

Core Competencies Report

The Core Planning Committee charged three groups working on the core curriculum revision to investigate and make recommendations regarding the following competencies: written communication, oral communication, second language, critical thinking, information literacy, mathematical reasoning and problem solving, and quantitative reasoning. In each case, committee members completed a set of readings and engaged in numerous discussions regarding the nature of each competency and how it might be shared across disciplines by a supporting core curriculum. We are in agreement that the seven competencies presented here are essential and foundational in the process of reasoning and set of skills each represents. This report provides an analysis and set of recommendations for each competency and concludes with a list of structural requirements for incoming first-year and transfer students.

Written Communication

We recognize that the importance of learning to write masterfully is central throughout the curriculum. There are several challenges in conceptualizing it as a competency shared within a core curriculum. It was important to acknowledge that the writing process must be fully embedded within multiple contexts with different purposes and audiences, appropriately address widely varying content, and be fully sensitive to the conventions of different disciplines and genres. It is a process that requires reflective iteration throughout our students' education, beginning in the first year and culminating in a senior-level capstone project. It can involve "working with many different writing technologies, and mixing texts, data, and images" (*AAC&U Written Communication Value Rubric*). Below we have provided a set of outcomes as an initial draft, requiring appropriate study and refinement by a designated faculty committee convened for the purpose of implementing this core competency within the core curriculum.

Suggested Outcomes

The outcomes listed below are derived from the AAC&U Written Communication Value Rubric. This document is based on the National Council of Teachers of English/Council of Writing Program Administrators' White Paper on Writing Assessment (2008) and the Conference on College Composition and Communication's Writing Assessment: A Position Statement (2008). These are focused on the *interdisciplinary nature* of writing as a core competency. By capstone-level, students will be able to:

- a) Demonstrate a thorough understanding of context, audience, and purpose that is responsive to the assigned task(s) and focuses all elements of the work (*Context of and Purpose for Writing*).
- b) Use appropriate, relevant, and compelling content to illustrate mastery of the subject, conveying the writer's understanding, and shaping the whole work (*Content Development*).
- c) Demonstrate detailed attention to and successful execution of a wide range of conventions particular to a specific discipline and/or writing task (s) including organization, content, presentation, formatting, and stylistic choices (*Genre and Disciplinary Conventions*).
- d) Demonstrate skillful use of high quality, credible, relevant sources to develop ideas that are appropriate for the discipline and genre of the writing (*Sources and Evidence*).

- e) Use graceful language that skillfully communicates meaning to readers with clarity and fluency, and is virtually error-free (*Control of Syntax and Mechanics*).

A critical feature of the outcomes is their developmental nature. We expect that students will achieve varying outcome levels depending on the degree of practice and their maturity as individuals. Accordingly, we make the following set of curricular recommendations.

Curricular Recommendations:

Writing is a process that develops over the span of a student's undergraduate education. Students should be introduced to the process early as a foundation and then develop fluency in the genres of their own disciplines as they progress. The supporting curriculum for this process includes:

- Foundational first-year curriculum: The first-year 3-unit writing course will be linked to the LLC-themed course or the LLC-linked course and work with faculty in those courses to provide integrated content and context. The writing course MUST BE completed during the first year. Initially, the First-year Writing Course may focus on literature in English and other language, but could be expanded to include other genres and disciplines across other academic divisions and units. We recommend that it be given a course designation such as WRIT (writing) or FYW (first-year writing) to distinguish it as a core course.
- Flagged Course above 100-level: Students will also be expected to take at least one flagged course above 100-level. These courses may be taken in the core, in the major, or as electives provided they meet the learning outcome requirements.
- Capstone experience: The process of writing should culminate in the capstone project, whether this project is embedded in a course for the major or the core or is accomplished independently through community service or other co-curricular context.

We also recommend that all students be screened for writing competency as they enter the university as first-year or transfer students. There are several writing proficiency exams that could be used, including UC's writing exam. Students who perform below a basic level of proficiency could receive assistance in several forms, including tutorial assistance and targeted sections of the First-Year Writing Course. Faculty who teach writing should be assisted by providing sufficient development opportunities to successfully embed writing into their courses.

