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Towards an Integrated Assessment Framework: Using Activity Theory to Understand, Evaluate, and Enhance Programmatic Assessment in Integrated Content and Language Learning

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Abstract

This article uses activity theory to analyse two different portfolio approaches as tools for programmatic assessment of Integrated Content and Language (ICL) programs. The two approaches include a) a model in which students construct portfolios by selecting artifacts from a range of different contexts and provide reflective commentary, and b) a model in which the portfolio consists of major textual artifacts produced across a design project, with no reflective component. Activity theory provides a tool to explore what these models can offer in terms of an assessment of the integration of content and language in disciplinary contexts, where texts serve to mediate the ongoing work of a discipline. By highlighting the work that texts do in context as well as the access to student meta-knowledge afforded by each portfolio, activity theory provides a means to understand the strengths and limitations of both models. Perhaps most importantly, it points to the need for portfolios to include well-designed reflections that can support both student learning and effective programmatic assessment.

Introduction

In their introduction to the special issue of *Across the Disciplines* (ATD) on integrated content and language learning (ICL), Gustafsson *et al.* (2011) highlight the diverse contexts in which ICL occurs. Practiced under various names in Europe, South Africa, the U.S., and elsewhere, ICL is a broad umbrella. The 'L' may refer to vocabulary, grammar, and syntax for non-native speakers as well as disciplinary literacy practices, discourse practices, or genre knowledge; it can encompass writing, presentations, and/or digital media. In this article, I generally use more precise terms where appropriate, and 'language' when referring to the full breadth of ICL foci. The 'C' is equally varied; the ATD issue, for example, examined ICL in mechanical engineering, social work, physics, medical school, economics, and psychology (Gustafsson 2011). ICL includes sites with one instructor and with multiple instructors in partnership, as well as courses whose outcomes lean heavily toward language and those that lean heavily toward content. Within this kaleidoscope of contexts, questions of assessment are equally complex. How can we evaluate the success of ICL efforts? What assessments will support continuous improvement of ICL work? How can programmatic assessment and student assessment interact to support learning? In light of the diversity of ICL approaches, such questions have no universal answers; work on writing assessment, for example, consistently emphasizes the need for localized approaches tuned to the context at hand (Paretti and Powell 2009a). We can, however, identify productive frameworks in which to develop localized approaches. Here I offer one such framework, using activity theory to consider the interplay between language and content, and apply it to programmatic assessment of ICL, using a case study in engineering to illustrate its implications. In adopting this programmatic perspective, though, I also probe the relationship between programmatic and student concerns to highlight ways that programmatic assessment methods help or hinder student learning.

Framing ICL: Academic Literacies, Rhetorical Genre Studies, and Activity Theory

The dominant theoretical frameworks for ICL emerge from a socio-constructivist perspective in which literacy and discourse practices construct and are constructed by disciplinary work (Gustafsson *et al.* 2011). Academic literacy (AL) provides a central framework for ICL, particularly in European and South African contexts. This framework, emerging out of New Literacy Studies, positions literacy practices at the center of questions about disciplinary epistemology and identity, attends to differences across disciplines, and addresses issues of power as personal and institutional identities collide (Lea and Street 1998). Learning the literacy practices of a discipline involves not simply mastering the mechanics of language (e.g. vocabulary, syntax), but also understanding the social practices of the discipline, including what constitutes knowledge, how it is created, and how meaning is socially constructed.

AL has also influenced writing programs in the U.S., often in conjunction with rhetorical genre theory studies (RGS). RGS stems from Carolyn Miller's 1984 article, 'Genre As Social Action,' which argues that genre is not merely a set of formal features, but rather a rhetorical response to recurrent social contexts (Miller 1984). RGS treats genre structures as rhetorical constructs that shape and are shaped by social interactions and exigencies; it has been used by a number of scholars to explore ICL contexts (Artemeva 2007, 2008, Artemeva *et al.* 1999, Berkenkotter and Huckin 1995, Carter *et al.* 2007 and Walker 1999). RGS-based pedagogies focus on helping students understand not only the common genres of their field, but also the uses of those genres, the nuances of their social meaning, and their role in the construction of disciplinary knowledge (Artemeva 2007, 2008, Artemeva *et al.* 1999, Bawarshi and Reiff 2011, Johnson Sheehan 1999, Keys 1999 and Walker 1999).[1]

Together, these frameworks point to several critical outcomes relevant to the language component of ICL, including an understanding of the epistemological frameworks used to construct knowledge, make truth claims, and evaluate evidence, as well as the common forms such knowledge-building takes and the ways in which those forms are actively used, received, and renegotiated within a community. Consequently, they offer rich insights into assessing the development of disciplinary communication practices (see, for example, discussions in Adler-Kassner and O'Neill 2010 and Paretti and Powell 2009b). They suggest fewer explicit outcomes, however, that address the content component of the partnership and its integration with the language domain. In this paper, I focus on that integration to better understand not how we assess language practices, but how we might assess the integration of language and content.

To do so, I use as a case study an ICL program in engineering in which predominantly native-English speakers are developing both technical and professional fluency. "Content" refers to technical expertise in materials science and engineering. The field focuses on the relationship between micro- (and even nano-scale) characteristics of materials (e.g. pore size, grain size, crystal structure, chemical bonds) and both the processing conditions that yield specific characteristics and the macro-level material properties (e.g. mechanical strength, ductility, corrosion resistance) that result from those characteristics. Students learn techniques for processing materials and characterizing material properties, approaches to analyzing and interpreting characterization results, relationships among chemical and physical processes

[1] For a fuller treatment of RGS, see Artemeva and Freedman (2008).

and material characteristics, properties and behavior of different classes of materials, and related concepts. Within this context, texts play a variety of roles, from experimental work plans, to laboratory notebooks documenting data collection, to presentations describing the results. Students must justify experimental decisions based on expertise (i.e. what will yield meaningful information) as well as on considerations such as cost and time. They must be able to present results for other experts, but also interpret them in ways that support decision-making by non-experts. Language – words, but also images, data tables, graphs, and other visual forms – consistently embodies both rhetorical arguments and disciplinary expertise.

