Student Learning Outcomes: Effectively Satisfying Multiple Accreditation Requirements

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Abstract

In June 2013, Lehigh University's Periodic Review Report[1] (PRR) was submitted to the regional accreditation body (the Middle States Commission on Higher Education, MSCHE) and re-accreditation self-study reports for nine undergraduate engineering programs were submitted to ABET, Inc. Assessment of Student Learning Outcomes (SLOs) is a primary requirement of both agencies, each with a significantly different scope, focus, reporting system, terminology and criteria or standards. Effectively satisfying both demands can be challenging for many reasons, including the need for leadership and coordination at many levels, avoidance of redundant effort, faculty buy in, and availability of resources. Below we discuss how we addressed and continue to address this multi-faceted challenge and earning an overall "superlative" review by MSCHE.

In 2010 our progress report was accepted by MSCHE that described "*progress made toward the assessment of student learning outcomes in the College of Arts & Sciences [using] qualitative & quantitative, direct and indirect means...[and] measuring progress toward those goals.*" These new assessment practices in Arts and Science complemented strong assessment practices in the undergraduate engineering programs, programs in the graduate-only College of Education, and graduate and graduate programs in the Business and Economics College, all accredited by other agencies. Except for a few scattered programs, the only area that lacked overall assessment practices was the P.C. Rossin College of Engineering and Applied Science's graduate programs.

This paper reports on how we are implementing graduate engineering program assessment practices to complement three existing and different ones in the other colleges while supporting the new overarching university-wide system. MSCHE indicated our 2013 report needed "*a comprehensive description of the evolution of student learning outcomes assessment practices across the university since the last visit [2008], with special attention to the evolution of such practices within the College of Arts and Sciences.*"

The university-level challenge was addressed first by creating a process whereby a standing graduate faculty committee and an appointed Enhancing Graduate Education (EGE) committee worked together to create a sustainable process for periodic program review that included a framework for interpreting the five new university-level graduate student learning competencies: *Knowledge, Application, Context, Communication,* and *Leadership.* Also required was development of a methodology for assessment and continuous improvement. This approach earned a very positive 2013 MSCHE evaluation: "*university assessment practices of graduate Student Learning Outcomes [were] particularly thoughtful ...[including] the plans, examples of implementation [and] the support structure.*

The recently developed framework for graduate SLO assessment allows graduate engineering to closely complement and support the new university system. The Technical Entrepreneurship program provides an example of leadership and best-practice sharing to demonstrate useful and sustainable SLO assessment practices. Finally, an *Assessment of Student Learning Assessment Processes* table is used to assess the evolution of college assessment practices.

1. The challenge: satisfying multiple student learning assessment requirements

The challenge we faced was: by 2013 develop overarching, integrated, comprehensive Student Learning Outcomes (SLO) Assessment practices at the university level for both undergraduate and graduate programs that complemented, but did not duplicate, the existing assessment programs in each of the college's academic programs.

Part of the challenge was the development of assessment practices for all university programs which did not have assessment plans, programs or results in place. These new efforts need to be acceptable to faculty and complement the existing assessment programs, and support the new university-level assessment program. In this paper, the focus of the program-level SLO assessment was for graduate engineering programs which did not have any assessment plans or practices in place in 2010 when the discussion of the nature of the university-level assessment began.

Meeting this challenge will also satisfy the expectations of Middle States Commission on Higher Education (MSCHE), the regional accrediting agency for Lehigh University, as stated in their 2008 recommendation:

> *at the time of the [2013 Periodic Review Report], the university provide a comprehensive description of the evolution of student learning outcomes assessment practices across the university since the last visit, with special attention to the evolution of practices in the College of Arts and Sciences.*

Satisfying this objective requires faculty and administration buy-in to add a new layer of assessment at the university level, and another layer for graduate programs without an assessment program.

2. Expectations from regional accreditation commission on assessment practices

The main driver to establish university-level student learning outcomes assessment was the MSCHE's 2008 recommendation provided above, and to be addressed in our 2013 Periodic Review Report[1]. Although other accreditation agencies set expectations for other colleges, the focus of this paper are MSCHE expectations of all graduate programs, with an emphasis on engineering programs. Because not all faculty and staff were familiar with MSCHE expectations, the first author made a presentation on that topic to several groups, including the Graduate Research Committee (GRC) in 2010 and 2011, as summarized below.

The expectations on Student Learning Assessment for undergraduate and graduate programs are covered in MSCHE's Standard 14, with multiple levels (university, college, program, and course). Their recommendations typically ask for *progress* or *evolution* (rather than completeness), and often identify specific areas that require special attention and follow up reporting. MSCHE evaluators do not necessarily ask that all gaps be closed, and those that are singled out typically have two years to submit progress or monitoring reports. Thus their philosophy is to ask and expect institutions to continually strive to achieve their 14 Standards. Thus the MSCHE could "recommend" that a university address a specific gap to retain accreditation that existed in past evaluations but not specifically mentioned. Conveying this

information to constituents was important step in buy in, and explained why could be singled out in the future even though they were not mentioned in the past.

Although MSCHE cannot dictate what a university must do, if their recommendations are not addressed, MSCHE accreditation can be put in jeopardy with severe consequences, i.e., accreditation is a requirement for eligibility for Title IV Federal Student Financial Aid funds, and would be disastrous for an institution to lose accreditation. So MSCHE "recommendations" are "required" to be addressed to avoid the potential (eventual) loss of MSCHE accreditation.

Also, when institutions do not evolve their practices adequately, they risk receiving a "blanket recommendation" that includes requirements not specifically part of their standards. For example although there is no specific requirement for external program review, American University received a recommendation that included implementation of a required external review for all programs, graduate and undergraduate even though it is not in their standards.