References:

Association of American Colleges and Universities (AAC&U) Written Communication Value Rubric. (2010)
Retrieved from <http://www.aacu.org/value/rubrics/WrittenCommunication.cfm>

Conference on College Composition and Communication's Writing Assessment: A Position Statement (2008). Retrieved from <http://www.ncte.org/cccc/resources/positions/123784.htm>

Haswell, R.H., (2008). Teaching of writing in higher education. In Bazerman, C., Ed. *Handbook of research on writing*. New York: Lawrence Erlbaum.

National Council of Teachers of English/Council of Writing Program Administrators' White Paper on

Oral Communication

Traditionally, USD has not required students to demonstrate their oral communication proficiency in the core curriculum. Investigating outcomes across disciplines, it is clear that many majors do understand its central role by requiring oral presentation skills as a program learning outcome. Moreover, every discussion of essential outcomes for our USD undergraduates has included this competency. Its contribution to a liberal arts education is noted by national level educational organizations such as the Association of American State Colleges and Universities (AASCU) and the Association of American Colleges and Universities. Additionally, in a 2010 national survey of employers, the areas they identified as requiring increased focus first include written and oral communication, then critical thinking and analytic reasoning, the application of knowledge in real-world settings, ethical decision making, and teamwork (Hart Research Associates, 2010).

Suggested Outcomes

Our understanding of the oral communication competency is based upon several key documents from the National Communication Association that are embedded in the outcomes below (Morreale, S., Rubin, R.B., & Jones, E., 1998; Simonds, C.J., Buckrop, J., Redmond, M., & Quianthy, D.H., 2012). We incorporate the conceptual definition of oral communication from the *AAC&U Value Rubric for Oral Communication* as “Oral communication is a prepared, purposeful presentation designed to increase knowledge, to foster understanding, or to promote change in the listeners' attitudes, values, beliefs, or behaviors. This conceptualization is meant to be applied to individual speakers who have constructed a presentation of sufficient length to be judged on its own merit” (AAC&U, 2010). We provide a set of outcomes in this document as an initial draft, requiring appropriate study and refinement by a designated faculty committee convened for the purpose of implementing this core competency within the core curriculum. By capstone-level, students will be able to

- a) Construct presentations with clear and consistently observable organizational patterns (specific introduction and conclusion, sequenced material within the body, and transitions); the pattern is skillful and makes the content of the presentation cohesive (*Organization*).
- b) Chooses language that is imaginative, memorable and compelling and enhance the effectiveness of the presentation. Language in presentation is appropriate to audience (*Language*).
- c) Masters delivery techniques (posture, gesture, eye contact, and vocal expressiveness) that make the presentation compelling, and appears polished and confident (*Delivery*).
- d) Applies a variety of types of supporting materials (explanations, examples, illustrations, statistics, analogies, quotations from relevant authorities) and makes appropriate reference to information or analysis which significantly supports the presentation or establishes the presenter's credibility/authority on the topic (*Supporting Material*).
- e) Delivers a central message that is compelling (precisely stated, appropriately repeated, memorable, and strongly supported) (*Central Message*).

There are two key features needed when considering how to embed these outcomes. Faculty should be able to evaluate individual speakers, including participants who are presenting in panels or groups.

Additionally, the presentations should be of sufficient length so that the outcomes can be achieved; therefore they are not suitable for oral exam answers).

Again, one critical feature of the outcomes is their developmental nature. We expect that students will achieve varying outcome levels depending on the degree of practice and their maturity as individuals. Accordingly, we make the following set of curricular recommendations.

Curricular Recommendations:

Students should be introduced to oral communication skills early and be encouraged to develop these in the core and in some majors throughout the span of their undergraduate education. We make the following curricular recommendations:

- Foundational First-Year Curriculum: out of our concern for the size of the core curriculum, we recommend that the outcomes for oral communication be embedded within the first-year LLC and LLC-linked one-unit requirements for integration for a total of two-units. This would enable students to practice these skills during the first semester for the purpose of some form of presentation (perhaps of an integration-based project) during the second semester.
- Flagged course above 100-level: Students will also be expected to take at least one flagged above 100-level course. These courses may be taken in the core, in the major, or as electives across a variety of disciplines provided they meet the learning outcome requirements.
- Capstone experience: The oral communication competency should culminate in the presentation of a capstone project, whether this project is embedded in a course for the major or the core or is accomplished independently through community service or other co-curricular context.