In partnerships such as this one, where content and language are interwoven, how do we develop programmatic assessments that address the integration of content and language? More broadly, how can assessment frameworks not only support the myriad of both ICL contexts and learning goals? Activity theory, I suggest, provides one productive lens for exploring these questions because it privileges neither content nor language, but instead considers the interplay between the two. First described in the work of Vygostky and Leont'ev in the 1930s (e.g., Vygotsky 1978) and more recently expanded by Engeström and his colleagues (e.g., Engeström and Middleton 1998 and Engeström *et al.* 1999), the theory takes as its unit of analysis the entire system associated with a given activity, including the object(ive) or problem that gives the activity its direction, the subjects that engage in actions associated with the object, the artifacts (e.g. texts as well as tools, signs, machines) that mediate the activity, and the final outcome. Engeström expanded the basic triangle (a subject interacting with an object, mediated by artifacts) to include the larger context circumscribed by the rules that govern the system, the communities in which the subjects operate, and the division of labor that shapes interactions (Engeström 1987, 1998).

Because of its focus on the entire activity and the interaction of system elements (Nardi 1992), activity theory has been used widely to analyze work in multiple contexts, including learning and cognition (Engeström 1987), design of situative learning environments (Hung and Wong 2000 and Jonassen and Rohrer-Murphy 1999), and design of technology (Nardi 1992). It is useful across these contexts because it considers both the system as a whole and individuals as intentional, conscious actors within the system. As Nardi explains, activity theory positions context not as an external space in which people and objects operate, but rather as something dynamically 'constituted through the enactment of an activity involving people and artifacts' (1992: 38), and it emphasizes individuals as sentient beings separate from and conscious of tools and tool use.

Championed in writing studies in the U.S. by scholars such as David Russell as a complement to RGS (1997), activity theory has been used to analyze disciplinary communication practices in academic and workplace contexts (Bazerman 1997, Dannels 2003, Dias 2000, Kain and Wardle 2005, McNair and Paretti 2010, Paretti 2008 and Spinuzzi 1996). In particular, it has been used to understand the difficulties students encounter in moving from school, where the goal is learning and the teacher is the primary audience (even when simulating workplace experiences) to work, where goals are linked to the work of the field and audiences are not evaluators but users of texts (Dannels 2003, Paretti 2008, Räisänen 1999, 2004 and Spinuzzi 1996). Because activity theory takes into account both textual dynamics and content knowledge operating within the disciplinary work, it provides a way to understand how content and language are integrated in the professional domain, and thus to analyze ICL approaches to assessment. In this framework, students are the subjects operating within their professional field, on an object appropriate to that field, in which texts are one among several mediating artifacts used to achieve the goal.

Some work on activity theory and assessment is already underway. For example, Räisänen (2006) used activity theory to reposition formative assessment in the ICL classroom, demonstrating how such assessment can serve as a critical mediating artifact for student learning. Her analysis shifts the dynamics between teachers and students and moves assessment from a post-hoc evaluation to a meaningful tool to support student development. Just as Räisänen's analysis illuminates student work as both an outcome subject to summative assessment and a learning tool supported by formative assessment, I consider texts produced in the ICL classroom as, alternately, the mediating artifacts and the outcome of the system (Figure 1).

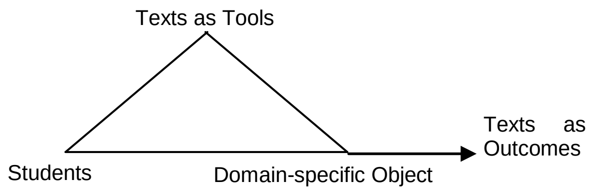

Figure 1. A Simplified ICL Activity System Illustrating Two Roles Texts Play

Importantly, these positions are not exclusive; texts can both mediate an activity and serve as an outcome. For example, in the context of the kind of formative assessment Räisänen describes, a group laboratory report may evolve through several drafts; the process of writing the report may help the team more fully think through their data analysis, and feedback from faculty and peers may help further sharpen the team's interpretation of their findings. As such, the report served to mediate the activity of collecting and analyzing engineering data to draw a conclusion. At the same time, the final version of the report may represent the primary outcome, presenting and arguing for the validity and meaning of the experimental findings.

In school, this duality is common; student texts, intentionally or not, often mediate their engineering work – for example, when they scope work to meet reporting requirements or when they gain understanding as they draft and revise documents and presentations. But these same texts are almost always also the product graded by the ICL faculty; they are the final measure of learning, but, except in cases of industry-sponsored projects, they rarely mediate real technical decision-making. In workplaces, however, texts are rarely the primary outcome; they are a means to an end. In the case of materials engineers, for example, a workplace object might be to determine processing parameters that will improve the wear-resistance of a given metal; the outcome is implementation of the new parameter set. Reports produced by the engineers serve as tools to convey the selected parameter set and convince supervisors to implement it; while working engineers might be evaluated overall on their ability to communicate as well as on the effectiveness of their work, individual reports are typically not 'graded' as isolated exercises structured to measure technical or professional competences.

This bifurcation between school and work, described in more detail by the research cited earlier, raises a significant challenge for programmatic ICL assessment – a challenge explored, but not necessarily resolved, in this paper. Specifically, activity theory suggests that it is difficult to assess texts apart from the activities they are intended to mediate. As a result, the degree to which students master surface features – including not only grammatical, syntactic, or mechanical structures but also regularized disciplinary genres, rhetorical patterns, modes of argument, and evidence structures – does not provide a full picture of the degree to which students can use textual artifacts appropriately in context to mediate work. Yet those concerned with assessing the effectiveness of ICL programs often have access only to the texts in isolation, with all of their features but without the lived context of use.

