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Design Students Perspectives on Assessment Rubric in Studio-Based Learning

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Abstract

This study examined students' perspectives on the use of assessment criteria and rubrics in graphic design studio at Kwame Nkrumah University of Science and Technology, Ghana. This assessment strategy was introduced with the desire to improve students' participation and involvement in studio-based learning programme. At the end of the semester, a questionnaire was used to gather responses from a sample of 108 students about their opinions on the use of assessment rubric. Analyses of the data collected demonstrate that students were generally positive about the use of rubric in the peer assessment process. Descriptive statistics showed that 86% of the students agreed that assessment criteria helped them in their learning; they found the peer assessment process as a valuable learning experience and 46% contended that they needed training in the use of assessment rubric. The results further suggest 89% of the respondents agreed that the use of assessment rubric enabled them to socially interact. The conclusion drawn from the evidence is that using assessment rubric directed learning activities and can have positive implications for the learning experience in studio-based learning.

Keywords

Assessment, assessment rubric, studio-based learning, graphic design

Cover Page Footnote

Acknowledgements Our sincere thanks to the second year students for their wholehearted engagement and their willingness to share with us their insights into the process and their learning.

Introduction

Assessment is of prime importance to education and student learning (Taylor 2006, Brown 2004, Koshy 2008). As Davies and Mahieu (2003) note, its cardinal function in the school system is to support learning. It is argued by many researchers that students put a premium on assessment, since it defines what they regard as important in their education and how they spend their time both in and afterwards as graduates (Ehmann 2005, Quinlan et al. 2007, Koshy 2008, Bain, 2010).

Undeniably, some have challenged assessment in the creative arts. Williams et al. (2010) comment on unreliable assessment of creativity; Leiva (2009) and Baptiste (2007) discuss subjectivity and non-transparency; Eshun and de Graft-Johnson (2011) challenge unplanned assessment of creative outputs; Ross & Mitchell (1993) contest the measuring of creative process, while Clary et al. (2011) point out the inconsistency in evaluating creative outcomes. The discussions on a range of assessment issues also relate to assessment in art and design disciplines. These studies show the importance of assessment in educating learners as well as the importance of some assessment techniques for art and design teachers in higher education.

This case study employed a learner-centered assessment approach involving student-led graphic-design activities for the International Social Poster Design Project. The project was undertaken by second-year Communication Design students at the Kwame Nkrumah University of Science & Technology in Ghana. In this follow-up survey, the researchers systematically grouped the students to create equitable teams for a project-based learning assignment. The students were introduced for the first time to the use of assessment rubrics in assessing graphic-design products and providing feedback in studio critiques. The aims of this study were to involve students in assessment and to investigate students' reactions to assessment rubrics and the peer-assessment process in the graphic-design studio.

Literature

Assessment Rubrics

Assessment rubrics are regarded as a descriptive scoring instructional tool (Moskal 2000, Oakleaf 2009, Egodawatte 2010) and an effective and versatile assessment tool for knowledge acquisition and the development of professional skills (Mertler 2001). Rubrics form the foundation on which teachers make academic judgements about students' performances and measure students' achievements and progress (Egodawatte 2010, Reynolds-Keefe 2010). Their use is becoming a growing trend in education due to their positive impact on teaching and learning (Andrade 2000, Dornisch & McLoughlin 2006). Rubrics make explicit to students how well the learning outcomes have been achieved. They are therefore applied at different qualitative levels of achievement (Andrade 2000, Jackson & Larkin 2002, Davies 2000, Elizondo-Montemayor 2004, Andrade & Du 2005, Pinto & Santos 2006, Kruger 2007). Kruger asserts that clustered or simplified rubrics could ensure consistency without repetition of the same standards, and considerably reduce the administrative load of assessment, thereby ensuring its promotion and use in learning. Furthermore, Andrade and Kruger admit the usefulness of rubrics in blurring the division between teaching and assessment, contributing significantly to both teaching and learning in classrooms. Andrade further states that rubrics make assessment of students' works quick and efficient, especially in large classes.