Following the first year, students may be guided through advising to courses that are flagged for oral competency at the 200- and 300-level. Students should also have some assistance available, such as mentoring and tutoring for students high in communication apprehension. Faculty who teach courses with the embedded oral communication outcomes should be assisted by providing sufficient development opportunities to successfully embed this competency into their courses.

References:

AAC&U Oral Communication Value Rubric (2010). Retrieved from:
<http://www.aacu.org/value/rubrics/OralCommunication.cfm>

Morreale, S., Rubin, R.B., & Jones, E. (1998). Speaking and listening competencies for college. Washington DC: National Communication Association.

Simonds, C.J., Buckrop, J., Redmond, M., & Quianthy, D.H. (2012). Revised resolution on the role of communication. *Report to NCA Legislative Assembly*. Washington DC: National Communication Association.

Second Language

We have required second language proficiency as an indispensable competency at USD for many years. Although Bok (2006) noted a trend toward dispensing with this competency in a number of colleges and universities, many argue that this requirement is foundational to equipping students for global contexts (AAC&U National Leadership Council, 2007). Second Language proficiency refers to the ability of students to achieve basic proficiency in a second language in speaking, listening, writing, and reading. It is also recommended that we include a cultural competency as well which is suggested below as the fifth and sixth outcomes.

Suggested Outcomes

The outcomes listed below are derived from the current outcomes for several languages at the 201 competency at USD. These were based on foundational criteria suggested by the American Council on the Teaching of Foreign Languages (ACTFL). We can begin with these as suggested outcomes that will require full development and formal acceptance by the faculty. But we should also acknowledge that the limits identified below are the bare minimum of acceptability to achieve intermediate levels of competency according to the ACTFL standards.

- a) Speaking: Intermediate Mid: Speakers at the Intermediate Mid sublevel are able to handle successfully a variety of uncomplicated communicative tasks in straightforward social situations. Conversation is generally limited to those predictable and concrete exchanges necessary for survival in the target culture. These include personal information related to self, family, home, daily activities, interests and personal preferences, as well as physical and social needs, such as food, shopping, travel, and lodging.
- b) Listening: Intermediate Low: At the Intermediate Low sublevel, listeners are able to understand some information from sentence-length speech, one utterance at a time, in basic personal and social contexts, though comprehension is often uneven. At the Intermediate Low sublevel, listeners show little or no comprehension of oral texts typically understood by Advanced-level listeners.
- c) Reading: Intermediate Mid: At the Intermediate Mid sublevel, readers are able to understand short, non-complex texts that convey basic information and deal with basic personal and social topics to which the reader brings personal interest or knowledge, although some misunderstandings may occur. Readers at this level may get some meaning from short connected texts featuring description and narration, dealing with familiar topics.
- d) Writing: Intermediate Low: Writers at the Intermediate Low sublevel are able to meet some limited practical writing needs. They can create statements and formulate questions based on familiar material. Most sentences are re-combinations of learned vocabulary and structures. These are short and simple conversational-style sentences with basic word order. They are written almost exclusively in present time. Writing tends to consist of a few simple sentences, often with repetitive structure. Topics are tied to highly predictable content areas and personal information. Vocabulary is adequate to express elementary needs. There may be basic errors in grammar, word choice, punctuation, spelling, and in the formation and use of non-alphabetic symbols. Their writing is understood by natives used to the writing of non-natives, although

additional effort may be required. When Intermediate Low writers attempt to perform writing tasks at the Advanced level, their writing will deteriorate significantly and their message may be left incomplete.

- e) **Cultural Competence: Diversity, inclusion, and social justice:** Students can identify and explain fundamental issues of diversity, inclusion, and social justice in historical and current contexts of culture in which the language is embedded (to be coordinated with the Inclusion and Social Justice requirement at local and global levels. See outcomes in DCC proposal.)
- f) **Cultural Competence: Intercultural competence:** Students can demonstrate the capacity to interact appropriately and effectively within diverse social settings and cultural contexts within the language community and beyond.