I am not arguing here that assessment focused on such features is irrelevant to ICL work; facility with a tool is necessary to effectively use it. Measures of such facility, whether considered as capacity for a non-native language or engagement in disciplinary literacy practices, provide an indicator of student learning and can be used for programmatic assessment. Such assessment is important in environments where students are working in a second or third language to demonstrate linguistic development, but it is equally important in AL and RGS approaches where mastery of literacy practices and disciplinary genres serves as a marker of professional identity. Effective rubrics to address such outcomes abound, exemplified by the VALUE rubric for written communication developed by the American Association of Colleges and Schools; the rubric addresses the purpose and context of writing, content, genre structure; uses of evidence; and grammar and mechanics, and provides descriptors for benchmark, milestone, and capstone practices in each category. ('The VALUE Project Overview' 2009). It and similar rubrics highlight mastery of discourse practices in ways that account for disciplinary conventions and expectations. Rubrics developed for individual fields or disciplines account for these conventions and expectations even more effectively because they identify patterns and structures specific to the field. ICL faculty can work in partnership to understand how different genres mediate disciplinary work and then develop rubrics to evaluate students' mastery of those genres (e.g. Thaiss and Zawacki 2006).

But from an activity theory perspective, the challenge remains: such rubrics do not account for the lived effectiveness of texts in mediating disciplinary work or for students' ability to adapt their language use to mediate work in different contexts. If texts mediate disciplinary work, genre and discourse mastery alone are not sufficient for programmatic ICL assessment; such assessments must consider the artifact in its context of use. Thus just as analysis of ICL pedagogies emphasize the *integration* of content and language experts in interdisciplinary partnerships (Airey 2011, Gustafsson *et al.* 2011, Harran 2011, Jacobs 2007, 2010 and Paretti 2011), activity theory reminds us that ICL assessment should also consider both disciplinary content and the work of the discipline itself.

Activity Theory and ICL Assessment: Portfolio Approaches

Treating texts as mediating artifacts within disciplinary activity systems lends itself to portfolio-based assessment because portfolios have the potential to present a more complex, complete version of the activity and its embodiment in language. They have seen wide use across professional fields as a way for students to demonstrate competence with a given domain such as nursing (Ramey and Hay 2003), teaching (Antonek *et al.* 1997, Beck *et al.* 2005), and engineering (Alha 2004, Bai and Pigott 2004, Gunn *et al.* 1997 and Turns and Lappenbusch 2006). They also have a relatively long history in U.S. writing assessment: they first gained prominence in the 1990s, where they were adopted by first-year writing programs, and have been used and theorized widely in writing studies research (Brinkman and van der Geest 2003, Driskill 2000, Peters and Robertson 2007, Scott and Plumb 1999, Williams 2002 and Yancey 1993, 1996, 2004). They have also gained visibility in European contexts as a result of the European Language Portfolio (Little 2002, 2005).

The value of portfolios for assessment is two-fold. First, they provide a means to assess a broader range of student work either across a single activity (i.e. multiple texts from one project) or across multiple activities within a domain (e.g. texts from different projects). Writing portfolios, for example, can showcase multiple genres, audiences, and writing purposes. Teaching portfolios can showcase lesson plans, assignments, courses, responses to student work, and teaching philosophies. Engineering portfolios can showcase technical skills in research, design, analysis, and modeling as well as professional skills such as teamwork and communication. Second, portfolios often include reflections and self-assessments designed to position and critique the portfolio artifacts. These reflective components vary widely across uses, but they can allow students to describe the work they have done and the skills they have gained, as well as the processes by which the artifacts were developed. Writing portfolios, for example, can ask students to explain the development of each text from draft through final copy, articulate ways audience and purpose shaped the document, and evaluate the current version for strengths and weaknesses. These reflections help evaluators assess metacognitive learning because they identify the degree to which students are cognizant of their choices and thus potentially able to transfer the skills represented in the portfolio from one context to the next. The importance of metacognition for both deep learning and transfer is widely established in educational research (Bransford *et al.* 2000) as well as in writing development in particular (Boiarsky 2004, Ford 2004 and Jarratt *et al.* 2009). Apart from ethnographic observation of an activity in progress over time (which is too labor intensive to provide a sustainable approach to assessment), reflections can be an effective means of illustrating the ways students see (or don't see) texts mediating disciplinary work. Where the texts within the portfolio may demonstrate students' technical knowledge and/or mastery of disciplinary genres and arguments, well-designed reflections can demonstrate their understanding of the integration of the two.

Portfolio assessment holds significant promise for programmatic ICL assessment. However, that promise is not without pitfalls, and activity theory illuminates both. To that end, I consider two examples of portfolio use in an ICL program in a Materials Science and Engineering (MSE) department. The Engineering Communication Program (ECP) focuses on acquisition of discipline-specific discourse in students' native language (English), drawing largely on rhetorical genre studies. The program includes two professional development courses that focus on communication, teamwork, and globalization in the context of the discipline, along with communication assignments in three upper-level technical courses and the year-long capstone project. ECP staff work closely with the MSE technical faculty to create assignments that support ICL. The portfolios described here represent divergent approaches to programmatic assessment (Paretti and Burgoyne 2009). Neither is offered as a model; instead, their limitations as well as their potential help identify challenges to ICL assessment and suggest paths forward.

Case 1: Activity system outcomes – from communications to professional portfolios

The first case explores two versions of a portfolio constructed by students in a standalone course at the beginning of their final year. For Case 1a, the communication portfolio, students submitted reports and presentations from ICL courses, along with a reflection that analyzed their communication expertise holistically and usability reports for each artifact that identified the audience and purpose and evaluated the success of each artifact (see Appendix 1). In each ICL course, students received formative assessment on assignment drafts and summative assessments for each assignment using rubrics that addressed both content and language. For programmatic assessment, a purposive sample of portfolios (based on grade distribution) was scored by an external team of communication faculty from other departments against the ECP outcomes, all of which focused on language. The evaluation team used rubrics to score portfolios based on the communication competencies displayed in the text; e.g. coherence, facility with multiple audiences and genres, use of visuals, use of headings, clarity of PowerPoint® slides. The results were used to inform curriculum revisions and to provide documentation of student outcomes for accreditation.