Egodawatte (2010) notes that "rubrics can help teachers analyze and describe students' responses to complex tasks and determine students' levels of proficiency. In addition, rubrics give students

more specific criteria detailing what is expected and what constitutes a complete response". Çikis and Çila (2009, p2016) opine that "agreed assessment criteria or objectives can be helpful to overcome arbitrariness, inconsistency, or subjectivity during the assessment process". This becomes useful especially when applied in the studio critique. Eshun (2011) reckons that a well-constructed, criterion-based assessment approach allows assessment to play a lead role in the learning process. Gasaymeh (2011) summarises the importance of rubrics by stating that "[a] well designed rubric can be used for the purpose of instruction, motivation, and evaluation in constructivist learning environment".

Involving Students in Rubric Development

According to Rust (2002), students appreciate an effective and usable rubric that is explicit and built from well-defined assessment criteria. Hudson (2005) recommends that assessment criteria should be based on specific indicators associated with intended learning outcomes, since the criteria become a referent for both the teacher and students, as noted by Pinto and Santos (2006). Consequently, Rudner and Schafer (2002) and Stix (1997) note that students' participation in developing the criteria and rubrics would motivate them and acknowledge their actions. Moskal (2003) adds that the overall benefits to students who are involved in developing a rubric include clarity about what skills they need to master, greater confidence in their abilities and more tenacity in solving problems themselves. Therefore, it has been recommended that a new partnership in the classroom/studio is required, where both the teacher and students contribute towards aligning the outcomes, pedagogy and measurement methods (Banta et al. 2009).

Effective Use of Rubrics in Assessing Creative Product

Rohrbach (2010) notes that many design educators now use rubrics in their evaluation process. Dornisch and McLoughlin (2006) suggest that a credible, effective and implementable rubric is capable of reducing two major concerns associated with assessing creative products/performance: over-subjective and/or inconsistent evaluation, leading to unfairness to students; and the unreasonable time involved in giving feedback to or grading students. Ehmann (2005) advocates embedding the use of criteria and rubrics in design-studio practices to enhance students' learning. Elizondo-Montemayor (2004) concurs, and strongly believes that assessment standardisation during work-in-progress was helpful because teachers and students would know exactly the expected outcome from each.

Critique of Assessment Rubrics

Despite the potential benefits of the adoption of assessment rubrics, their use has not escaped strong criticism. For instance, Sivan (2002) and Pinto and Santos (2006) argue that the exclusive use of assessment rubrics may not achieve effective learning outcomes. They point out that simply following the assessment rubric during assessment does not enhance students' learning experience. They further argue that there is the need to move beyond basic usage to a more innovative approach that guarantees students the experience of ownership. Egodawatte (2010) agrees, contending that training and guidance on the use of rubrics will help reduce the discrepancies, and intrinsically motivate students to use them for learning. Along similar lines, Gullo (2005) argues that an assessment rubric may lack reliability and validity, potentially being too general and difficult to use effectively. He further acknowledges that when too much focus is put on the number of criteria, rather than on actual indicators of the quality of the student's work, it fails to facilitate successful learning and performance.

Exclusive use of assessment rubrics has also been found by Mertler (2001) to be characterised by the challenge of converting rubric scores to grades to meet assessment needs. Mertler contends that simply mapping the scores to letter-grades is not appropriate; rather, the conversion should be by “process of logic”. Moskal and Leyden (2000) recommend careful planning in the construction and implementation of assessment rubrics, given the challenges associated with their reliability and validity as a scoring scheme. Dornisch and McLoughlin argue that the continual updating and maintenance associated with the use of rubrics can be very time-consuming. Rohrbach (2010) further reports on some design educators’ and students’ lack of enthusiasm for the use of rubrics in assessment. While students appreciate the clarity rubrics offer, they prefer feedback that is personal and poses questions, even though this is less informative.

Anderson and Mohrweis (2008) assert that discussing the rubric with students before the commencement of any new design project provides the ground rules that support, and remind students of, the expectations for the particular dimensions of their creative product. The over-reliance on the criteria is likely to be a setback in the assessment process, because of the inherent intolerance to anything outside the criteria. Cronjé (2009) warns against the use and abuse of structure and standardisation when using rubrics in assessment, especially when there are indications that assessment may be reduced to an almost mechanical checking of items on the list.

Notwithstanding, teachers are determined to implement innovative assessment. Egodawatte (2010) found that

[u]sing an analytic scoring rubric is a more time-consuming task since the rater has to look for and separately rate each component of a performance. This level of detail is useful when the focus is on diagnosis or helping students to understand the expectations for each part of the performance. This may be especially useful for helping students to learn even though it is time-consuming (p78).