In summary, it is important to convey key information to administrators, faculty and staff so they understand the expectations and ramifications of not maintaining regional accreditation.

3. Overview of established college-level student learning assessment practices

Programs with established SLO assessment practices are summarized in this section. Section 4 describes the university-level undergraduate practices, Section 5 describes the university-level graduate practices, and Section 6 describes how we are closing the remaining gap in college-level practices in the P.C. Rossin College of Engineering and Applied Science.

Accredited programs with established SLO assessment considered to be "mature" include:

- accredited programs in the Business & Economics College (undergraduate and graduate)
- College of Education (graduate)
- P.C. Rossin College of Engineering and Applied Science (undergraduate)

SLO Assessment is part of the accreditation process of numerous accreditation agencies (MSCHE, AACSB, ABET, PA State Department of Education). Each accreditation agency has different criteria and standards, each with a different scope, focus, reporting system and timing. Effectively satisfying all demands can be challenging for many reasons, including leadership and coordination at many levels, avoidance of duplicative effort, faculty buy in, and availability of resources.

A Student Learning Outcomes (SLO) Assessment gap was identified by MSCHE in 2008, resulting in a recommendation that we report on *progress toward assessment of Student Learning Outcomes in* graduate and undergraduate programs *in the College of Arts and Sciences* (CAS) by April 2010. In response, CAS developed an in house software application used by each department each semester to document selected direct evidence of student learning, and now has an established college-level assessment practices. Thus while not "mature" the College of Arts and Sciences now has established assessment practices.

The evolution of assessment practices in each college can be summarized by a table such as Table 1: *Rubric for Evaluating Student Learning Assessment Processes by Colleges* to illustrate their progress. A similar practice for graduate programs is being developed.

The third round of self-study engineering reports that describe the SLO assessment were submitted to ABET in 2013; previous ones were in 2001 and 2007. The rest of this section describes mature SLO assessment practices for a typical undergraduate program.

The Environmental Engineering Bachelor of Science program adopted a Performance Indicator approach for assessing the Program's 11 Student Outcomes (SO, listed from (a) to (k)). With this approach, two to three Performance Indicators are used to directly evaluate the students' attainment of each SO. For example, SO (a) is "An ability to apply knowledge of mathematics, science, and engineering". Three Performance Indicators were developed for this SO, with the first being an "Ability to mathematically describe an environmental engineering system." Overall, the program faculty developed a total of 27 Performance Indicators for assessing and evaluating the 11 Student Outcomes.

The Environmental Engineering ABET committee has identified two courses to be used for the assessment and evaluation of each SO. The two criteria used to select these courses are (1) they are required courses and (2) they are upper-level courses typically taken in the Junior or Senior years. The instructors of these courses are free to select an assessment instrument (e.g., exam question, homework question, project report, laboratory report, or presentation) for each Performance Indicator associated with their assigned SO. Based on the assessment instrument chosen, the instructor develops a rubric for each Performance Indicator and selects Performance Criteria that are used to evaluate the students' ability to meet that Performance Indicator. The instructor's rubric generally follows a three-tiered approach for assessing the students' performance: "Developing", "Satisfactory" and "Proficient." The instructor may select a single Performance Criterion based on the rubric (e.g., 90% of all students at or above "Satisfactory") or multiple Performance Criteria (e.g., 90% of all students at or above "Satisfactory" and 50% at "Proficient"). The instructor presents the rubrics and Performance Criteria to the Environmental Engineering ABET committee for discussion and the committee may either approve them or recommend revisions.

Once the rubrics and Performance Criteria are approved, the instructor assesses and evaluates the students' ability to meet each of the Performance Indicators for the assigned SO and recommends changes to the course, if required. The instructor's assessment and evaluation of each Performance Indicator is reviewed by the Environmental Engineering ABET Committee and the committee makes recommendations on any required changes to assessment at the program level. The schedule uses a staggered approach, with two to four classes (five to ten Performance Indicators) being evaluated each year, with each SO being assessed a minimum of two times during each seven-year ABET review cycle.

This approach results in three loops of data flow and feedback. Loop 1 focuses on the process of assessing and evaluating the Performance Indicators for each SO and feedback may include recommended changes to the rubric or Performance Criteria. Loop 2 focuses on the instructor's

Table 1. Rubric for Evaluating Student Learning Assessment Processes by Colleges

This table was developed by Middle States Commission on Higher Education for institutions to use as a tool to help them assess the status of their current assessment efforts as a summary of progress made and guidance on remaining focus to meet the expectations of Middle States. Because Lehigh University has college-focused assessment model, we adapted this form for college use rather than use at the institutional level. This example indicates where one of our four colleges determined themselves to be prior to 2001 (lightly shaded cells), and in 2012 (darkly shaded cells) for undergraduate assessment processes.