Although the portfolio served an important purpose in assessing the communication component of the program, the model is limited in several ways. First, the programmatic scoring rubrics, the reflections, and the portfolio structure offer no connection to the technical content component of the ICL partnership. Although the activity systems from which the portfolio artifacts were drawn were discipline-specific and the texts represented students' technical as well as communication expertise, the programmatic assessment provided useful information about the effectiveness of the language component of the program, but very little information about content mastery or the effectiveness of the content/language integration. However, because the artifacts were all technical in nature, an assessment team of domain experts could evaluate students' content mastery and domain competence; even in such cases, though, the reflections and usability reports, because they focused explicitly on communication, would yield little insight into how students understood their technical work. Expanding the scope of the reflections and usability reports to directly engage technical as well as language issues could provide such insights, but such expansions would require careful attention to the available space for such work in the course (i.e. to students' time investment relative to the weight of these assignments).

Second, the texts in the portfolio were typically artificial – they simulated domain activities, but did not represent authentic information exchange and mediation of disciplinary work. Most were post-facto 'write-ups' of technical work submitted to faculty for grading (e.g. laboratory reports, business proposals, journal articles). In almost every case, the artifacts were representations of students' final work, and rarely represented the kind of new knowledge generated in the workplace; they were, in short, the outcomes of school-based activity systems where the object was to learn. And as suggested earlier, the learning that can be assessed in this way generally focuses on identifiable features (grammar, mechanics, argument, genre) rather than authentic participation real work. That is, because no engineering-related action depends on the texts, we cannot measure the effectiveness of the texts in mediating such action.

Third, the portfolio held limited value for students because of its communication orientation. MSE students seek to become engineers, not technical writers, and a portfolio focused on communication showcases only one dimension of their expertise. By focusing on their development as communicators, not as engineers, the process inadvertently separated content and language. The usability reports mitigated this separation slightly because they were designed to provide insight into students' understanding of the role of texts within disciplinary activity systems. They were helpful in evaluating students' ability to adapt texts to different audiences and to understand audience goals. However, without a more detailed understanding of the pertinent activity system, evaluators had limited ability to assess or evaluate the ways the texts mediated and integrated with content. As language rather than content experts, they could use the usability reports to judge the degree to which students were conscious of adapting writing to audience, but not the appropriateness of the adaptation or the effectiveness of the literacy practices.

To address some of these limitations, the ECP staff transformed the communication portfolio into a professional portfolio (Case 1b). Students began by evaluating their engineering expertise using accreditation criteria (ABET Engineering Accreditation Commission 2007) and the behaviors expected of new engineers (Davis *et al.* 2005 and National Academy of Engineering 2004). Drawing on this self-evaluation as well as their own career goals, they constructed a portfolio that includes a résumé, a professional statement, a series of textual artifacts that demonstrate their engineering skills, and a short commentary on each artifact that explained its context and the skills it demonstrated. Artifacts could be drawn from any source, including ECP assignments internships, undergraduate research, or other courses. Because the portfolio was used for programmatic assessment, some requirements remained, but they were designed to allow students to present themselves as engineering professionals (see Appendix 2).

The professional portfolio addressed some concerns. By shifting from communication to engineering, it more closely reflects an integration of language and content, with domain expertise as the focus and language as a mediating tool. The professional portfolio provides a series of artifacts that embody the outcome of domain work in textual form, but the outcome is not the text but rather the engineering skill(s) the text embodies. Thus even if the texts were outcomes from an academic activity system, the portfolio sought to help students see them as representations of engineering work. This approach parallels professional portfolios in fields such as teaching or industrial design, in which the language component of ICL is embedded within examples of domain expertise.

However, the structure remains limited as a programmatic ICL assessment tool. The professional statement and artifact descriptions address students' understanding of the profession and their role(s), but at the expense of reflecting their understanding of how language mediates activity. Although students described document contexts, those descriptions were limited, and they provided little insight into students' metacognitive understanding of academic literacy and disciplinary discourse. Evaluators cannot assess students' understanding of audience, purpose, voice, etc. (unless students identify expertise in communication as a skill they wish to demonstrate). The kinds of surface features noted earlier can still be evaluated using this approach, and the ability to move across audiences, purposes, and genres can be inferred, but the reflective components elide students' metacognitive understanding of textual and discursive practices, the ways texts mediate work, and ultimately the integration of content and language. This limitation is compounded by the fact that the portfolio includes only outcomes from various activity systems, with no indication of how texts mediated activities in situ or to how students' technical expertise developed across the activity through textual exchanges.

The two versions of this portfolio represent a trade-off between assessing language expertise and assessing content expertise. Both offer artifacts that represent outcomes of unseen activity systems. This invisibility makes it difficult to understand how texts mediate work, and therefore to assess the programmatic effectiveness of the language/content integration. But the approaches suggest avenues for improvement. First, disciplinary faculty could be included as evaluators to enhance the assessment of content knowledge and to build ICL faculty partnerships. Second, usability reports or similar language-focused reflections could be included in the professional portfolio. The challenge there lies in creating reflective assignments that are useful and meaningful for both learning and assessment without being burdensome for students. While portfolio construction can benefit students professionally (Turns and Lappenbusch 2006), the benefits must be balanced against the costs, including the need for standalone courses, faculty mentoring, and student time. Yet the potential gains from well-designed and supported reflections can provide valuable learning opportunities for students and potentially meaningful programmatic assessments for ICL faculty.