These specific recommended outcomes are ACTFL standards for fluency, evidence of outcome achievement at these specified levels. Our current curriculum based on a third semester 3-unit course is insufficient for most students to achieve the first four of these outcomes. Accordingly, we make the following set of curricular recommendations.

Curricular Recommendations:

This core committee is fully aware of the desire not to add core courses. However, the current curricular model we have adopted means that the majority of our students are not able to achieve the bare minimum proficiency standards. We therefore recommend:

- Proficiency for core courses must reach intermediate levels identified in above outcomes; increase the current units from 3.0 to 4.0 for language courses.
- The language requirement must be completed in consecutive semesters if students must take more than one course (up to three).
- Students should be encouraged to develop global cultural competence in keeping with the ISJ requirement.

We also recommend that all students be screened for second language competency as they enter the university as first-year or transfer students. Competency can be met through AP, IB, or competency exams. A placement exam will be given to place entering or transfer students. Students should also receive assistance in several forms, including mentoring and tutorial assistance through the *Language Commons*.

References:

AAC&U National Leadership Council (2007). *College learning for the new global century*. Washington DC: AAC&U.

American Council on Teaching of Foreign Languages. Retrieved at: <http://www.actfl.org>

Bok, D. (2013). *Higher education in America*. Princeton, NJ: Princeton University Press.

Critical Thinking

It has been clear from the beginning of our discussions that “critical thinking” is an academic standard that we all expect students to achieve; as one committee member commented, “We all believe that we *should* teach critical thinking in all of our classes.” Based on a set of readings and our discussions, we considered what dimensions might represent a “core” critical thinking concept and therefore were intended to be applied across disciplines (Facione, 1990; Costa and Luckey in Fasko, 2003) The results appear in the table below. We recognize that the conceptualization and operationalization of critical thinking as outcomes would require much greater elaboration and refinement but these may serve as an initial construction:

CT Dimensions	Critical Thinking Descriptions
Explanation of issues/problems	Asks questions and formulates ideas in engaging abstract concepts in the process of defining the scope of an issue or problem
Support	Employs or uses support, data, or assumptions to arrive at conclusions via discipline specific procedures, practices, or techniques.
Influence of assumptions	Consider influence of held assumptions when presenting an issue or problem.
Student’s thesis	Constructs a clearly articulated formulation of a well-defined problem or question, while acknowledging parameters and multiple perspectives.
Conclusions	Reaches well-supported conclusions and implications for future, fruitful avenues of inquiry.

Despite our attempts to arrive at a general consensus about our conceptualizations, we decided that the process is best understood when it is contextualized within a discipline and embedded in a process of inquiry. It was not long after this mutual construction that we reread the inquiry descriptions from the breadth group:

- **Artistic inquiry:** Students deploy critical skills to delve into works of art, architecture, music, and/or theatre within their historical contexts and experiential dimensions, questioning received knowledge and presuppositions.
- **Historical and Literary inquiry:** As students probe literary theory, the assumptions of periodization, and the interstices among genres, they learn to critically analyze or create original poetry, prose fiction, creative nonfiction, drama, and/or other cultural products. Students come to understand the formal features of a text, deploy techniques in close reading, and interpret primary and secondary sources. Through the in-depth study of history and historiography, students develop the capacity to examine truth claims and think

historically as they recognize the reciprocal relationship of social context and individual action.

- Social and Behavioral inquiry: Students think systematically about humans, societies, organizations and their interactions. Within the framework of theoretical and methodological perspectives, they evaluate evidence and apply their understanding to the real world.
- Scientific inquiry: Scientific and technical literacy is gained through guided inquiry that includes hands-on opportunities to formulate hypotheses, conduct experiments, analyze data, and interpret results. Students are expected to develop scientific models, create algorithms, or engineer solutions. These activities will allow them to understand better how science, engineering, and technology are used to identify and solve complex problems that face society in the 21st century.

