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Part One – Hamline Plan Designation

The Hamline Bulletin provides the following description of the current R requirement:

“The human mind has developed systems of thought that aid understanding and problem solving. Mathematics is the prime example, having been developed and refined for over 2000 years. But there are other systems of formal thinking, including logic and statistics. Every Hamline student takes at least one course to become familiar with formal reasoning and its applications.”

To our knowledge there is no defined list of learning outcomes for this Hamline Plan component, but the R course proposal form defines formal reasoning as “abstract thinking/reasoning” and “the process of symbolically understanding and solving problems”. The proposal form then asks the instructor to address the following:

“How does this course place its problems in a formal or abstract format/context that aids the development of reasoning ability? For example: How is symbolic notation used to clarify issues and problems? How is data analysis presented in a universal way that would allow broad application of the principles taught?”

Our taskforce believes that the current R combines two important and distinct types of learning: formal reasoning and quantitative reasoning. Courses that incorporate formal reasoning (such as Logic, Introduction to Programming, or Linear Algebra) utilize symbolic representation and inductive and/or deductive reasoning to structure complex ideas and information, but do not necessarily touch on numeric calculation/analysis. Quantitatively oriented courses in mathematics, business, and the natural sciences, on the other hand, strengthen student skills in data analysis and mathematical reasoning without heavy emphasis on symbolic representation and formal logical reasoning.

We are proposing a change to the R requirement to recognize two subcategories, formal reasoning (R1) and quantitative reasoning (R2). The R1 would emphasize formal reasoning in the sense that the current R does, that is, formal reasoning as exemplified by mathematical proof, logic or formal statistical inference (hypothesis testing). **A student could fulfill this requirement with a single 4-credit course that carries both letters** (e.g., Statistics) **or 2 courses** (e.g., R1 in Music Theory or Logic and R2 in Chemistry & Society). [Please note that this is a change from prior versions of this proposal where we proposed an 8-credit requirement. While the taskforce believes that repeated exposure helps build deeper skills in this area, we believe that even a single course - so long as it satisfies the learning outcomes of R1 and R2 - represents a significant improvement to the existing R. Students/programs are encouraged to build-in additional R1 and R2 courses where appropriate.] Upon completion of R1 and R2, students would be familiar with formal inductive and deductive reasoning (R1) and would have applied these in a number of contexts to solve diverse problems (R1 and R2), in particular quantitative contexts and problems (R2).

This new R requirement (composed of R1 and R2) aligns with the HU promise that graduates will be able to “solve problems in innovative, integrative, analytical, and ethical ways” and “use information competently and responsibly”. It has been pointed out that the Hamline Plan does not currently require an integrative, interdisciplinary learning experience, as postulated in the first of these learning outcomes. By requiring two elements of reasoning instead of one, it is more likely that a student would apply what

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she has learned in one type of reasoning to another (e.g. applying knowledge from a formal logic course to what she is learning in a natural science course).

Hamline students can approach the R requirement in a number of ways and it can be satisfied without increasing the overall credit requirement of the Hamline Plan – the examples below are just a few possibilities (please note that the following examples are based on the expectations of the taskforce after conversations with faculty in multiple disciplines):

- Logic and Chemistry & Society
- Statistics for the Behavioral Sciences
- Fundamental Concepts of Mathematics and Physics for Poets

Learning outcomes for Formal Reasoning (R1) - students who take an R1 course will be able to:

- Understand the difference between inductive and deductive reasoning and demonstrate familiarity with basic methods of assessing inductive strength or deductive validity
- Understand and make use of symbolic and abstract representations
- Solve problems that require rigorous formal demonstrations with multiple steps

Learning outcomes for Quantitative Reasoning (R2) - students who take an R2 course will be able to:

- Explain information presented in mathematical forms (e.g., equations, graphs, diagrams, tables, words) and convert information from one form to another
- Perform calculations successfully and express quantitative evidence in support of a conclusion or recommendation
- Make and evaluate important assumptions in data analysis and recognize the limits of the analysis

Based on this curricular proposal and corresponding learning outcomes, the revised description of the R is as follows:

“The human mind has developed systems of thought that aid understanding and problem solving. Mathematics is the prime example, having been developed and refined for over 2000 years. But there are other systems of structured analysis, including logic and statistics. Every Hamline student takes one or more courses that touch on each of these two areas: formal/logical reasoning and quantitative analysis.”

Part Two – Supporting the Revision Proposal

The grounding principles that anchor the Formal Reasoning requirement remain the same: formalized, abstract, and/or deductive modes of thinking represent a distinctive mode of inquiry. Investigation of these modes of thinking provides our students with an opportunity to become aware of their strengths and limitations and to improve their skills of rigorous, disciplined thought.

The explicit delineation created by the R1/R2 designations clarifies the importance of both formal and quantitative reasoning. All Hamline graduates should have the ability to understand, manipulate, analyze and communicate information with numeric content. This is in line with expectations of nearly

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all professional and graduate educational settings and is consistent with the general education requirements of most domestic and international undergraduate institutions.