No plans　　= **No** documented evidence that the institution has **plans** to do this.
No evidence = The institution appears to be aware that it should be done, but **no documented evidence shows it is happening**.
A few areas　= The institution has documented evidence it is happening **in just a few areas** (e.g. specialized accreditation).
Some areas　= The institution has documented evidence that it is happening **in some but not most areas** (for example, in a number of academic programs but not yet in general education)
Most areas　= The institution has documented evidence—not just assurances—that this is happening **in most but not all areas**.
Everywhere　= The institution has documented evidence—not just assurances—that this is happening **everywhere.**

	For college academic programs, the general education curriculum, and institutional goals articulated in the mission statement, vision statement, or elsewhere:	No plans	No evi-dence	A few areas	Some areas	Most areas	Every-where
1	Institutional leaders demonstrate sustained—not just one-time or periodic—support for promoting an ongoing culture of assessment and for efforts to improve teaching.		2000			2012	
2	Clear statements of expected learning outcomes at the following levels have been developed and have appropriate interrelationships:						
	a. Institutional level		2000		2012		
	b. Unit (college, student affairs, etc.) level		2000		2012		
	c. Program level		2000			2012	
	d. Course level		2000			2012	
3	Those with a vested interest in the learning outcomes, and are involved in developing, articulating, and assessing them at the Program or major curriculum level		2000			2012	
4	Statements of program-level expected learning out-comes are made available to current and prospective students.		2000		2012		
5	Course syllabi include statements of expected learning outcomes.		2000			2012	
6	Targets or benchmarks for determining whether student learning outcomes have been achieved have been established and justified; the justifications demonstrate that the targets are of appropriate college-level rigor and are appropriate given the institution's mission.		2000			2012	
7	Multiple measures of student learning, including direct evi-dence, have been collected and are of sufficient quality for use with confidence to make appropriate decisions.		2000			2012	
8	The evidence of student learning that has been collected is clearly linked to expected learning outcomes.		2000			2012	
9	Student learning assessment results have been shared in useful forms and discussed with appropriate constituents, including those who can effect change.		2000			2012	
10	Student learning assessment results have been used to improve teaching		2000			2012	
11	In any areas in which the above are not yet happening, there are concrete, feasible and timely plans are in place.		2000		2012		
12	Assessment processes have been reviewed and changes made to improve their effectiveness and/or efficiency, as appropriate.		2000			2012	
13	There is sufficient engagement, momentum, and simplicity in current assessment practices to provide assurance that assessment processes will be sustained indefinitely.		2000			2012	

course, where the instructor assesses the students' performance and makes recommended changes to his/her course for improving student performance, if warranted. Loop 3 focuses on improvements to the broader program curriculum and to the program's assessment and evaluation method itself. These improvements may include enhancement of topics across multiple courses, changes to the program curriculum, development of new assessment instruments (e.g., presentation rubrics) and changes to the Performance Indicators.

4. **Development of university-level assessment of undergraduate student learning practices**

Under the leadership of Student Affairs, careful review and consideration of national research including *Learning Reconsidered 2,*[2] the *Frameworks for Assessing Learning and Developmental Outcomes,*[3] student development theories, institutional "best practice" models, internal data, and extensive discussions, and evolution over several years at our institution, a set of student developmental competencies were developed. The 2012 version of the competencies are:

1. *Intellectual Exploration:* Student's ability to develop an interest in, and therefore adopt strategies and behaviors, to advance their cognitive and academic abilities; exploration of, how to learn/integrate their academic experiences and also begin to understand and develop an inherent drive for/value of life-long learning.

2. *Individual Identity Development:* Student's exploration and understanding of personal values, attitudes, beliefs, and feelings about self; student's need to (re)visit the question "Who am I?" and "What does that mean?"

3. *Interpersonal Development, Equity, Community and Global Engagement*
   The identification, understanding and implementation of the skills necessary to build relationships in life; the ability to understand who students are in relationship to others who are different from them; ability to evaluate the type and quality of interactions with others. Feeling a part of the community and therefore developing a commitment to broadly shared ideas and interests; working together for a common purpose; developing a sense of personal responsibility for promoting the growth and sustainability of the larger community.

Table 2 provides an undergraduate Student Developmental Competencies (SDC) Map which provides a specific list of skills associated with each of the core areas (across columns), and at Level I, II, and III (rows potentially corresponding to First Year, Second Year, and Third Year/Beyond). These are identifying skills developmentally appropriate for traditional-aged college students as they matriculate through their undergraduate years. The third competency is broken into two sub-areas when examining in detail.

University assessment practices benefit from strong leadership from the Student Affairs Office. Additional information available from the authors include university links to the Student Affairs Office Strategic Plans for understanding each of the core areas and as a resource to guide planning and curriculum development of individual departments, programs, and services. One example of the latter is the process for obtaining core competency grants for faculty and staff to help implement the SDC.