It seemed to us that there was a great deal of conceptual overlap between the general processes we were describing in the table and the methods of inquiry described in each of the four domains. Indeed, several cognitive theorists have suggested that the critical thinking process is, in fact, domain-specific, with sets of epistemic and methodological assumptions unique to each domain (Brookfield, 2011; Nufher, 2012) Considering critical thinking as foundational to the inquiry process has implications for curricular design we will discuss in the final section of the Critical Thinking-Information Literacy (CTIL) report.

Because of the way that we are conceiving of critical thinking and information literacy, we will discuss each competency separately but then combine our recommendations for the curriculum into one section.

Information Literacy

When we began our discussions, there was some confusion over the term “information literacy” itself. After reading several sources, we present the general definition of information literacy as provided by the Association of College & Research Libraries (ACRL) as the beginning basis for understanding this competency, including information searching, application, and evaluation processes as described in the table below (AAC&U, 2010; Eisenberg, Lowe, & Spitzer, 2004).

Suggested Outcomes

We recognize that these dimensions would require further work by the committee which would oversee this competency. We also acknowledge that this definition would not include a competency in information technology, but it does incorporate some aspects of digital competency, such as manipulating information-seeking strategies and programs. We have also assumed that the processes described in the table would be fundamentally part of the inquiry processes described earlier and will therefore have implications for the core curriculum.

IL Dimensions	Information Literacy Descriptions
Determine the extent of information needed	Effectively defines the scope of the research question or thesis, determining key concepts. Types of information (sources) selected directly relate to concepts or answer research question.
Access the needed information	Accesses information using effective, well-designed search strategies and most appropriate information sources.
Evaluate Information and its Sources Critically	Selects variety of information sources appropriate to the scope and discipline of the research question, using multiple criteria (such as relevance to the research question, currency, authority, audience, and bias or point of view).
Use Information Effectively to Accomplish a Specific Purpose	Communicates, organizes and synthesizes information from sources to fully achieve a specific purpose, with clarity and depth.
Access and Use Information Ethically and Legally	Applies correctly information use strategies, including use of citations and references; choice of paraphrasing, summary, or quoting, preserving original integrity; demonstrates a full understanding of the ethical and legal restrictions on the use of published, confidential, and/or proprietary information.

Curricular Recommendations:

We propose that the critical thinking and information literacy competencies be embedded within the four methods of inquiry that will serve as a basis for the breadth requirement in the core. Initially we considered the possibility of a separate “foundations” course that might combine several competencies, such as critical thinking, information literacy, and writing, a model used by several institutions. But there was less support for this model than embedding CTIL within the methods approach. Conceptually, these seemed to be the better fit and would require no additional coursework.

Because all competencies are expected to be acquired through a developmental process, we would assume that the competencies would be embedded as follows:

- Foundational First-Year Curriculum: out of our concern for the size of the core curriculum, we recommend that the outcomes for critical thinking and information literacy be embedded within the first-year LLC and LLC-linked method of inquiry requirements, but these could also be embedded in other breadth requirements. This would serve as an initial foundation for understanding interdisciplinary approaches to these processes

- Flagged course above 100-level: Students will also be expected to take at least one flagged course above 100-level for critical thinking and information literacy. These “method of inquiry” courses may be taken in the core, in the major, or as electives across a variety of disciplines provided they meet the learning outcome requirements.
- Capstone experience: The critical thinking and information literacy competencies should culminate in the presentation of a capstone project, whether this project is embedded in a course for the major or the core or is accomplished independently through community service or other co-curricular context as students prepare to leave USD.

Transfer students who enter at the second or third year should be assessed for their critical thinking and information literacy so that they could be advised to take targeted flagged courses for transfer students (like our current transfer preceptorials) that would emphasize critical thinking and information literacy as fundamental to the process of inquiry.

References:

AAC&U Critical Thinking and Information Literacy Value Rubrics: Retrieved at:

<http://www.aacu.org/value/rubrics>

Brookfield, S. (2012). *Teaching for critical thinking*. Chapter 6 [Reading and writing critically]. San Francisco: Jossey-Bass.

Costa, A. (2003). Communities for developing minds. In D. Fasko, Jr. (Ed.) *Critical Thinking and Reasoning*, New York: Hampton Press.