Case 2: The design portfolio – a longitudinal view of one activity system

Where Case 1 drew on texts from multiple activity systems, Case 2, the design portfolio, focused on a single system in which texts mediated students' work on an authentic, open-ended project in the field. The portfolio consisted of artifacts created during a year-long design project: a written proposal and presentation; intermediate written progress reports each with a corresponding presentation; and a final written report and presentation. The portfolio included videos of each presentation, along with PowerPoint® slides. Students received timely feedback on each artifact (including drafts) that exemplified the formative assessment Räisänen (2006) argues for, in which faculty serve as coaches and feedback addresses issues of both content and language (e.g. the design of an experimental plan as well as the description of that plan in the proposal). The assignments were designed to provide sites of meaningful exchange between the course instructor, acting as a project manager, and the students about the project progress (Paretti 2006, 2009).

Because the design portfolio represents a single activity system constructed over time, it is amenable to course-based ICL contexts and potentially more able to examine the mediating role of texts as well as student development with respect to both discourse practices and technical competence. Although the design portfolio did not capture informal texts, it did capture project development, including the evolution of students' technical knowledge, their ability to apply that technical knowledge to design and conduct experiments, and the division of labor among team members—components all invisible in the professional portfolio. Because intra-team communications were not included, the portfolio did not capture the ways texts mediate work among team members, but it did capture mediations between students and the course instructor (Paretti 2006). It also captured students' facility with multiple audiences and genres since different reports were intended for different audiences, including immediate peers, faculty, and more public audiences and included written and oral presentation of information.

For programmatic assessment, the portfolios were evaluated by the departmental Advisory Board, which included senior managers, researchers, and younger engineers from industry as well as faculty from similar programs. The Board evaluated a stratified sample of portfolios (high, medium, and low) using a rubric based on accreditation criteria (ABET Engineering Accreditation Commission 2007) (see Appendix 2). By reviewing the complete portfolio, evaluators could trace project development from inception through intermediate stages to conclusion, and develop a holistic sense of students' work as engineers. The assessment emphasized content competence, intra-team collaboration, and engineering decision-making. While the texts were still intermediate products of the activity system that provided external constructions of students' knowledge and practice, they also mediated project development over time, and changes (or lack of change) from text to text were important assessment points. The assessment results then informed both the ECP and the technical curriculum, often in integrated ways (e.g. changes in both laboratory courses and laboratory reports to improve students' selection of characterization methods).

These portfolios thus illuminated the ways in which content and language interact in specific professional contexts. Students engaged in work designed to replicate professional experience, and the textual artifacts captured that work as it unfolded. However, the portfolio included no opportunity for selection or reflection, and thus did not capture students' metaknowledge to better evaluate the depth and transferability of their learning. The portfolio can be evaluated based on disciplinary norms, but the absence of the dialogic interaction between instructor and team as well as the lack of full intra-team communication limits evaluation of how these texts serve to negotiate among all of the project's actors (engineers, managers, technicians, clients). Nonetheless, the approach provides substantial insight into the integration of content and language because it traces their co-evolution over time in context.

Reflective assignments could enhance both programmatic assessment and student development (Adams *et al.* 2003 and Turns 1997), but again the challenge is time. Students are often fully absorbed in the domain work itself, particularly in open-ended design projects where they encounter a series of problems and must immerse themselves in new learning; the time involved in reporting alone is often burdensome. Adding reflective commentary has, in the past, proven more of a hurdle than a site for productive learning. However, recently added project analysis assignments offer potential sites for reflection that are valuable to both students and program evaluators as students evaluate project development, team dynamics, and personal learning and make mid-project corrections. As with the professional portfolio, much of the value in the design portfolio as a tool for evaluating ICL programs lies in the design and implementation of an effective reflection component.

Summary: Portfolios, Activity Systems, and ICL

The portfolio approaches described in this article seek to balance, in varying ways, the content and language components of ICL work to support both programmatic assessment and student learning within disciplinary activity systems. Interrogating these approaches through activity theory provides an important reminder of the ways disciplinary work is at the center of ICL partnerships, even as that work is embodied in and mediated by language practices. For most students, professionals, and disciplinary faculty, mastery of a field's literacy practices, discourses, and genres is not an end in itself, but rather one component of students' broader professional development. When we turn to ICL assessment, then, we must consider approaches that enable us to examine not only content or language alone, but also their interaction. That is not to say that the two components should never be assessed separately. But in the context of ICL, one of the fundamental questions program administrators must ask is whether students are learning to use language in ways that actively and sufficiently support their professional work.

Portfolios offer significant possibilities for such assessment. In part, they do so by providing access to a range of texts designed to accomplish different goals for different audiences using different dimensions of disciplinary expertise. But perhaps even more importantly, when reflective components are integrated meaningfully into the process, they can demonstrate students' meta-understanding of their field and/or of the role language plays in the field. Yet as the analysis of the case studies suggests, portfolios are limited by practical considerations (e.g. student time and effort, course complexity) and by the components of the activity system they address. As evidenced by their widespread use in writing courses, portfolios provide a strong tool for understanding, supporting, and evaluating students' ability to master a range of disciplinary discourse practices. They can also serve as effective tools for representing students' domain-specific knowledge and skills. They remain limited, however, in bringing together the language and content domains in ways that illuminate students' understanding of the mediating function of texts in disciplinary contexts and their larger sense of the relationship between language and content. When portfolio artifacts are collected across a project, some of that mediation may be visible but even in these cases, key information remains hidden. Moreover, as research on the split between school and work suggests, portfolios constructed from academic assignments represent substantially different activity systems than workplaces. This difference, though not a barrier to learning or to transfer, does require careful attention to the kinds of meta-knowledge our students are developing as well as to what, precisely, our assessments are assessing.

Nonetheless, portfolio assessment is a promising approach for programmatic evaluation. It is most successful, as the cases here suggest, when the process includes both content and language faculty, when evaluation addresses both domains, when student reflections provide insight into their metacognition, and when the portfolio artifacts reflect activities as they occur not just after they are complete. In such cases, portfolio assessment can provide actionable information about the extent to which ICL programs foster content and language learning. As we continue to explore portfolios that include reflection, intermediate informal and formal texts, and evidence of content knowledge, we can continue to move toward assessment models that offer the same degree of integration and partnership that we currently see in ICL teaching.