Table 2. Undergraduate Developmental Competencies Skill Development Map, 2012

Strategic Plan	Intellectual Development	Individual Identity Development	Interpersonal Development, Equity, Community & Global Engagement	
			Interpersonal Development/Equity	Community and Global Engagement
Level I	• Manages time to complete tasks with consideration for priorities • Knowledgeable of support services on campus • Utilizes support services as needed • Understands personal learning style • Communicates effectively orally • Communicates effectively in written form • Identifies educational goals • Engages with intellectual content outside of academic course of study	• Understands one's individual background, culture, experiences, roles, interests, etc. • Identifies personal strengths, styles and abilities • Explores and clarifies personal values • Sets manageable and meaningful personal goals • Exhibits an awareness of one's emotions • Assumes responsibility for one's choices and actions	• Listens effectively to others' viewpoints • Aware of conflict management styles • Establishes mutually rewarding interpersonal relationships with peers, friends, and romantic partners • Understands group dynamics and operates successfully in group settings	• Able to identify the various communities of which one is a part • Feels a sense of belonging within one's community • Understands and participates in relevant governance systems • Understands the role of society and communities in shaping personal values • Participates in service/volunteer activities
Level II	• Asks intellectual questions to inform personal views • Gathers multiple sources of information before formulating a conclusion • Applies prior information to new/different experiences • Engages in experiential learning opportunities to put knowledge and skills into action	• Manages emotions appropriately • Initiates action toward achieving personal goals • Demonstrates resiliency and ability to overcome obstacles • Seeks opportunities/involvements aligning with interests, strengths, and values • Demonstrates commitment and follows through on personal decisions	• Navigates personal role in diverse group settings • Learns about others' cultures and engages in relationships with people of different backgrounds, cultures, etc. • Contributes to the achievement of common group goals • Demonstrates assertive behaviors when appropriate • Recognizes social injustices and inequities	• Explores "community need" first when serving others • Demonstrates integrity when interacting within community settings • Articulates a personal meaning of "global citizenship" • Respects the identities and practices of various cultural groups and societies • Speaks up when witnessing wrongdoing or harm to others in community settings • Seeks global experiences
Level III	• Demonstrates an appreciation for various forms of expression • Integrates in class and out of class learning into career exploration and personal and professional decision-making • Demonstrates confidence in ability to pursue future intellectual and professional opportunities • Employs complex reasoning when faced with a problem to solve	• Accomplishes tasks in an environment where little direction is given • Understand the intersections of one's multiple identities • Recognizes relationship between health/wellness and accomplishing life goals • Uses moral/ethical reasoning to inform actions and decisions	• Appropriately challenges unfair and intolerant behavior and the use of stereotypes by others • Seeks diverse viewpoints to inform decisions • Solicits and incorporates personal feedback • Builds networks and establishes relationships to support goal accomplishment • Seeks opportunities to mentor/teach others • Facilitates productive dialogue within groups	• Advocates on behalf of the needs and equitable rights of others • Engages in controversy and public discourse in a civil manner • Initiates change for the common good • Articulates the advantages and challenges of a diverse society • Recognizes the interconnectedness of the world

Faculty buy-in and acceptance of the undergraduate SDC has not been rapid, partly because the historical development and implementation was led by Student Affairs, and partly because the faculty are more involved with their college assessment programs. However, the expansion of the post-orientation, eight-week required " evoLUtion" seminar is designed to help students reconnect with their orientation group and to discuss important issues relevant to their adjustment and success at our institution, including understanding SDC expectations. With increasing faculty involvement as evoLUtion seminar leaders, a gradual evolution of integration and acceptance by faculty is expected to occur.

5. **Development of university-level graduate student learning assessment practices**

Faculty-led, college-focused assessment practices already provide sound assessment of student learning in many areas, and we wanted to avoid redundancy in the university-level system.

With national attention including more focus on graduate programs, implementation of university-level graduate student learning outcomes assessment was a high priority for the appointed Enhancing Graduate Education (EGE) committee. In parallel, in 2010 the standing faculty Graduate & Research Committee (GRC) reviewed their charge as having responsibility for overseeing the quality of graduate programs and began discussing a possible framework for graduate program review.

As part of that effort, GRC requested the Deputy Provost to provide expectations (and requirements) of MSCHE for program review. His 2010 discussion with the MSCHE Vice-President liaison indicated that our approach to include student learning outcome assessment with program review would also satisfy expectations of MSCHE, provided that there was a university-level assessment process supported by programs with well-defined outcomes and established assessment practices. Thus although the gap was mostly closed for most graduate and undergraduate programs, including the new practices in College of Arts and Sciences, one requirement not satisfied was that they support the university-level effort, which did not exist in 2010.

Issues were debated by EGE and GRC and periodically shared with administrators including department chairs, faculty, senior leadership, and board of trustees. Faculty buy in was enhanced by announcing that the stand-alone, administration-selected EGE committee would act as a sub-committee to the faculty standing GRC committee for SLO assessment and graduate program review. A summary of those discussions follows.

In 2010, the first step was to select Student Learning Outcomes. Extensive discussion resulted in our determination that overly specific outcomes could create conflicts with or duplicate requirements from other accreditation agencies, and not likely to be useful. Conversely, we decided not to adopt general learning goals such as those selected by *The Graduate School-New Brunswick* which has 3 foundational learning goals for their students:

1. Attain marked ability, scholarship and research skills in a broad field of learning
2. Engage in and conduct original research
3. Prepare to be professionals in their discipline

We felt such general goals would be too general and would not be useful in the framework we imagined, because we wanted a little more specificity. Thus flexibility and usefulness were key requirements, with assessment appropriate for all the diverse graduate programs across campus, those with external accreditation requirements and those without.

Eventually we discarded the term "Student Learning Outcomes," because discussions kept returning the focus on the program and what they were offering to the students rather than on the students directly. Other complications for implementation of university-wide student learning outcomes included:

- Some programs are accredited, others are not
- Some programs have sophisticated assessment practices, a few are being formed
- Different terminology for student learning assessment hinders discussion and acceptance; for example ABET recently changed the term *Program Outcomes* to *Student Outcomes* for engineering programs, MSCHE does not require any particular terminology, but uses *Student Learning Outcomes* in their Standards, and the College of Business and Economics uses *Objectives* as required by AACSB (Association to Advance Collegiate Schools of Business)
- We wanted the focus to be on the student, whereas often the focus was on what the program delivered
- Initial discussions of graduate outcomes had a narrow focus on *knowledge in a single area*, which is very different than the new broad undergraduate competencies

Once we adopted the term *Student Developmental Competencies* (SDC) instead of *Student Learning Outcomes* (SLO), discussions then clearly focused on what the student was learning and how they were developing, rather than what the program planned or provided. In December 2011, our MSCHE liaison officer indicated such an approach would be acceptable to MSCHE. Our debates then led us to define our expectations of graduate students in a graduate student vision:

> *We aspire for graduates of our doctoral, master's and certificate programs to achieve leadership and personal accomplishment in their professional pursuits. They will attain both depth and breadth of knowledge needed to advance the theory and practice of their chosen fields and will be adept at applying that knowledge. They will be committed to lifelong learning and to mentoring those who succeed them. They will be creative, embrace complexity, and productively challenge accepted paradigms and theories. They will be outstanding communicators and collaborators, able to build, work with, and lead diverse teams. Our graduates will be champions of constructive and ethical action who proceed with intention and integrity.*