Limitations of Assessment Rubrics

Some limitations of assessment rubrics relate to the lack of agreement on what a good assessment rubric is, and the resistance to change amongst academic staff (Haugnes & Russell 2008). The somewhat contradictory conclusion reached by the different studies on assessment rubrics can be partly explained by the type of assessment rubric practice examined, students’ learning styles and educational background and the nature of the academic discipline within which the assessment rubric is being applied. These factors may affect the adoption and effectiveness of assessment rubrics in any design-studio context.

Despite the mixed evidence on the perceived effectiveness of assessment rubrics, there is a growing consensus among contemporary assessment scholars (Boud & Associates 2010) that to address some of the limitations associated with the exclusive use of rubric, there is a need to adopt a more innovative approach to learning.

Neglect of Students' Perceptions of Assessment Rubrics

Whilst existing research on assessment rubrics has undoubtedly increased understanding and appreciation of authentic assessment, a common concern is that mainstream studies in this area have focused largely on the adoption of authentic assessment and the challenges of its implementation in higher education (Boud & Associates 2010). As a result, the students' perceptions of assessment rubrics, particularly in project-based learning, are a relatively neglected and less-understood area of inquiry (Howell 2011). The few existing studies of assessment rubrics that have explored the students' perceptions have found that the perceptions of assessment rubrics are not influenced by gender. Howell, for instance, found that gender did not affect the attitude of students towards the use of rubrics in assessment.

The generalisability of these findings to specific studio learning platforms has not been clearly established. Perhaps not surprisingly, there has been a growing call from art and design educators and scholars for studies that explore students' perceptions of assessment rubrics, to enable instructors to develop a better understanding of students' experience, and thus to augment their satisfaction and performance (Ellmers 2006). This study aims at responding to this call by systematically examining students' perceptions of and engagement with an assessment rubric tool in peer assessment. Three research questions guided the data collection:

- What are students' opinions about the impact of assessment criteria in a graphic-design course?
- What are students' opinions about the use of rubrics as an assessment tool for a graphic-design studio project?
- How do students use the criteria to complete the graphic-design task?

Empirical exploration of these issues will deepen our understanding of students' perceptions of the use of assessment rubrics and optimise the design of modules that can enhance students' learning experience and performance. The use of assessment rubrics that forms the context of this study is a standard system that contains very similar components to the more general alternative-assessment platform used by most universities. This has potential to enhance the generalisability of the findings beyond the specifics of this particular study.

Method

Subjects

The participants were full-time, second-year undergraduate Communication Design students at the Kwame Nkrumah University Science and Technology in Ghana. The students were registered for DAD 251 Graphic Design I and DAD 252 Graphic Design II courses respectively during the 2010/11 academic year. One hundred forty students out of a total population of 546 (student population within the Department as of 2010) were sampled for the study. Sixty-two were female (mean age: 31.5, SD: 8.7, range: 19–46) and 78 were male (mean age: 22.3, SD: 3.5, range: 19–26). All participants who volunteered to respond to the questionnaire were given the newly developed and revised Student Opinion Questionnaire (SOQ), which was self-administered.

Graphic-Design Course

The DAD 251 Graphic Design I course included graphics, technical communications, problem solving, the design process, data collection and data analysis. This course consisted of basic skills

and hands-on studio segments. The DAD 252 Graphic Design II course also consisted of basic studio skills, but included a graphic-design component to engage students in a communication-design project. Both courses also consisted of sketching, design exercises and portfolio assignments. Participants in the current study were coded and given numbers for identification purposes according to procedures approved by the Institutional Review Board.

DAD 251 consisted of a 28-week mandatory module that ran throughout the full academic year. The module had four pieces of formative assessment (per semester), and was assessed by a combination of coursework (60%) and end-of-semester examination (40%). The module was delivered through a four-hour, weekly studio/lecture. Most of the materials used in the module were presented in lectures, including lecture materials for each topic, design briefs and relevant internet and library resources. A combination of innovative teaching and a pragmatic approach was adopted. The students were fully involved in the determination of assessment criteria and the establishment of the rubric used in the peer assessment. Students were continually reminded and encouraged during theory sessions to make use of assessment criteria/rubrics to enhance their learning.

