Assessing multi-disciplinary learning: Requirements and recommendations.

K. D. (Kelly) Meusen-Beekman, J. J. L. (Jeroen) Schepers, and P. A. M. (Ad) Kleingeld

Defining multidisciplinary learning
A common framework used in multidisciplinary learning builds on the extent of topic integration. This can be portrayed on a continuum moving from a disciplinary approach to increasing cross-topic connections and greater degrees of integration (Daly, Brown & McGowan, 2012; Drake, 2012; Fogarty & Pete, 2009). On the latter side of the continuum, a multidisciplinary approach indicates that a central theme is identified and used to organize and correlate the disciplines being integrated (Brough, 2012; Dowden, 2007). Interdisciplinary work applies to subjects that are relatively clear in their differences, but consists of shared key concepts, skills and attitudes and actions (Drake, et al., 2015). Within transdisciplinary work, students go beyond the disciplines.

Multidisciplinary Assessment
Assessing the quality of multidisciplinary work is complex, with regard to exchanging methods, translating categories, and testing outcomes against multiple standards of quality. To improve the quality of multidisciplinary assessments in general, our literature study and practical study[1] suggest several requirements and recommendations prior, during and after (multidisciplinary) assessments (see Table 1).

Table 1
Improving assessment quality

Prior	• Criteria are crucial; they should establish the level of achievement that is required for a student to pass the course and should be directly related to the course learning outcomes.
	• Clarifying and sharing criteria between assessors and students is required prior to the assessment, preferably at the start of the course or project.
	• The understanding of the criteria involved is crucial for producing agreement between assessors and for providing an accurate evaluation of the student's overall proficiency.
	• Criteria for multidisciplinary assessment should include validity within and beyond the disciplines.
	• The assessed task needs to be consistent with the theory, and the scoring structure (such as criteria or rubric) must follow rationally from the domain structure.
	• Training in assessment may be useful to enhance assessors with knowledge and skills with regard to multidisciplinary assessment.
	• To prevent variability in the assessment scores due to disagreement caused by differences in experience and differences in lecturers' attitudes regarding students or content, the development of assessment skills is necessary to improve the quality of individual assessments and to decrease inconsistency among them.
During	• The assessment must stand on valid indicators of what counts as accomplished student work.
	• Evidence of learning should be authentic and demonstrate valid learning.
	• Depending on what knowledge, skills and attitudes need to be assessed either

---

[1] Meusen-Beekman, K.D., Schepers, J.L.L., & Kleingeld, P.A.M. (2016). Multidisciplinary Course Assessment with Multiple Assessors at TU/e

	separately or integratively, holistic or analytic scoring can be preferred. Further discussion on the main goals and the integrative grounding of a course is required to determine whether analytic or holistic judgment is emphasized.
	• Interrater reliability is improved when clear standards are defined, and interpretation of criteria is discussed. To improve the intrarater reliability for assessors, a rubric can be useful. • Extensive grading guidelines need to be included, to clarify criteria, standards and rating scales. • Assessors need to be supported in assessing the quality of a task by seeking support in improving knowledge on domains outside their expertise through delving into research, by using extensive answer models, and by the possibility to consult colleagues. •
After	• Multidisciplinary assessments tend to be more effective when consistent and constructive feedback on students' progress, processes, results and limitations is provided. • A common understanding on qualitative feedback is necessary, to ensure that each student receives consistent and constructive feedback on their learning process. • In an ideal situation, the assessment and results are independent of those who score. Multiple assessors to assess each report can enhance quality assurance. The possibility of assigning assessors to assess specific subassignments within their domain of expertise can improve reliability.

Based on our literature study and practical study, we provide the following main findings to improve the assessment of IE Quickscan (1JK100):

• The IE Quick Scan can be a promising integrating platform through which students can consider all aspects of their professional roles and responsibilities as engineers in a multidisciplinary project. However, a more flexible approach to assessing the quality of the final product is recommended. Due to a potential misfit between the description of some subassignments and the company context, answer models are not always suitable and students are not rewarded for their creativity or flexibility of their solution. Evaluation of flexibility and creativity can be included in the grading form.

• The IE Quick Scan can improve clarity about criteria and indicators of quality. Prior to, during and after the course, lecturers need to be aware of the assessment criteria, including validity for, within, and beyond the disciplines. Students need to be informed, beforehand, about the criteria and standards and the links to specific learning outcomes and objectives. Assessment criteria should establish the level of achievement that is required for a student to pass the course and should be directly related to the course learning outcomes.

• Although the IE Quick Scan is multidisciplinary and thus features theories from several disciplines, there is little integration. It is suggested to enhance this integrative component to promote students' cognitive advancement.

• An assessor may indicate where a student's answer was inconsistent with the answer model for a specific element in the report, but is unlikely to provide more examples or details of what a perfect answer should have looked like, due to a lack of expertise in certain domains. More elaborate answer models, or adjustment of some of the assignments can help avoid that assessors evade

student's questions about their assessment.

- Some lecturers/assessors feel ill-equipped to establish meaningful assessments across multiple disciplines, due to the limited quality of the answer models or a lack of expertise in certain fields. It is imperative that answer models are improved and more clearly indicate what type of answer should be graded "insufficient", "sufficient", or "good". A rubric can be used to support the assessments.

- To improve the quality of feedback by assessors, during and after the course, a meeting can be organized to present and discuss good and bad practices. Also, the rationale behind multidisciplinary assessment and the process and steps of assessment can be explained.

- The written assignment holds for 70% of the score. In addition, at two stages during the project, students need to prepare and make an oral presentation, and participate in a peer group-review, where their own view(s) are subjected to constructive peer group criticism. The assessor judges students' efforts in the peer reviewed sessions.

- There are many ways in which peer review can contribute to the value of the course. Effective peer review can contribute to learning, for example when it is used as formative assessment. It seems worthwhile to evaluate the impact of peer review on student capabilities.

- Our study showed challenges in accomplishing homogeneity and reliability. Multiple assessors or assessment by experts in certain domains can be considered to not only prevent inflation of grades, but also to improve the quality of assessments.

- Assessors also indicated to have too little time to assess the final reports, thus being unable to fulfill responsibilities. In addition, the high workload (balancing teaching activity with the high demands on research activity) leaves the assessors feeling subject to conflicting demands. It is strongly advised to provide assessors with more time in their schedules to supervise and assess Quick Scan students.