Eisenberg, M.B., Lowe, C.A., Spitzer, K.L. (2004). *Information literacy: Essential skills for the information age*. 2nd edition. Santa Barbara: Libraries Unlimited.

Facione, P. (1990). The American Philosophical Association Delphi Report. Millbrae, CA: California Academic Press.

Luckey, Jr., G.M. (2003). Critical thinking in colleges and universities: A model. In D. Fasko, Jr. (Ed.) *Critical Thinking and Reasoning*, New York: Hampton Press.

Nuhfer, E. (2013). A metadisciplinary approach to a curriculum for higher reasoning: Educating in fractal patterns. *The National Teaching & Learning Forum*, 22 (5), 1-5.

Mathematical Reasoning and Problem Solving

The Two Types of Reasoning

It may seem to individuals who are not conversant with the terms that mathematical reasoning and quantitative reasoning are referring to the same processes. However, as we define these competencies with their affiliated outcomes, you will begin to discern some important distinctions.

Mathematics as Inquiry and Competency¹

Mathematics has two principal forms (De Lange, 2003, p. 77; Niss, 2003, pp. 218 – 219; Steen, 2003, p. 69):

1. It is the practice of *mathematical reasoning² and problem-solving*, independent of discipline, point of view, or belief. The problem-solving algorithms and techniques developed when solving mathematical problems transfer to other disciplines because of their abstract nature.
2. It is the *universal language of science and technology*, a language that transcends the individual disciplines and allows precise statement and study of fundamental laws of the natural world, technical world, and the social world.³

We offer the following as a definition of mathematical reasoning: creating, following and assessing chains of mathematical arguments; explaining, interpreting, and correctly applying definitions, theorems, and results; having familiarity with the idea of mathematical proof (including the ability to understand and explain simple proofs, to understand and derive mathematical formulas, and to recognize the difference between proofs and informal arguments). This type of reasoning is crucial when creating and stating problems to be solved, building mathematical models, solving problems, understanding the results and solutions of others, and correctly using our current (and ever-increasing) body of knowledge in mathematics and other fields. This type of reasoning should not be confused with nor limited to the ability to use methods to compute and manipulate quantities.

The language of mathematics is used to model real-world processes. Mathematical models enable us to describe and study the behavior of these processes, which can allow us to discover and describe phenomena and properties of these processes that were not easily noticeable without the use of the model. The language of mathematics is independent of any field and it is often the bridge that allows experts in different fields to communicate and work together and expand our current body of knowledge.

Suggested Outcomes

We have therefore identified three learning outcomes as essential to mathematical reasoning and problem solving (MRPS):

¹ Portions have been taken from the 1/14/13 report from the USD Mathematics Department on *Mathematical Competency for USD graduates*.

² Mathematical reasoning is understood to be abstract and rigorous.

³ For example, the motion of a ball, growing balance of a bank account, measurable changes in social attitudes, spread of a rumor, or dynamics of an epidemic, can all be described by the same mathematical equation.

1. **Problem solving and modeling.** Demonstrate problem-solving skills, including applying mathematical methods to solve problems, working with mathematical models, and persisting in the face of difficulty.
2. **Mathematical reasoning, argumentation, and proof.** Be able to create, follow and assess chains of mathematical arguments; be able to explain, interpret, and correctly apply definitions, theorems, and results; be familiar with the idea of mathematical proof (including the ability to understand and explain simple proofs, to understand and derive mathematical formulas, and to recognize the difference between proofs and informal arguments).
3. **Communication.** Be able to clearly communicate mathematical reasoning, argumentation, proof, and solutions to problems (including using appropriate justification, complete sentences, and correct notation, terminology, and symbolism).

MRPS Curricular Recommendations

Mathematics can also be regarded as an indispensable foundation, which means that students should take their mathematics (MRPS) course in the first year or two of their studies at USD. All students should be assessed by either successfully passing a mathematical competency exam or by completion of a MRPS core mathematics course in which the learning outcomes listed above have been embedded. Students may take an additional math course which could also satisfy the quantitative reasoning (QR) requirement.

