COMMUNITY COLLEGE OF PHILADELPHIA
MATHEMATICS DEPARTMENT

Response to the Proposal to Form a New Developmental Mathematics Department

From a perspective of attaining mathematical competence, teaching elementary mathematics does not mean bringing students merely to the end of arithmetic or to the beginning of "pre-algebra." Rather, it means providing them with a groundwork on which to build future mathematics learning.
– Liping Ma, 1999

Summary: On Monday, November 12, 2012, Vice President of Academic Affairs Judith Gay presented to the Mathematics Department a formal proposal to create a new Developmental Mathematics Department.[1]

The Mathematics Department is firmly against this proposal on the following grounds:

1) The proposal does not present a cogent rationale or verifiable evidence that the formation of a new department will have any educationally significant expectation of addressing the issues of concern of the Vice President.
2) The Mathematics Department has been addressing these concerns in various ways for many years and approached the Vice President in 2005 with a comprehensive plan grounded firmly in evidence supported by national studies.[2] This plan has received little continued support from the College administration. The department has been developing strategies grown from this plan in subsequent years and has evidence of improvement within reasonable expectations.
3) The potential consequences of the proposal are far-reaching and without careful consideration could lead to profound and highly undesirable repercussions relating to, among other things, the administration of personnel, the articulation of standards between the developmental and the regular departments, as well as how the elementary courses transfer to other institutions.

Introduction

The Mathematics Department has always been concerned about its elementary offerings, typically labeled "developmental" courses, and the learning experiences that students have when taking them. These courses cover topics and concepts that are essentially learned in primary and secondary school. Math 016 Arithmetic contains concepts typically learned in school roughly up to grade 5. Math 017 Elementary Algebra and Math 118 Intermediate Algebra topics are learned in grades 6 through about 10. Collectively the elementary courses cover the development of mathematical knowledge that a student would learn over the course of about 7 to 10 years.

It is plainly clear that student performance in elementary math courses around the country is a problem and CCP is not atypical in that respect. The Mathematics Department, not being content with these lackluster results, has spent much time discussing the underlying issues as well as implementing changes in teaching methods on an individual basis in an attempt to improve performance and understanding. Some have even created their own class notes. Previous collective attempts to address student performance have been tried but have not had the lasting impact desired. Eight years ago, the department created and instituted a comprehensive plan to address the issues of concern in the elementary mathematics arena and has continued to develop these initiatives, frequently with little support from the College. Among the many products of these initiatives is the creation of foundational materials for the elementary math courses developed by departmental faculty as well as comprehensive uniform departmental final exams drawn from banks of over 2000 exercises created with the participation of departmental faculty. These materials have been publicly available since Spring 2010 and currently reside on the departmental website.[3]

The overarching goal of the department for students in the elementary courses is the acquisition of lasting mastery of the concepts presented. We see the maintenance of standards at all levels and the certification of proficiency to those who demonstrate adequate mastery as integral to meeting our objective. In this way, we wish to avoid setbacks in subsequent student endeavors that call for mastery of the mathematical concepts found in the elementary courses. Our goals are supported by and coincide with current literature, research and reports in developmental mathematics.[2]

In 2005, the Committee for Elementary Mathematics and its Effects on the Curriculum (CEMEC), consisting of math faculty, developed a comprehensive plan addressing issues they perceived within the elementary courses such as math placement and barriers to success like students' difficulty (at all levels) with the arithmetic of fractions.[4] Dr. Gay suggested they create a pilot to study various aspects of the plan they had developed. A report on this pilot was compiled and presented in Fall 2008.[5]

Results from this report as well as more recent data provide some evidence that the department's objective of students acquiring lasting mastery is being achieved. The proposal operates from a preoccupation on student pass rates as a global measure of the effectiveness of a course. The department asserts that this is too narrow a metric as it does not measure whether students have truly internalized the concepts. A student's success throughout his or her mathematical courses is a much more appropriate measure of success than raw pass rates. Many students do not "succeed" in a particular course for reasons beyond the control of the College. What students know and can demonstrate they have learned upon completion of a sequence of courses is the critical test of student performance and the effectiveness of those courses. All curricula that require any mathematical knowledge of their students directly benefit from efforts of the department to enhance long-term learning.