In response to some concerns expressed by faculty about the rationale for the formal reasoning requirement, it is important to note that (despite the choice of “R” as the symbolic letter), the curricular goal is not focused on reasoning itself, but on the formal nature of some kinds of reasoning. Granted that most every course at Hamline teaches students how to reason, that is, how to construct and evaluate arguments, the fact remains that there are important differences between types of reasoning. The interpretation of a text, the evaluation of an oral presentation, and the critical appraisal of an experimental design each involve distinctive skills and patterns of reasoning that should not be considered interchangeable.

Likewise, one mode of reasoning that has played an important role in the development of human knowledge is a pattern of formal, abstract analysis and argumentation. Often this is accomplished through the manipulation of symbols, but the symbolic character of such reasoning is not as salient as the fact that it abstracts from the details of particular subject matters and contexts. A mathematical derivation, a proof in formal logic, and a computational algorithm have in common that they are formal structures, built according to exactly specified rules, independent of particularities of specific contexts. The analysis of an argument about the nature of Evil in a Humanities class will have to pay attention to the historical, philosophical, textual, and theological details. When the argument is abstracted from its context and analyzed simply in terms of its logical structure, a very different kind of reasoning is being employed. The current Hamline Plan recognizes the importance of students gaining some facility with both of these kinds of reasoning, and others as well. Our proposal is fully in keeping with that goal.

Although formal reasoning is closely associated with the discipline of mathematics, quantitative and formal reasoning are not the same. Our current curriculum includes two distinct and important elements under one requirement, and the proposed changes would disentangle and clarify them. A formal proof in geometry or logic, or a correctly structured computer program, might very well involve no numbers at all. Conversely, the characterization of a set of data from a scientific experiment might involve sophisticated quantitative analysis that does not abstract very far from the details of the situation or pay explicit attention to patterns of argumentation, and thus not constitute formal reasoning.

In response to some concerns expressed by faculty about increasing the demands on students, it is worth noting that for the great majority of students the proposed revision to the Formal Reasoning requirement would not increase the number of courses required for graduation. A very great proportion of students take a course in Statistics, which could very well satisfy both Formal Reasoning and Quantitative Reasoning requirements. Those students who do not satisfy the current requirement with Statistics typically take a course in Mathematics, Computer Science, or Logic. Each of those courses would satisfy the revised Formal Reasoning requirement. Many, if not most, Natural Science courses would satisfy the Quantitative Reasoning requirement, and each student will still need to take two of these.

Because of the 4-credit minimum and the number of ways students can satisfy this requirement, this proposal does not “double the number of R’s”. What is “doubled” is the number of specific skill sets associated with the letter R, but the number of actual courses required is not doubled. There are, of course, some students who would have to take an additional course in order to graduate under these new requirements. For instance, consider a student who takes the Logic course to satisfy the current R requirement and also takes two natural science courses that do not involve the analysis or characterization of numerical data. Under the current Hamline Plan, this student could graduate with an undergraduate degree. Under the revised plan, this student would have to adjust their schedule in order

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to take Statistics instead of Logic, or one natural science course that involved quantitative reasoning. Neither of these changes would impose an undue burden on the student; rather, the student would be much better served by their undergraduate education if they made such a change.

Part Three – Implementing the Revision Proposal and Assessing Learning Outcomes

For R1 and R2 there should be no barriers to implementation except due to perceived complexity of the new plan as it involves two letters instead of one. Fortunately, there is precedence for this. For the current Cultural Breadth HP letters (G, I, L) students must take 12 credits accounting for at least two letters. In the case of R1 and R2, students must take 8 credits and receive both letters in the process. For the propose R, they would need to take a minimum of 4 credits but account for both R1 and R2.

Some time and thought will need to go into designating which courses will be assigned which letters. There will be courses with both letters (e.g. Statistics, Computer Science) and there will be courses with just R1 (e.g. Logic) or just R2 (e.g. Calculus 1). Natural Science courses with laboratory sections might consider also including material satisfying the R2. This process should take place during the 2012-13 academic year so that the new Rs can be on line in 2013-14.

Courses will need to be carefully assessed to assure that formal reasoning (R1) and or quantitative reasoning (R2) components are indeed included. Courses currently carrying the HP letter R would be the natural candidates for R1 and R2, and professors teaching these will need to review the rubrics included in Appendix A to determine what if anything needs to be changed to fulfill the intent of the new letters. In the case of formal reasoning (R1), the professor will be responsible for assuring that some form of assessment consistent with the rubric will take place. In the case of quantitative reasoning (R2), assessment of quantitative skills through formal testing will need to be a component of the course.

There are no anticipated resource implications associated with this proposal. With implementation of the R1/R2 scheme, it is possible that some students with math anxiety would be forced into courses with quantitative content that they would otherwise have avoided. The Quantitative Reasoning Center is dedicated to helping students and the faculty teaching them overcome these problems, and more tutoring hours or more dedicated faculty involvement might become necessary. Currently, however, more than 85% of Hamline graduates take a statistics course during their career, and for these, the R2 course can be in the R with which they feel most comfortable. It is also anticipated that some N courses would carry an R2, awarded for quantitative work done in the lab setting, and this would further reduce the need for students to register for an additional course far from their comfort zone on account of the R1/R2 requirement.