Questionnaire

To address the aims of this study, a self-report questionnaire survey with a five-point Likert scale was used to investigate the selected design students' perceptions on the use of assessment rubrics. The Likert scale involved the following: strongly disagree (1), disagree (2), neutral (3), agree (4) and strongly agree (5). The questionnaire was semi-structured and had 17 items. It was divided into four different categories, each starting with a number of multiple-choice questions. This was done to increase the reply frequency, allowing less motivated students to answer the questionnaire quickly using the multiple choice questions. The questionnaire aimed to determine how important students considered the assessment criteria and rubric for their graphic-design studio work. The factors were: use of the assessment criteria, use of the rubric in the graphic-design studio and difficulty in the use of assessment criteria in the practical realisation of the task. The questionnaire requested participants' demographic information (age, gender, academic level) and detailed consideration how often they used the assessment rubric. Precise instructions were given to help respondents complete the questionnaires accurately. The results for each factor are discussed in the results section.

The data were analysed using the Statistical Package for Social Science (SPSS) 16.0 for Windows software. This involved calculation of frequency scores. The frequency scores were most valuable as a means of describing the research sample.

Reliability Levels

To calculate the reliability of survey items within the construct of respondents' agreement on the use of assessment rubrics, Cronbach's alpha levels were calculated across rubric items within the questionnaire. An overall Cronbach's Alpha reliability coefficient of .924 indicated high consistency of ratings across rubric items. Table 1 provides data from this study on the reliability and internal consistency of these instruments, as well as scale mean and standard deviation from the mean of each variable. Cronbach's Alpha scores for each variable exceeded .80

TABLE 1: Reliability and Internal Consistency of Variables

Scale Independent Variables	Cronbach's Alpha	Mean	Std. Dev.
Assessment criteria	.824	1.74	.876
Assessment rubric	.818	1.68	.823
Use of assessment rubric	.830	2.48	1.035

Completion Rate

Of the 140 students who completed the questionnaire, only 108 students completed usable questionnaires, representing a 77.14% response rate. Thirty-six percent (39) of the respondents were female; 64% (69) were male.

Results

Students' Opinions Regarding the Impact of Assessment Criteria in Learning

Table 2 shows that 86% of the respondents agreed that assessment criteria enhanced their learning experience. About 85% used peer-assessment to be proactively involved in learning during the course. Also, about 78% used the assessment rubric to understand the course material through multiple sources of learning; while 66% became independent learners through the use of peer assessment. Moreover, 65% used the assessment rubric to control the pace of their learning. However, the correlation is best considered as being descriptive rather than predictive. The study revealed that the use of criteria and rubrics for peer assessment had a remarkable positive impact on students' learning in the studio, and offered notable potential for equipping them for lifelong learning after school. The students in the study reported using the criteria to become independent learners, self-initiate work and regulate their learning. These findings corroborate many aspects of Andrade and Du's (2005) study examining such areas as academic self-regulation, goal-setting and planning; and Venable and Summit's (2003) findings that assessment criteria gave students the lead in learning.

Table 2: Analysis of Students' Opinions Regarding the Impact of Assessment Criteria in Learning

Items/Statements	SA/A (%)	N (%)	SD/D (%)	M	SD
Q1. I have used assessment criteria in enhancing my learning experience	86.11	8.33	5.56	1.74	.876
Q2. Assessment criteria helped me in getting proactively involved in learning the course	85.18	12.04	2.78	1.68	.823
Q3. Assessment criteria helped me to understand the course material through multiple sources of learning	78.30	16.98	4.72	1.98	.905
Q4. Assessment criteria helped me to become an independent learner by doing more work on my own	66.35	24.30	9.35	2.18	1.003
Q5. Assessment criteria helped me to control my pace of learning by going fast or slow	65.74	25.93	8.34	2.21	.973

N =108, SA/A: Strongly Agree/Agree, N: Neutral, SD/D: Strongly Disagree/Disagree

Students' Opinions Regarding the Use of Assessment Rubrics in Graphic Design

Table 3 shows that the majority of the students (about 90%) responded that they were more interactive as a result of using assessment rubric. Interestingly, 66% of the students indicated that they had no problem in operating the assessment rubric. Better still, only a minority (27%) indicated that they did not need training in peer assessment, in contrast to the majority 73% preferring prior training in peer assessment. Over half (58%) indicated that peer assessment was fully operational, supporting earlier responses that prior training would help solve many of the teething problems. Finally, 75% of the students agreed or strongly agreed that their learning process had seen improvement since the implementation of the assessment rubric. More than half (52%) indicated that there was adequate support for those who encountered any problem apart from technical problems. A sizeable percentage of neutral responses were recorded for Q10 and Q12. This may be due to students' apathy towards the introduction of new studio activities. Cronbach's coefficient was 0.831, again indicating very high reliability of survey items in measuring opinions of the rubric.