The proposal to create a new developmental mathematics department because "our current approach to developmental mathematics is not working" overlooks the fact that the department is engaged in comprehensive efforts to address these issues of concern. With little more to go on, the

proposal appears to be primarily motivated by dissatisfaction that certain short-term student outcomes (in contrast to lasting mastery) are not being realized.

The Vice President's Proposal

Dr. Gay claims that the creation of a new department to oversee developmental mathematics is "a reasonable approach to organizing our effort." She cites two studies into the comparative effectiveness of centralized (separate departments) vs. decentralized (single department) models for developmental math and also refers to efforts at area colleges that have had some success in improving developmental math as part of her argument for a new department.

Dr. Gay refers to two articles: *Program Components and Their Relationship to Student Performance*, by H. R. Boylan, L. B. Bliss and B. S. Bonham, and *The Location of Developmental Education in Community Colleges: A Discussion of the Merits of Mainstreaming vs. Centralization*, by D. Perin.[6][7] Dr. Gay states, "one of the advantages of the centralized approach is the focus it brings to working on developmental education." Both articles discuss the correlation between the organizational model and student performance; however, neither claims that the success that was observed was a consequence of the organization model. Dolores Perrin in her conclusion to the latter article writes:

> "Although centralized models have been recommended by experts in the field, Boylan and his colleagues (Boylan et al., 1997; Boylan, 1999) suggest that it is not the centralization itself that might be responsible for superior outcomes but the fact that this structure makes it easier to coordinate services and promote communication among staff. Coordination and communication may come more easily in a centralized model but are, of course, entirely possible in a situation where remedial education is incorporated in a larger department." [8]

Based on the available research, centralizing developmental mathematics into its own department is neither necessary nor sufficient for effective developmental mathematics education. In fact there is almost no recent literature about developmental mathematics that recommends a centralized approach. Interestingly, many studies have criticized common U.S. methodologies for focusing "almost entirely on practicing routine procedures, with virtually no emphasis on understanding of core mathematics concepts that might help students forge connections among the numerous mathematical procedures that make up the mathematics curriculum."[9] A centralized model may have difficulty forging these connections without a clear understanding of what students will be expected to know once they leave the developmental environment.

Dr. Gay also mentions effective initiatives at area colleges. While there may be something to learn from these efforts, all of these institutions have implemented their changes within a decentralized system. None have separate developmental mathematics departments. We are aware of several of these initiatives and wish to obtain objective comparative statistics on their efficacy in order to better understand what they have achieved. One faculty member from Delaware County Community College commented that being able to teach both developmental and non-developmental courses permits her a clearer understanding of what students will encounter and assists her in her lesson development.[10] The promising initiatives at these area colleges might not have been as effective coming from a centralized model and perhaps may have never happened without the broader decentralized structure.

It is misleading to compare developmental math at CCP to the community colleges in Bucks, Delaware and Montgomery counties, whose incoming students are very different than ours with regards

to educational background, age and socio-economic status. According to IR Report #230, "developmental math students at CCP were much less successful than students at other PA community colleges."[11] Considering that on average CCP students tend to be older than at other community colleges and many are products of the Philadelphia public school system (which has its own problems in mathematics), the lower success rate is not particularly surprising. It is not a stretch to understand that on average a CCP student will have less mathematical ability when entering college than a student entering a suburban community college who has recently graduated high-school. Social characteristics that have been shown to correlate with educational success, such as median family income and unemployment, are significantly worse in Philadelphia, yet we compare favorably in many aspects to our neighbor institutions. CCP's completion, transfer and goal attainment rates are comparable to nearby community colleges.[11] Failing to factor the background of our student body into any assessment of developmental education reform brings the validity of the assessment into question.