What came out of that process was the agreement that we ought to identify a short list of graduate student developmental competencies based on the vision, but need not closely parallel the undergraduate competencies. Our main criterion was: *what do we, as faculty, feel are important for graduates to achieve at some level in their 21st century graduate program.* The first and foremost competency was knowledge and was unanimously agreed as the cornerstone of graduate programs and the one that faculty valued the highest. After some debate, and input

from a variety of sources, conference talks, discussions and workshops, the EGE recommended adoption of five graduate student developmental competencies:

1. *Knowledge*
2. *Application (of Knowledge)*
3. *Context (of Knowledge)*
4. *Communication*
5. *Leadership*

The development of the graduate competencies occurred over two academic years, went through many versions with incorporation of input from constituencies. The first version of our table linked rubric-style entries of higher achievement levels corresponding to the various levels of graduate programs (certificates, masters, doctoral) in the downward direction against the five competencies across the table. Immediate feedback indicated that it would be too constraining because these competencies would be highly variable across colleges, and programs, even when at the same degree level (e.g. masters). So instead of degree level, the second version used *beginning*, *intermediate* and *advanced* for the levels, which were recast as *entry level* (immediately after graduation), *mid-level* (a few years after graduation) and *top level* (after substantial time in the field). Appendix 1 provides this version of the table which may be more appropriate for institutions seeking more specificity that we eventually adopted. The graduate competencies then somewhat paralleled the undergraduate competencies which uses *Level I* (first year), *Level II* (second year) and *Level III* (third year and beyond.

Further discussion indicated we should not try to define specific levels, so we listed a number of examples for guidance, with lots of flexibility to let the program faculty define for themselves what the competencies mean for themselves. Consistent with MSCHE documents on program level outcomes, it is fine for a program to not contribute to all outcomes; one of MSCHE's example is that an undergraduate chemistry program include university-level outcomes on leadership. Further feedback from MSCHE officers emphasized that the process should truly be useful and sustainable, and not to do it just to satisfy MSCHE.

After getting approval from each of the four college faculties and Lehigh University faculty, the GRC accepted the EGE report using the competencies listed in Table 3

EGE and GRC provided the clearly defined roles of those involved, (see Appendix 2). Those related specifically to SLO assessment are briefly summarized below:

1. *Role of the GRC* is to set expectations and be sure the graduate program review process is followed, which will include striving towards mature assessment practices which are a part of the process. GRC also helps facilitate sharing of best practices and provides guidance.
2. *Role of the Graduate Associate Deans* includes develop their college's *c*alendar of graduate program review and submit to the deputy provost for posting on the provost's web site, which determines when the SLO assessment practices will be presented to the GRC. All graduate programs at Lehigh University are scheduled to be reviewed (along with SLO assessment) on a 5 to 7 year cycle. They also help program leaders understand expectations, sharing best practices and coordinate with the review presentation.

Table 3. Graduate Student Developmental Competencies, with examples.

	Knowledge	Application	Context	Communication	Leadership
	Knowledge, methods and modes of thought and reasoning in the field.	Use of knowledge and methods of the field to understand and solve problems; fundamental professional responsibilities.	Development of the field over time; relationship with related fields and those with which it is applied.	Communication of ideas with peers and others	Recognizing constructive roles of self and others; assembling, leading and working in teams; mentoring; ethical awareness and action.
	Examples of specific competencies				
Increasing level of development ↓ ↓ ↓ ↓	Clear mastery of content in the field or the portion of the field appropriate to the degree. Recognize the limitations of current knowledge in the field; the ability to pose original questions that challenge current understanding. Contribute to advancement of knowledge in the field. Contribute to revision of established knowledge or theoretical frameworks.	Apply knowledge per established practice in the field. Recognition of established knowledge or practice applicable to a well-formed problem. Understanding of ethical dimensions of practice and making decisions accordingly Solve complex, unstructured or ill-structured problems; ability to contribute to ongoing evolution and advancement of practice in the field. Recognize ethical implications of decisions and act accordingly Marked creativity in solution of complex, unstructured, or ill-structured problems, contributing to significant advancement of practice in the field.	Awareness of development of the field over time; understanding of relationships with related fields or those along with knowledge in the field is applied. Predict or articulate the trajectory of change in knowledge, practice and dominant methods or frameworks; ability to discern previously unrecognized relationships between the field of study and other fields. Import methods or theoretical frameworks from one field into another.	Sound communications in multiple modalities, as appropriate for professional practice in the field. Communicate content in the field to others at different levels of understanding. Discern others' needs for information and understanding according to their goals and backgrounds and to inform them accordingly. Construct compelling arguments appropriate to the backgrounds and perspectives of a range of audiences.	Work effectively with peers in shared work. Understanding effects of own communication and action on others' thinking, motivation and behavior; taking ethical action accordingly. Work effectively with others of complementary capabilities. Advocate or guide others in ethical decision-making and action; consciousness-raising and ethical advocacy. Recognition of others' potential contributions according to their backgrounds and preparation; active role in development of other people; ability to assemble and lead productive teams.

3. *Role of the individual program leaders* is articulation of program goals and assessment:
   a. Explain how their program interprets the five new university-level graduate student learning competencies: Table 4 shows how the MBA program interpreted (mapped) their MBA Objectives to the university-level competencies. Their Objective #1 maps across three competencies (*Knowledge, Application and Context*); Objective #2 maps to *Context*, Objective #3 maps to *Leadership*, Objective #4 maps to *Communication*, and Objective #5 maps to *Application*. This example clarifies that program don't need have a one-to-one match to competencies or use the same terminology.
   b. Develop the methodology and set goals for incorporating the learning competencies into their academic program
   c. Decide the means of assessment and continual improvement.