Table 3: Analysis of Students' Opinions Regarding the Use of the Assessment Rubric

Items/Statements	SA/A (%)	N (%)	SD/D (%)	M	SD
Q6. The assessment rubric helps explain the subject more clearly	76.64	14.95	8.41	1.98	.976
Q7. Students are more interactive as a result of using the assessment rubric	89.81	5.56	4.63	1.58	.930
Q8. I have no problem in operating the assessment rubric in the studio	66.66	24.07	9.26	2.20	.930
Q9. I do not need any training to teach me how to use the assessment rubric	27.10	28.97	43.93	3.22	1.155
Q10. I find the assessment rubric in full working order whenever I want to use it	58.34	31.48	10.19	2.31	.950
Q11. My learning process has improved since the implementation of the assessment rubric	75.93	16.67	7.41	2.04	.935
Q12. If there is something unclear with the rubric, support is immediately available	52.78	31.48	15.74	2.48	1.035

Students' Opinions Regarding the Difficulty Associated With the Use of the Assessment Rubric

Table 4 shows that almost 80% of students responded that they knew how to use the assessment rubric in the graphic-design studio. A little over 58% indicated that the assessment rubric helped them in preparing for the studio critique/lecture, as compared to one-third who were neutral. About 31% were silent on the question. About 76% of respondents admitted that the assessment rubric helped in explaining the subject more clearly, compared to fewer than one-tenth who completely disagreed with the statement. The majority (83%) mentioned that the assessment rubric helped them to stimulate their problem-solving skills through visual experiences, and that they had actually learnt from others by looking at their work. A sizeable proportion (86%) strongly agreed or agreed that the assessment rubric helped them to further develop and stimulate their

communication skills, as compared to fewer than 5% who disagreed. About 75% indicated that the assessment rubric made their learning more interesting. Overall, the results indicate that the students had a quite positive learning experience with, and attitude towards, the use of the assessment rubric. Cronbach's coefficient was .830, again indicating very high reliability of survey items in measuring opinions of the use of rubric. Our findings also validate the impact of the rubric for learning that was described by Andrade and Du (2005), who found that students overwhelmingly approved the use of a rubric in the graphic design studio and claimed it helped them to improve their practical skills, learning and understanding of the subject, and to prepare them adequately for lectures and studio work. In the current study, students' comments about the use of the rubric were positive. This is consistent with Andrade and Du's (2005) findings, where students knew "what's expected". Remarks by students in the current study about using the rubric to prepare for studio critique and lectures, improving their problem-solving skills, developing their communication skills and understanding the design concepts effectively are important findings that harmonise with Ehmann's (2005) findings.

Table 4: Analysis of Students' Opinions Regarding the Difficulty Associated With the Use of the Assessment Rubric

Items/Statements	SA/A (%)	N (%)	SD/D (%)	M	SD
Q13. I know how to use the assessment rubric available in my graphic-design studio.	79.44	16.82	3.74	2.05	.761
Q14. The assessment rubric helps me in preparing for the studio critique/lecture.	58.34	31.48	10.19	1.79	.902
Q15. The assessment rubric helps me to stimulate my problem-solving skills through visual experiences.	83.33	9.26	7.41	1.89	.919
Q16. The assessment rubric helps me to further develop and stimulate my communication skills.	87.03	9.26	3.70	1.69	.855
Q17. Students can understand and grasp the concepts more easily and effectively as a result of using the assessment rubric.	74.07	16.67	9.26	2.08	.967

N=108, SA/A: Strongly Agree/Agree, N: Neutral, SD/D: Strongly Disagree/Disagree

Qualitative Analysis of Students' Comments

This analysis was intended to provide more insight into students' perceptions of use of rubrics in assessing creative product and of the importance of peer assessment to quality design education. Approximately 20% of the students (20) in the focus group offered comments, but all were fairly brief. Most were complimentary, and only a few offered some information helpful to the purpose of this study. The latter expressed a desire for more direction from the instructors, and for a more sustained programme, especially given the ways in which they were expected to use the rubric in assessing various components of graphic design. These suggestions had benefits mainly as fact-finding and feedback to instructors on ways they could improve the assessment process.