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Appendix 1: Portfolio Assignments

Case 1a: Communication Portfolio Assignment

Commentaries

Your portfolio needs to include two types of commentaries: 4 individual usability reports on different texts and 1 overall reflection on the development of your communication abilities.

Individual Usability Reports

For four of the documents in your portfolio, you need to explain how you designed the final product to meet the needs of the particular audience and situation and evaluate the work's success. Each reflection should take the form of a memo to Ms. Burgoyne and Dr. Paretti, and include the following information:

- Audience and Goals - Who was the document or presentation intended for? How would you describe the audience (e.g. education, background relating to the material at hand, attitudes, constraints, concerns, etc)? What goals did this audience have? What did they want or need to do with the information you provided? What outcomes did you want (beyond a passing grade!)?
- Rationale - How did you design the document to meet the audience's needs and achieve your desired outcomes? Consider issues such as what information you chose to include or exclude, how you organized the material, what visual elements you included (headings, lists, graphics, etc.), and even what media you used (print documents, presentations, videos, etc.)
- Evaluation - Based on your goals and the audience's goals, describe how well the text succeeded. Did the audience react the way you wanted? Did they get the information they needed easily or did they have to struggle (or not get it at all)? What evidence supports your evaluation?

In each area, please be as specific as possible and use concrete details from your work and the situation to make your case.
Note that each of these usability reports should be an attachment in the appropriate element (i.e. with the document or presentation it refers to).

Overall Reflection on Your Development

You have done a great deal of writing and speaking over the past few years, hopefully with at least some positive effects. In an essay, please trace the development of your ability to communicate effectively (in writing and orally) during this time. As a guide, consider both the program goals and the rubric below:

Program Goals

- Write prose that conforms to Standard Written American English.
- Write clearly, concisely, and coherently.
- Speak clearly and articulately in front of both large and small groups (e.g. appropriate tone, volume, speed). Demonstrate proficiency in the common forms ("genres") of engineering communication: business correspondence, poster sessions, laboratory reports, proposals (written and oral), progress reports (written and oral), at least one type of professional report (journal articles, recommendation reports, design reports, feasibility reports).
- Identify the explicit and implicit goals, needs and expectations of their audience in any communication situation.
- Identify their own explicit and implicit goals in any communication situation.
- Identify additional factors that bear on the communication situation.
- Identify the genre (e.g. recommendation report, feasibility study, proposal) and the medium (e.g. paper, electronic, oral) best suited to helping the audience and the author achieve their goals.
- Adapt the content, organization, language, tone, and medium of the appropriate genre to meet the demands of the specific communication situation at hand.
- Select the most effective means of visually representing engineering data/information based on the specific situation (audience, purposes, context).

- Design information to make it easily accessible for audiences (e.g. using meaningful headings, subheadings, lists, and related visual cues to make documents easy to skim; designing slides to help audiences easily follow presentations; providing tables of contents, lists of figures/tables, indexes).
- Locate and use resources to learn the communication practices/conventions of any culture, and adapt communication accordingly.
- Conduct effective meetings.
- Maintain effective project documentation.
- Develop documents and presentations collaboratively in a team environment.
- Provide effective feedback to colleagues based on oral or written presentations.
- Communicate ethically.

Communication Rubric

	Novice - Follow Prescribed Formats	**Intermediate - Adapt Standard Formats to Audience/Situation**	**Advanced - Create Effective Communication Even When No Format is Prescribed**
Content & Organization Select and organize information based on audience, purpose and context.	Include content specified by a given assignment, organized according to a prescribed pattern or format ("genre").	Adapt the content and organization of prescribed formats ("genres") based on an understanding of audience needs and interests.	Select and organize content to accomplish specific goals based on an analysis of audience needs and outside factors affecting the desired outcome.
Visual Design Effectively incorporate visual elements (graphics as well as headings, lists, and related text features).	Include all graphics and headings specified by the assignment.	Adapt visual elements to the needs of the specific communication situation at hand: - Expand required headings to convey targeted information - Create bulleted lists to highlight most relevant information - Modify required graphics to highlight key information	Creates visual elements that most effectively communicate essential content to intended audience: - Create headings, subheadings, and lists based on audience needs/interests - Graphically represent engineering data in ways that effectively speak to audience needs/interests
Writing Style* Produce documents that are easy to read.	Follow the rules of standard academic English (grammar, punctuation, spelling). Use common forms of transitions (transitional phrases, repetition of key words) to link ideas.	Develop transitions between ideas that reflect the logic, knowledge, and interests of the audience. Use language appropriate to audience.	Write concisely.
Delivery* Speak in a manner that holds the audience's attention.	Avoid verbal and physical distractions. Make eye contact with audience. Modulate voice to avoid monotone speech.	Appear relaxed and comfortable. Speak to audience rather than to presentations slides, computer, etc.	Engage the audience, moderating their responses and adapting the presentation delivery and content accordingly.

Collaboration	Create documents and presentations in a collaborative environment	Provide effective feedback to colleagues on documents and presentations	Organize collaborative writing/speaking projects

Although the reflection can address any issues with respect to the goals and the rubric, you might want to consider questions such as:

- To what degree have you satisfied each of the program goals?
- How would you evaluate yourself against the rubric?
- What were your strengths and weaknesses when you entered the MSE Communications Program?
- What are your strengths and weaknesses now?
- What key changes, if any, have you made to your writing or speaking?
- Has your understanding of communication (what it is, how to approach, what defined 'good') changed over time? If so, how and why?
- What classes and experiences (inside or outside the MSE Curriculum) have been most influential?
- What areas do you still feel you need to work on?
- What plans do you have for continuing to improve?
- This reflection should be a separate element in your portfolio presentation.