References:

- De Lange, J. "Mathematics for Literacy." *Proceedings of the National Forum on Quantitative Literacy, Washington, D.C., December 1 – 2, 2001.* Ed. Bernard L. Madison and Lynn Arthur Steen. Princeton, New Jersey: National Council on Education and the Disciplines, 2003. 75 – 89.
- Niss, M. "Quantitative Literacy and Mathematical Competencies." *Proceedings of the National Forum on Quantitative Literacy, Washington, D.C., December 1 – 2, 2001.* Ed. Bernard L. Madison and Lynn Arthur Steen. Princeton, New Jersey: National Council on Education and the Disciplines, 2003. 215 – 220.
- Steen, L. A. "Data, Shapes, Symbols: Achieving Balance in School Mathematics." *Proceedings of the National Forum on Quantitative Literacy, Washington, D.C., December 1 – 2, 2001.* Ed. Bernard L. Madison and Lynn Arthur Steen. Princeton, New Jersey: National Council on Education and the Disciplines, 2003. 53 – 74.

Quantitative Reasoning as Inquiry and Competency (Literacy):

Citizens in the 21st century are awash in data, but are poorly prepared to draw meaning from this overwhelming volume of information. Students need to cultivate their ability to apply mathematical and quantitative reasoning to topics within mathematics and to a variety of other disciplines in order to solve complex problems and issues they will face, such as social justice and sustainability. Quantitative reasoning in this context refers to the ability to convert relevant information into mathematical forms (e.g. equations, graphs, diagrams) and to derive meaning from data presented graphically or in tabular form. Furthermore, students need to evaluate the validity or quality of data and express quantitative

evidence in support of an argument, while recognizing the assumptions and limitations of their information. Development of these competencies thus reinforces student learning within the framework of USD's mission and allows them to explore complex issues more deeply and to participate in generating solutions to national or global problems.

Several proponents of quantitative reasoning (QR) define the term very broadly as "the habit of mind to consider the power and limitations of quantitative evidence in the evaluation, construction, and communication of arguments in public, professional, and personal life" (Grawe, Carleton College). The four facets of QR identified by Steen (2001) include: 1) QR requires a basic skill set; 2) QR demands application in context; 3) QR involves argument; 4) QR is a habit of mind or a way of thinking. According to Grawe, students at Carleton are expected to: think quantitatively, implement methods competently, interpret data and evaluate thoughtfully, and communicate their findings effectively.

Suggested Outcomes

We recommend at least implementing the three outcomes listed below. These are derived from the AAC&U VALUE rubric on Quantitative Literacy:

1. **Interpretation and representation.** Explain information presented in mathematical forms (e.g., equations, graphs, diagrams, tables, words) and convert relevant information into various mathematical forms (e.g., equations, graphs, diagrams, tables, words).
2. **Application, analysis and assumptions.** Make judgments and draw appropriate conclusions based on the quantitative analysis of data, while recognizing the limits of this analysis and make and evaluate assumptions in modeling, estimation, and statistical tests.
3. **Communication.** Express quantitative evidence in support of an argument or decision (in terms of what evidence is used and how it is formatted, presented, and contextualized).

It should be recognized that these QR learning outcomes represent our initial recommendation that would require further work by the faculty implementation committee for this competency. Moreover, there are a number of proponents in the field who urge faculty development in teaching QR across the curriculum so that the outcomes are embedded into courses across divisions. We found examples of illustrations in the sciences, social sciences, and humanities. Experts recommend development that builds skills and nurtures a community of scholars across campus working on curricular improvement and revision.

QR Curricular Recommendations

We recommend that all students be screened to assess whether they need a basic skills course in QR; this course should count toward graduation to better motivate students. There are several measures we should explore to help with initial screenings. For example, Bowdoin uses a QR entrance exam for advising students that was originally piloted at Bowdoin, Colby-Sawyer, and Wellesley Colleges with robust samples of students over several years (need reference). Students below basic levels should be enrolled in a basic skills course within the first year to bring skill-levels up to par. Beyond the basic skills course, which many students would NOT need, students will take a QR-flagged course; there would be no set required QR courses in the curriculum. Courses would be flagged as QR courses inside and

outside of the core/major. The QR-flagged courses may occur exclusively in the core or as electives for some students, or they may also occur exclusively in some majors. It would be rare that students would have to take an extra course to meet the QR-flagged course requirement.