Limitations of this Study

This study has a few limitations:

1. During the assessment process, not all the students fully appreciated and understood the meaning of the rubrics, though they were all taken through some basic training. This might lead to inaccurate assessment.
2. Due to the large class size and time and logistical constraints, we could only include teacher and peer assessment under "others". If we had expanded the process to include assessment from more people, such as other teachers, we could have had more-accurate feedback.
3. There was no formal follow-up plan to help students to move to a higher level of competency in rubric usage. As a result, students may not know how to improve on their rubric usage and peer-assessment competencies.

Discussion

Overall, the results indicate that the students have quite positive attitudes toward using assessment rubrics in peer assessment in the graphic-design studio. This supports the findings of Ballantyne et al. (2002) that students improve on their interpersonal and negotiation skills through peer assessment. This is consistent with the instructor's observation that the students who were engaged in the exercise exhibited more enthusiasm than other students. However, as observed from classroom activities and students' casual comments, some felt they were doing the instructor's job for him or that peers were incompetent when it came to assessment.

From the analysis of the questionnaires, this study has identified several conditions that are critical to the successful implementation of assessment rubrics in a graphic-design studio. Early introduction of the assessment rubric is vital for smooth implementation of peer assessment in higher education, since it will build students' competencies and confidence in using the assessment rubric. This project shows that if the rubric is introduced to first-year students, it stands a greater chance of succeeding; hence the process needs to be structured very carefully and implemented thoroughly to deepen students' appreciation for it (Ballantyne et al. 2002). Instructors should therefore incorporate practice sessions to familiarise students with the process of assessment. These sessions should include access to exemplars of good, average and poor work, along with feedback on students' performance as assessors.

The introduction of instructor moderation will be a valuable addition to the development of the rubric. This will address students' concerns relating to the perceived "skewness" of the criteria to their benefit, and their lack of enthusiasm in participating in the development of an effective rubric that aligns with the curriculum, learning outcomes and assessment of the learning process. It will consequently enable instructors to monitor the nature and quality of students' learning processes and outcomes. Touching on reliability and validity of the use of the rubric, the students unanimously agreed that prior training is very crucial to the successful use of the rubric. This lends credence to Lovorn and Rezaei's (2011) claims that training sessions had a significant positive impact on raters' ability to implement a rubric. In addition, students should be prevailed upon to understand the significance of adopting a reflective, not a judgemental, approach to the use of the rubric. Otherwise, they might simply, and inappropriately, focus on ticking boxes, without seeing how they can improve on their own work based on what they see in the work of their peers.

Finally, the extent of the use of rubrics in peer assessment needs to be carefully controlled across an academic programme in graphic design.

This experience astonished us for a number of reasons. Positive outcomes included the finding that when the students were confronted with the reality of participating in the assessment process, they understood better than we expected. Other quite positive aspects were the wealth and multiplicity of the defined criteria, the care in the accomplishment of the design task and the sense of responsibility of involving students in their own assessment. Despite the fact that when the study was conducted the students lacked the skills to use the rubric in peer assessment, the result was very satisfactory. Therefore, it will be an interesting project to track the attitudes of this group of students as they progress to higher levels. While the size of the population and duration of this study was modest in educational-research terms, it does provide some pioneer experience in graphic design in higher education for instructors intending to attempt an authentic approach in assessment.

Conclusion

The action-research process used in this study has facilitated the development of procedures for the implementation of an assessment rubric in a large class in a design studio. It is clear that there are specific difficulties associated with running peer assessment using an assessment rubric in large classes. Overall, however, this study suggests that the benefits in relation to student learning outweigh the challenges of administrative and staff commitment when using an assessment rubric for peer assessment in large groups. It can be concluded that, given suitable training and facilities, graphic-design educators concerned about enhancing tertiary teaching and learning can benefit from an awareness of rubrics and how they can be effectively used in assessing and improving students' skills in studio critique, oral communication, technology and problem solving.

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