We decided to follow the MSCHE philosophy to ask programs to strive to achieve the goal and report on the evolution of SLO assessment program over time, and a mature assessment program expected after the second cycle of review. Thus the process is still being defined and implemented, and will vary in the degree that programs meet the expectations.

The programs that have gone through the review process in the first two years of the program include all graduate programs in the College of Business and Economics, several programs each in the College of Education and College of Arts & Sciences. Because the SLO assessment program was still being developed when these programs were reviewed, a great deal of latitude was allowed for this first review. Higher expectations will be expected in the future.

In summary, the EGE proposal avoided dictating to programs what the assessment process should entail, leaving programs to defining the assessment process. Debate continues about the interpretation of the five competencies and nature of the assessment process. We decided that because programs are defining what they mean by the five competencies, they ought to define their assessment program.

6. Developing college-level graduate student learning assessment practices

The graduate associate dean of engineering is currently coordinating the effort for academic program review and SLO assessment. The graduate programs in the P.C. Rossin College of Engineering and Applied Science are currently implementing the framework described in Section 5 for program review and assessment program for SLO. The process is being discussed and is evolving. The graduate programs are adopting the 5 university-level graduate student developmental competencies: Knowledge, Application (of Knowledge), Context (of Knowledge), Communication and
Leadership. They will interpret what the program means by them, and begin to develop an assessment program that will mature by the second cycle of program review, currently planned for every seven years. The Technical Entrepreneurship program has chosen competencies and implemented an assessment program as highlighted next.

Table 4. Mapping of MBA Objectives to Graduate Student Developmental Competencies.
The Five University Level Competencies for all University Graduate Students (top half) and mapping of MBA Program Objectives (bottom half, numbered 1 to 5 in parentheses) to competencies.

		Knowledge	Application	Context	Communication	Leadership
University-level Competencies		Knowledge, methods and modes of thought and reasoning in the field.	Use of knowledge and methods of the field to understand and solve problems; fundamental professional responsibilities.	Development of the field over time; relation-ship with related fields and those with which it is applied.	Communication of ideas with peers and others	Recognizing constructive roles of self and others; assembling, leading and working in teams; mentoring; ethical awareness and action.
MBA Program Competencies		Provide a clear understanding of business concepts and the skills necessary to apply them in the context of the overall organization. **(MBA#1)**			Develop written, oral and virtual communication skills critical to our students' success. **(MBA#4)**	Develop students' abilities to provide leadership while working in teams. **(MBA#3)**
			Enable students to solve complex, unstructured busi-ness problems**. (MBA#5)**	Integrate diversity, globalization and ethics throughout the core curricu-lum**. (MBA#2)**		

Master of engineering in Technical Entrepreneurship (TE)
Having been approved in 2011 and launched in 2012, the Masters of Engineering in Technical Entrepreneurship (TE) is in its second year of operation. From the initial design of the 12 new TE courses that are required for this 30-credit graduate professional degree, the TE leadership and participating faculty embraced concept and challenge of

1. interpreting the five university-wide learning competencies as they relate to technical entrepreneurship,
2. developing the methodologies for incorporating these into the curriculum, and
3. developing the means of assessment and continuous improvement.

As the associate program administer for the TE program stated, student learning, as well as the assessment of that learning, is what we, as educators do. It is not new. What is new and needed for most faculty is a standard way to communicate this common goal.

The TE program leadership and faculty took full advantage of the 20 years of assessment experience gained by Lehigh University's award winning and nationally recognized Integrated Product Development (IPD) program. IPD is a truly multidisciplinary, project based capstone design sequence of courses where student teams work with mentors from established and start-up companies on developing real-world products and services. In 2013 the IPD program enrolled 210 students working 35 teams of 6 students on 23 sponsored projects. Over the course of the IPD program's development, the program outcomes, the student learning objectives and the assessment methods and tools were developed, practiced and continuously improved.

TE graduate student learning competencies
Based on the continued growing interest in IPD students to develop and commercialize their own products, the TE master of engineering program is designed as a continuation of the undergraduate capstone design experiences with a focus on developing student entrepreneurs. The learning competencies of the students enrolled in the TE program include the following:

1. Professional, personal, and interpersonal *skills*
2. *Knowledge* of the integrated product development and company start-up processes.
3. *Application* of the IPD and company start up processes in a global context.

These three general competencies are incorporated in specific TE course where warranted and throughout all 12 TE courses as needed. As noted in Table 5, TE#1 corresponds to university competencies 4 (Communication) and 5 (Leadership); TE#2 corresponds to university competencies 1 (Knowledge) and 3 (Context) and TE#3 corresponds to university competencies 2 (Application) and 3 (Context). These can be expressed as a mapping for Technical Entrepreneurship in a similar table as the one for the MBA (Table 4).

Incorporating the learning competencies into the TE curriculum
By starting the development of the TE program with the learning competencies as a design guide, the curriculum specifically addresses the three Knowledge, Application and Development learning competencies. Table 5 maps each of the 12 courses in the TE program to the competencies. The 12-month full-time 30-credits TE masters has three 10-credit semesters that include:

1. the "*skill development*" semester
2. the "*design"* semester
3. the *launch* semester

The first semester focuses heavily on skill development. The design and launch semesters have specific courses that focus on (1) knowledge of the IPD and startup processes, and (2) apply that knowledge to specific student-initiated projects. Individual skill development continue throughout both the second and third semesters.

