high student numbers in that semester. The graph shows that the current method we use (method 5) has resolved this issue as the average marks in both sessions are similar. This may be an indication that our methods of quantification of all

feedback factors into marks calculation have fixed the inconsistencies of average marks between two semesters. However, this conclusion would need to be further verified with more data in coming semesters to assure that this has not happened by coincidence.

Conclusion and Future Work

This paper has shown the importance of quantifying the different feedback factors: peer, supervisor, client and academic-panel, in individual marks calculations in capstone programs, rather than referring to the feedback to make judgments. This quantification also mitigates issues associated with the use of academics with varying experiences.

Future work includes further analysis of our data to unravel hidden insights based on projects features, clients background and supervisor's skills. Further, the researchers would explore the possibility of using ongoing feedback mechanisms similar to work done by Ferrell et al.⁽⁷⁾ so that it provides an opportunity for individual students to improve as the semester progresses. In addition, work is underway to implement all MSWord based feedback forms and SIG-CP as a web-application.

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