Case 1b: Professional Portfolio Assignment

Course Goal

This course is designed to enable you to create an electronic professional portfolio that presents your abilities as an engineer. The portfolios can serve at least three purposes:

- To help you evaluate your own strengths and weaknesses as you move from being a student to being a practicing professional
- To create a portfolio for you to use in job searches and grad school applications
- To provide the department with a record of your achievements that can be used to assess and improve the curriculum
- To provide you with a means to evaluate the curriculum and provide feedback to the department based on your own experiences

The Porfolio

Your portfolio needs to include 3 types of information:

- A **résumé** (for corporate/goverment careers) or **curriculum vitae** (for academic careers) summarizing your background
- A **professional statement** that describes your current strengths as an engineer, using items from your own work to illustrate those strengths
- A **work showcase** that includes
    - at least 6 different examples of your work to demonstrate your strengths - papers, projects, posters, videos, course assignments, workplace documents, etc.
    - a brief description of each artifact that explains what it is, why it was created, and what it demonstrated.

Professional Statement

Your professional statement should explain your current strengths, skills, and areas of expertise to your faculty, the department, and external audiences such as employers or graduate school admission committees.

The structure of your professional statement is up to you; you can use it as your personal statement for graduate school if you're headed that way, or simply use it as a tool to reflect on your own strengths as an engineer. It should be a statement about yourself and your work that

- identifies your particularly strengths (leadership? laboratory research? analysis and critical thinking? communication?) and your areas of interest or specialization (biomaterials? ceramics? technical sales?)
- describes concrete examples from your experiences to illustrate those skills; at least some of these examples should be tied to the work showcase you include with the portfolio.

To help frame your self-assessment, consider the 15 ABET requirements, the 10 roles identified in the Engineering Profile, and the characteristics of the Engineer of 2020 defined by the National Academy of Engineering. Although you are not restricted to the skills and abilities identified in these documents, they represent current thinking by government, industry, and academic experts on the expectations for today's engineering graduates, and so should play into your assessment at least to some degree.

Although there is no length requirement for the statement, I would expect something on the order of a single-spaced page. The statement should describe your strengths in concrete terms, referring to the work showcase as appropriate to substantiate your claims.

Work Showcase

Your work showcase serves as the data to support the claims you make about yourself in your résumé and personal statement. It should include examples of your work that effectively demonstrate your current skills and strengths as an engineer - homework assignments, reports, papers, presentations, laboratory results, etc. However, because these portfolios also serve as assessment tools for the department, please include the following types of work:

- Individual AND collaborative projects
- Oral AND written work
- Work developed for at least two different audiences/contexts
- At least 1 example that demonstrates your understanding of professional and ethical responsibility
- At least 1 example that demonstrates your understanding of the environmental, global, economic, cultural, and social impact of engineering

In addition to collecting these examples, you need to describe them. Your descriptions should briefly describe what the artifact is, the context in which you created it, and the reason you've included it in your portfolio. For example:

"The poster entitled "Novel Uses for Biomaterials" was created for an undergraduate research symposium at Virginia Tech. The poster summarizes the research I conducted on XXXX for Dr. XXXX during the summer of 2006. My research focused on XXX; I designed, conducted, an analyzed experiments that examined XXXXX. I am the primary author of the poster, though I did receive feedback from my advisor and from the graduate students in our research group. The poster demonstrated my abilities as a researcher - in particular, my ability to design experiments. [briefly explain the approach to experimental design]."

Appendix 2: Scoring Rubric for the Design Portfolio

Does the portfolio show evidence of	**Novice**	**Intermediate**	**Advanced**
A: an ability to apply knowledge of math, science, and engineering? MSEs use math, science, and engineering-based constitutive behavior to model, understand, and predict material properties, processes, and structure .Models and descriptions appropriate at all dimensional scales (electronic, atomistic, molecular, microstructural, mesoscopic, and macroscopic) assist MSEs in designing and developing new materials and processes, and promote the understanding of the origins and mechanisms of property development. Lifetime analyses (e.g., corrosion, fatigue) require strong foundations in the sciences and engineering.	The teams demonstrated that they recognized, and could link, aspects of their project to concepts from earlier courses in math, chemistry, physics, and/or engineering; however, they made no attempt to apply or use the concepts to understand, explain, or develop and analyse an approach beyond simple recognition.	The team demonstrated a depth of knowledge as to how aspects of their project relate to the fundamental concepts. The team was able to apply simple, but appropriate chemical-, physical-, mathematical-, or engineering-based models to describe their results or to assist in the development of their experimental plan.	The team developed an original, physics-based theoretical- or phenomenological -based model to describe experimental results, or used an original model as a means to provide guidance for the development of an experimental plan.
B: an ability to design and conduct experiments, as well as to analyze and interpret data? Discovery is a critical component in the MSE discipline. Characterization of structure, properties, and process are fundamental to higher levels of understanding, optimization, utilization, and technological advancement. The design of experiments and the effective presentation of results, including written, oral, graphical, and tabular coupled with meaningful ties to theory are of importance.	The team designed experiments appropriate to the project and correctly analyze/interpret the results, but both the experimental design and the subsequent analysis are significantly limited or insufficient with respect to project goals.	Within time and resource constraints, the design of experiments and analysis/interpretation of data generally address the project goals, but either the design or the analysis shows some weakness or limitation.	Both the design of experiments and the analysis and interpretation of data effectively provided the information necessary to successfully meet the project goals.