References

AAC&U Value Rubric for Quantitative Literacy. Retrieved at: <http://www.aacu.org/value/rubrics>

Gaze, E. (October, 2013). *QR across the curriculum: From creating assignments to measuring outcomes*. Presentation for WASC Retreat on Core Competencies: Quantitative Reasoning. Pomona, CA.

Grawe, N., Lutsky, N.S, & Tassava, C.J. (2010). A rubric for assessing quantitative reasoning in written arguments. *Numeracy*, 3, Retrieved from:
<http://scholarcommons.usf.edu/numeracy/vol3/iss1/art3/>

Steen, L. A. (2001). *Mathematics and democracy: The case for quantitative literacy*. Princeton, NJ: The Woodrow Wilson National Fellowship Foundation.

In this last section, we would like to identify features of the seven competencies that are shared. These are followed by a general model draft that would show how the pieces of the core curriculum might potentially fit together.

Common Features across Competencies:

- **Development course structure:** competencies may be embedded in foundational courses or exist in stand-alone foundational courses; however, all must be embedded as course outcomes in at least two additional flagged courses above 100-level in the curriculum: one as preparation for the capstone and one at the capstone level. These may be taken inside or outside of the major.
- **Foundations level courses:** These must be completed in the first year. First & Second Semesters: LLC breadth and linked 3-unit course (CTIL) + 1-unit integration (OC) + Writing course (WC) OR Mathematics (MRPS) course (flip with second semester)
- **Entry-level screening (includes transfer students):** All students must be tested for competencies in writing, mathematics, quantitative reasoning, and second language. Competency exams would allow students to test out or to be placed in appropriate-level courses [AP credit may be allowed for some competencies]. International students should be screened for proficiency at entry. Transfer students would participate in a preceptorial course that embeds CTIL (critical thinking and information literacy) and OC (oral communication). Transfer preceptorials should provide specific competencies that need strengthening.
- **Capstones:** Capstone experiences can vary widely by program; some are full courses within a program's curriculum occurring during students' final year as undergraduates. Others could be senior projects that exist outside of the curriculum and may incorporate other characteristics, such as community service learning. From a competency perspective, we wish only to comment on the general expectation that a capstone experience a synthesis of competencies at degree completion. The details of implementation would still require further work.
- **Successful implementation:** We cannot underscore enough how necessary it will be to provide adequate faculty development and support to successfully implement the recommendations contained in this document. It is clear that the focus on competencies, as well as other core elements such as interdisciplinarity, will require a process of implementation, which includes time to learn and implement new pedagogical emphases and to assess these for effectiveness. Faculty should also be encouraged to attend development seminars and workshops through an incentive process for course redesign. This foundational shift requires considerable change and administrative support will be absolutely necessary in order to ensure its success.

Respectfully submitted by the members of the Core Competency Committees:

Communication Core Curriculum Committee: Tom Dalton, Accounting Program, School of Business Administration; Carole Huston (facilitator), Communication Studies Department; Ron Kaufmann, Marine Science-Environmental Studies Department; Amanda Petersen, Languages and Literatures Department; Deborah Sundmacher (English Department); Irene Williams, English Department; Larry Williamson, Communication Studies Department

Critical Thinking-Information Literacy Core Curriculum Committee: Harriet Baber/Michelle Gilmore-Grier, Philosophy Department; Lisa Burgert, Copley Library; Jane Friedman, Mathematics Department; Carole Huston, (facilitator) Communication Studies Department; Nathalie Reynolds/Michel Boudrias, MARS-ENVI Department; Sandra Sgoutas-Emch, Psychology Department; Stefan Vander Elst, English Department

MRPS/QR Core Curriculum Committee members: Jennifer Gorsky, Mathematics Department; Diane Hoffoss, Mathematics Department; Carole Huston (facilitator), Communication Studies Department; Anne Koenig, Psychological Sciences Department; Sue Lowery, Biology Department; Perla Myers, CAS Dean's office and Mathematics Department; and Dirk Yandell, Economics Program, School of Business Administration.

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