Methods of assessment and continuous improvement
Following the IPD program example, the assessment of the TE program is based on a philosophy that all assessment must be direct, authentic and formative. To this end the TE faculty team has developed a set of rubrics for each of the deliverables required in each of the 12 courses. Some are more detailed and better practiced than others. We have the advantage of having over 30 separate rubrics from the IPD program[4] as examples and the administrative director of the program is a noted expert in assessment methods. While skill and knowledge competencies are considered straightforward, the application competency is a challenge as there is a wide range of products and companies being developed at any one time by the 25 or more TE students.

The development of these rubrics and other assessment methods are a regular topic of discussion at the bi weekly TE faculty and staff meeting. In these meeting lead by the program director, we discuss what we have done, what we are doing and what we are going to do next. We have a

Table 5. Mapping learning competencies to TE courses with a qualitative importance rating.

		University Competencies	Leadership & Communication	Knowledge & Context	Application & Context
		Technical Entrepreneurship Competencies	Skill Development	Knowledge Development	Application Development
	#	TE Course Number, Title, (credits)			
Skills Semester	1	TE 301. Creativity and Systematic Innovation Methods (3)	High	Medium	Low
	2	TE 407. Intellectual Property Creation and Management (2)	High	Medium	Low
	3	TE 302. Methods in Visual Thinking (2)	High	Medium	Low
	4	TE 303. Methods in Prototyping, Modeling and Testing (3)	High	Medium	Low
Design Semester	5	TE 401. Integrated Product Development (IPD) Process (3)	Medium	High	Low
	6	TE 403. Entrepreneurial Startup Process (3)	Medium	High	Low
	7	TE 405. Entrepreneurial Startup Projects (2)	Medium	Low	High
	8	TE 461. Integrated Product Development (IPD) Projects (2)	Medium	Low	High
Launch Semester	9	TE 402. Integrated Product Development (IPD) Process (3)	Medium	High	Low
	10	TE 404. Entrepreneurial Startup Process (3)	Medium	High	Low
	11	TE 406. Entrepreneurial Startup Projects (2)	Medium	Low	High
	12	TE 462. Integrated Product Development (IPD) Projects (2)	Medium	Low	High

collective focus on what we are trying to accomplish with regards to the competencies, what seems to be working, what did not work and how do we know. Based on consensus we decide what we will try next, add, remove or reconfigure and how recourses can be reallocated to achieve our student learning objectives.

7. Summary and conclusions

The overall evaluation by our regional accreditation commission of our 2013 Periodic Review Report[1] (PRR) was *"superlative."* They praised our undergraduate Student Development Competencies (SDC) and found our graduate competencies plan to be *"particularly thoughtful."* However, the PRR really just told the story of activities and practices at Lehigh University, and without strong assessment programs, the story would not be superlative or thoughtful. Also, none of the programs can proceed without buy in from faculty, and there is still a lot of implementation work, ensuring administration provides resources and faculty and staff recognition for assessment efforts.

Key factors in continued successful implementation include communication to constituents via workshops, presentations, reports, and other vehicles regarding expectations, guidance and examples of best practices. Communication of the need and importance and providing sufficient development time are essential factors in securing faculty and staff buy in.

Lehigh University's model is to set expectations and ask programs to strive to meet those expectations, which follow the philosophy used by our regional accrediting agency, which allows lead time for programs to strive to achieve their standards, and thus allowing programs needing more development to benefit from best practices of early adopters of assessment practices.

"Assessment of assessment plans and practices" is another important aspect of successful practices. We continue to assess how we are meeting our own expectations using tools such as Table 1, where the college self-evaluates the status of 13 Student Learning Assessment Practices using simple an assessment practices rubric for each, assessing which of the following that the practice has:

- no plans in college
- no evidence in college
- in a few areas in college
- in some areas in college
- in most areas in college
- everywhere in college

For the first time ever at Lehigh University, we now provide students with our expectations of their development from matriculation as undergraduate or graduate students to post-graduation with undergraduate (Table 2) and graduate degrees (Table 3). Some programs with exemplary assessment practices include the MBA (Table 4), other undergraduate and graduate business programs, programs in the graduate-only College of Education, graduate Technical Entrepreneurship in engineering (Table 5), and all nine undergraduate engineering programs (see Section 3). These programs provide guidance as "best practices" examples for other programs at different developmental points.

Although we have strong support for our new assessment plan, which complements the many fine existing ones, implementation is still occurring and diligence is needed to continue to meet the challenge.

Appendix 1. University-wide Graduate Student Competencies Table, early version with three post-graduation levels (entry, mid and top).