Does the portfolio show evidence of	**Novice**	**Intermediate**	**Advanced**
C: an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability? According to documents submitted to ABET by the University Materials Council ". .. design in MSE may include:design and evaluation of a material for a specific application; reverse engineering and design improvements involving materials; design and evaluation or optimization of a material's processing method; or design of a method for determining, controlling, or selecting material's characteristics or properties." Some use the need to make a technically- or scientific-based decision, or an iterative-loop, towards an objective or result as evidence of design.	The team defined a few constraints on the process and made decisions based on those constraints. The final results satisfied most of those constraints. However, many other constraints could and should reasonably have been addressed in the project. Other limitations might include a poor decision-making process or failure to satisfy constraints.	The team defined several relevant and important constraints and made decisions with respect to those constraints. The final results satisfied most of those constraints. Limitations might include omitting one key constraint, weaknesses in the decision-making process, or failure to meet one constraint.	The team defined all or most of the relevant constraints and made decisions systematically with respect to those constraints. The final results successfully met those constraints.
D: an ability to function on multidisciplinary teams? MSE is a broad field, touching and impacting just about every other discipline in one way or another. MSEs must have broad abilities and backgrounds to effectively interact with their professional colleagues in an industrial or scientific setting. Fundamental studies in chemistry, physics, programming, generic engineering skills, humanities and social studies as well as effective communication skills enable the MSE to effectively interface and interact within a diverse circle of professional responsibilities.	The team had a project plan, but the plan does not appear very efficient and contributions of individual team members are not always clear. All team members may not have contributed equally or the team may not have synthesized results.	Project plan and work distribution was reasonable, but evidence of collaboration and teamwork was limited in some way (e.g. not all team members appear to have contributed equally or the team showed little evidence of collaboration or synthesis of results).	Project was organized and work divided effectively; each team member contributed significantly to the project and the project demonstrated collaboration among members and synthesis of work.

Does the portfolio show evidence of	**Novice**	**Intermediate**	**Advanced**
E: an ability to identify, formulate, and solve engineering problems? Nearly all MSE core and engineering subject courses require students to solve problems of both a traditional or classic nature, as well as problems unique to the discipline of MSE. The senior capstone design experience provides students with the additional opportunity to deal with open-ended problem solving skills, and/or with solving unanticipated problems towards the meeting of an objective or goal.	The team appears to have successfully grasped the rationale and motivation for the project; however, the depth of their understanding does not seem to extend beyond that likely provided by their faculty advisor. In addition, their ability to identify and resolve problems that occurred over the course of the project was limited to obvious problems and simplistic solutions.	The team understands the objectives and rationale for the project provided by their advisor, and has contributed additional, independently-secured background info, theory, experimental methods, or hypotheses to the project. The team demonstrated reasonable competence in identifying and resolving problems throughout the project, but either ignored or failed to address one or more key issues or appeared to rely heavily on advisor intervention.	The team has made independent decisions regarding problem resolution, project redefinition, analysis approach, etc. Moreover, the team independently and effectively identified and resolved problems as they occurred throughout the project.

Does the portfolio show evidence of	**Novice**	**Intermediate**	**Advanced**
F: an understanding of professional and ethical responsibility? MSEs are involved in all aspects of engineering innovation, design, and implementation. Many applications ultimately involve public trust, safety, and societal well-being. Professional responsibilities may be considered those one owes to employers (company loyalty, adherence to policies, attention to the company's interests) and to the profession as a whole (using appropriate techniques, applying disciplinary standards to one's work), while ethical responsibilities typically extend to individuals and groups and involve the impact of one's action on the full range of stakeholders.	The team did not appear to behave unethically, but professionalism, though occasionally in evidence, was lacking in a number of instances.	The team did not appear to behave unethically, and most of their work appears to demonstrate professional responsibility.	The team conducted themselves professionally throughout the project and did not appear to violate any ethical considerations.
G: an ability to communicate effectively? Engineers must understand not only the mechanics of communication (grammar, transitions, well-designed PowerPoint slides) but also how to adapt documents and presentations to the needs of a wide range of audiences including technical colleagues, managers, technicians, investors, and clients.	Sufficient project documentation exists, but has significant weaknesses in presentation (oral and/or written), organization, and ability to select relevant content.	Most project documentation is clear and effective, but the team showed some weaknesses in a particular area (e.g. oral delivery, correctness, organization, wordiness).	All written and oral project documentation clearly and effectively communicates relevant information. Relevant content is organized to support project management and evaluation, and reports and presents are professional.

Does the portfolio show evidence of	**Novice**	**Intermediate**	**Advanced**
H: the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context? MSEs are involved in the primary beneficiation, processing, manufacturing, and specification of materials for engineering applications. Each of these steps involve quality of life issues for society, e.g.,resource utilization, energy consumption, economic prosperity, and environmental stewardship.	The team identified at least one broader impact of the project.	The team identified several potential impacts of the project, but omitted other obvious or important impacts.	The team clearly identified all or most potential impacts of this project.
I: a recognition of the need for, and an ability to engage in life-long learning? Like all technology-heavy fields, MSE is evolving rapidly. Successful graduates will requires skills that enable them to learn new technologies, concepts, and skills appropriate for present and future contributions.	The team gathered some necessary information. Gaps might include limiting information-gathering to the beginning stages (proposal), omitting important sources, leaving significant information gaps.	The team gathered most of the necessary information throughout the project, but may have omitted one or two important sources or issues.	The team gathered all additional information necessary to complete the project from multiple sources (literature, experts, vendors, etc.).
J: a knowledge of contemporary issues? Interpretation of what constitutes a contemporary issue for purposes of engineering accreditation varies. Some view it as a recognition of world and local events and the impact the MSE discipline may have on such events – for example, hurricane-resistant materials, materials for energy, weapons research, etc. Others view contemporary issues as emerging technologies such as nanotechnology and biomaterials. Likely, both interpretations are appropriate.	The project proposal and final report referred to at least one contemporary issues relevant to the project.	The proposal and report provided some detail regarding contemporary issues relevant to the project and attempted to tie the project to those issues.	The proposal and final report clearly contextualized this project with respect to contemporary issues both within the field of materials science and nationally/globally.

Does the portfolio show evidence of	**Novice**	**Intermediate**	**Advanced**
K: an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice? Proficiency with certain tools have become necessary for effective practice for MSEs.For example, computational skills, statistics, basic metallographic and microscopy skills, materials characterization techniques, and fundamental processing tools. Confidence with regards to the operation of basic laboratory or manufacturing based equipment is essential.	The team used some appropriate techniques and tools, but skill levels appeared novice and other available tools/techniques should also have been included.	The team demonstrated reasonable skill in using most of the available tools and techniques appropriate to the problem.	The team effectively and successfully employed the appropriate tools and techniques available.