Possible Competency Name ========>	Knowledge	Application of Knowledge	Context	Communica-tion Skills	Leadership/ Collaboration
Possible text to describe what competency addresses ===========>	Knowledge, methods and modes of thought and reasoning in the field	Use of knowledge and methods of the field to understand and solve problems	Development of the field over time; relationship with related fields and those with which it is applied.	Communication of ideas to peers and others	Recognizing gaps in knowledge and ability that can be filled by others; assembling, leading and working in teams; ethical awareness and action
1 ENTRY LEVEL (At graduation)	Graduate has clear mastery of foundational content and practices in field, suitable to graduate-level entry to chosen profession.	Graduate applies knowledge to practice and solves problems logically and systematically.	Graduate has general understanding of how things he/she does and achieves in chosen professions contribute to related fields and perhaps more globally.	Graduate communicates clearly, both orally and in writing, using techniques appropriate to chosen profession.	Graduate employs management and leadership appropriate to chosen profession and is able to build, work with or direct groups with diverse skills and backgrounds.
2 MID-LEVEL (A few years out)	Graduate has more than foundational content knowledge in field, demonstrating additional professional knowledge appropriate to one with several years of experience in field.	Graduate is able to solve complex, unstructured or ill-structured problems to enhance practice and/or theory.	Graduate under-stands how know-ledge and practices in chosen field affect related fields and acts in ways that enhance global applicability of what he/she does and achieves. Graduate has broader appreciation of how accomplishments contribute to society.	Graduate is adept at communication and persuasion, building articulate arguments orally and in writing. His/her communications demonstrate appreciation of audience and context, particularly in settings of chosen profession.	Graduate demonstrates effective leadership in field and utilizes techniques to optimize effective-ness of those with whom he/she works, particularly when there is notable diversity among those involved. Graduate has attained position of leadership appropriate to years of experience in field.
3 TOP LEVEL (After *substantial* time in field)	Graduate has extensive knowledge in field, drawing on existing knowledge and professional experience to generate new knowledge and practices. Graduate is recognized for new knowledge or practices he/she has generated.	Graduate solves complex unstructured or ill-structured problems effect-tively, often using creative new methods His/her methods and solutions contribute significantly to field and are recognized for this contribution.	Graduate has demonstrated impact across multiple contexts, both within field and outside it. Graduate serves as nexus for multiple fields and contexts in ways that increase benefit and impact of his/her accomplishments. Graduate has been recognized for key role in synergist and convergent efforts.	Graduate is powerful communicator whose messages are widely monitored and whose opinions and arguments are globally appreciated. Graduates is in high demand as speaker and presenter or as writer in field and more globally and his/her communica-tions have major impact on opinion, knowledge or practice or benefit society greatly.	Graduate has led significant initiatives in chosen profession and exerted leadership at regional, state, national or international level. Graduate has been recognized formally for leadership efforts and others turn to him/her to advance field or society in general.

Appendix 2. Roles and responsibilities for program review and competencies, from *Framework for Program Review Report* **submitted to the Graduate and Research Committee (GRC) by the Enhancing Graduate Education (EGE) Committee.**

The EGE recommendations for program review are best explained in terms of the roles and responsibilities of the stakeholders in the process.

Role of the Program: Articulation of Program Goals
As part of its framework for program self-study, a program should identify its individual goals and their relationship to university-wide competencies. The colleges may provide specific processes for doing so. Typically, a program will
1. interpret the university-wide competencies in the context of that program's field of study and the likely career needs of students in the program and then set its goals for development of student competency in each area.
2. identify its specific entry requirements, learning objectives, curriculum, degree requirements, etc., that support achievement of its goals and determine how it assesses student progress up to the time of graduation. This is something all programs presently do, whether tacitly or through formal processes defined by their colleges.
3. describe how the program will assess the degree to which its goals are being achieved after graduation.

Role of the Program: Periodic Program Review
1. Program review should be conducted at regular and appropriate intervals, on a schedule determined by the college, in concert with GRC, taking into account factors such as allocation of administrative support and alignment with accrediting agency cycles. For graduate programs accredited by external agencies, program reviews should seek synergy across review processes and avoid unnecessary duplication.
2. The program review should include diligent and frank self-assessment of the extent to which a graduate program is meeting its goals, attending as much as possible to evidence of competency leading to success after graduation.
3. The review should support formulation of action plans for continuous improvement, included how to address identified deficiencies. Self-assessment, augmented by any input from accreditation bodies or external advisors, should determine the need for revision of a program's goals and/or the means through which its goals are met.
4. In formulating action plans, the program should consider how they align with and complement college and university strategic plans.

Role of Colleges in Program Design and Review
1. The college assures that each of its programs completes a diligent and substantive periodic review according to its schedule and provides support for conducting those reviews. This may include establishing appropriate review processes for use within the college as well as necessary administrative support.
2. In concert with the GRC, colleges establish and maintain the calendar of reviews for their graduate programs.
3. Internally, colleges make use of the results of program reviews to enhance graduate programs and address college strategic needs and priorities.
4. Colleges make available to the GRC reports on the outcomes of graduate program reviews.

Role of Graduate Associate Deans (GADs)
1. GADs monitor the schedule of periodic reviews for graduate programs in their colleges. GADs notify the GRC when changes to that schedule are necessary, providing an explanation for any change.
2. GADs work with deans and graduate programs to determine who should prepare summaries of program reviews and make review presentations to the GRC. In some cases, this presenter may be the GAD.
3. GADs serve as agents for sharing problems, solutions and best practices, within colleges (in accord with college practices) and across colleges.
4. GADs assist colleges, departments and graduate programs in understanding university (GRC) expectations.
5. GADs help the university-level committee (GRC) understand college, department and graduate program priorities and needs.

Role of the Graduate and Research Committee (GRC)
As specified in the Rules and Procedures of Lehigh University, GRC has responsibility to *"[r]eview the appropriateness and quality of graduate programs and research activities in relation to the educational objectives of the university.*" Because these recommendations are framed specifically in terms of fulfillment of university-wide goals by each graduate program, GRC has a central role. Because the work of each program, with support from its college, needs to set its own objectives and determine how best to meet them, the natural role for GRC is in setting expectations and facilitating exchange of information. GRC can also play a critical role in discerning university-wide needs.
1. The GRC sets expectations for periodic reviews of all University graduate programs, reviews that are diligent, creative and constructive.
2. In consultation with the colleges, the GRC derives a calendar for all periodic program reviews.
3. The GRC reviews summaries of the periodic program reviews.
4. The GRC facilitates sharing best practices among graduate programs, both within and across departments and colleges.

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