Dr. Gay argues that the Mathematics Department has not achieved improvement in developmental mathematics. She does not opine whether the department will not or cannot achieve such improvement in outcomes but only that a new direction incorporating new focus and new thinking (perhaps by way of new faculty) is required. We claim that she has not shown sufficient cause for such a change nor enough detail as to why a new department will bring about the outcomes she desires.

Developmental Mathematics at CCP

Developmental mathematics at CCP has always been an area of concern to the Mathematics Department. In 2004, several math faculty formed the Committee for Elementary Mathematics and its Effect on the Curriculum (CEMEC). Over the course of a year it developed a comprehensive plan to address problems in developmental mathematics.[4] After some modification, a pilot to explore some of the ideas in the plan was approved by the College administration. Features of the pilot were discussed by math faculty at a NADE conference in 2006 and many thought it was a well-formed, carefully considered plan. Although the pilot had some disruptions, it was carried out, concluding in 2007. A report was written and presented to the administration in 2008.[5] Although the department felt some of the results had promise, the administration chose not to continue support for the initiatives in the pilot. Although the CEMEC initiative enjoyed a very brief time as part of *Achieving the Dream*, it was ultimately discontinued by the College.

As an outgrowth of CEMEC, several of its original members developed the materials used for the pilot into finished texts to be used by interested faculty. These materials are still in use today and are publically available on the departmental website.[3] Math 016 Arithmetic and Math 017 were eventually revised to better resemble the models proposed by CEMEC. At the same time that these revisions went into effect, uniform departmental final exams were instituted, in Spring 2010.

Current departmental efforts in developmental mathematics include ideas from the original CEMEC proposal: revision of the math placement process, better advising regarding developmental math, improvements to Math 016 and 017, as well as course development designed to give students better pathways to college readiness, and a selection of courses that meet the math General Education requirement that are alternatives to Math 118. These plans have been shared with Dr. Gay. Details of these efforts will be incorporated in a dynamic document called the *MathTree*. It will include descriptions and status of current and completed projects. It will be available on the departmental website soon.

All these efforts stem from the department's objective to provide students the opportunity to learn and acquire lasting mastery of the material. We are not only interested in whether a student passes

an elementary course, but also whether that student is able to take the knowledge forward and succeed in subsequent courses (and not only in mathematics course, but also any course that has a mathematical prerequisite). The critical question is whether the student truly knows what he or she needs to know in order to succeed at college.

In the interest of full disclosure, the grade distribution rates for Maths 016, 017 and 118 for Spring 2008 through Spring 2012 are listed below:

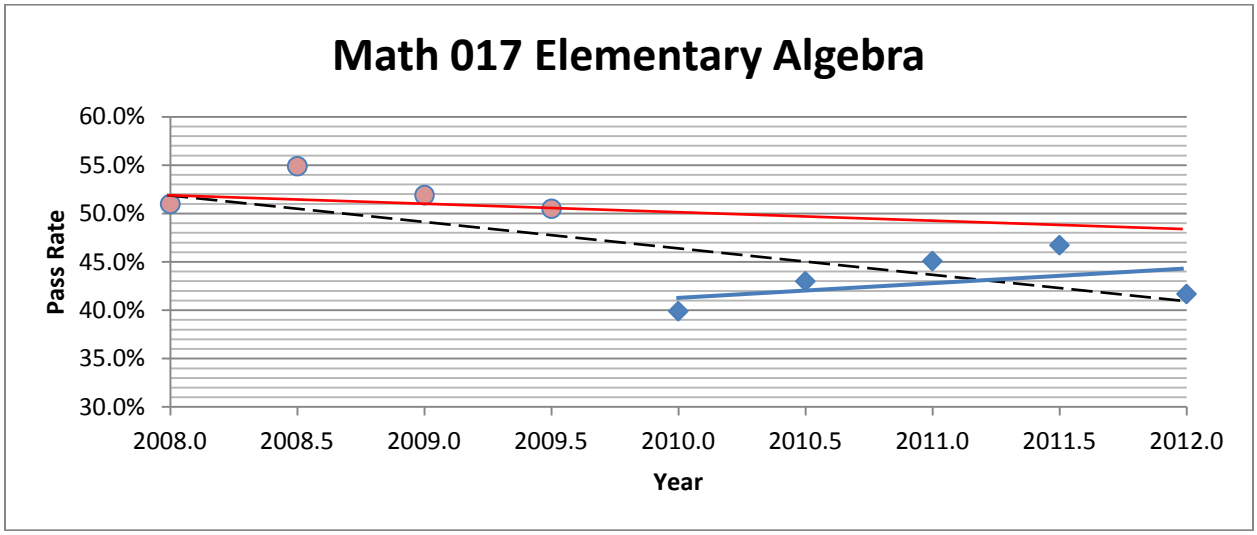
Term	Math 016 Arithmetic			Math 017 Elementary Algebra			Math 118 Intermediate Algebra		
	P	MP/F	W	P	MP/F	W	A/B/C	D/F	W
SP 2008	55.0	32.0	13.0	51.0	39.0	10.0	50.0	30.0	19.0
FL 2008	61.3	31.5	7.2	54.9	34.1	11.0	52.4	30.9	16.7
SP 2009	52.5	37.1	10.4	51.9	35.8	12.2	50.8	29.3	19.8
FL 2009	59.5	33.6	7.0	50.5	38.1	11.4	51.4	34.5	14.0
SP 2010	42.6	43.0	14.4	39.9	44.6	15.5	43.2	35.5	21.2
FL 2010	54.3	37.0	8.7	43.0	44.1	12.9	41.8	39.1	19.1
SP 2011	43.7	44.0	12.4	45.1	39.7	15.2	43.1	36.4	20.5
FL 2011	42.6	46.6	10.8	46.7	41.6	11.6	43.2	39.2	17.6
SP 2012	44.9	42.8	12.3	41.7	45.8	12.5	43.4	39.1	17.5

All values are expressed as percentages.
Successful outcomes: P =Pass, A/B/C
Unsuccessful outcomes, MP/F = Making Progress/Fail, D/F, W = Withdrawn
Note: The double underline indicates where the departmental final exam was instituted.
(We are considering a D an unsuccessful outcome for Math 118 as it is does not meet prerequisite requirements, however it may meet general elective requirements for success.)

Dr. Gay described this data as not showing improvement. If there had been no change in the composition of the courses over this period, we would agree. As one can see from the chart above the success rates for each of the elementary courses experienced a drop during Spring 2010. This coincides with the implementation of the departmental final exam in all three courses as well as the first use of the revised course content for Maths 016 and 017. The department expected there to be a drop as a uniform standard was established and new revisions were implemented. However, we were disappointed that the decreases were as significant as they were.

If one looks at a trend line (or regression line) for each of the courses over the whole period Spring 2008 to Spring 2012, the lines are clearly going down. However, if you look at the trend lines for the periods Spring 2008 to Fall 2009 and Spring 2010 to Spring 2012 separately, it is interesting to see that the lines in the latter half are increasing while trend lines from the earlier half are relatively flat or slightly decreasing.

As an example, let's examine Math 017:



Spring = 20xx.0, Fall = 20xx.5. Red circles are before the revision. Blue diamonds are after the revision.

It is clear that if the two periods are separated, the trend lines give a clearer picture of what is happening in the course. The red line is the trend line for the previous version of Math 017. It had a slight downward trend, decreasing by about 0.9% per year (this translates into about 12- 15 fewer students passing each year on average). The blue line indicates an upward trend of about 1.5% per year (about 20 – 25 more students passing per year on average). If one continues these trend lines forward, the blue line overtakes the red line in Fall 2013. The dashed line is the trend line for the entire period and does not give an accurate measure of the situation. Data for Math 016 and 118 show mildly positive trend lines in the latter period as well.

All of the previous data assume success is measured against the total number of students enrolled at the 20% census. If one measures the success against the number of students who complete the course (that is, ignoring withdrawals), one will see the relative success rates are 58.6% for developmental math courses as a whole.

It has been observed that while not successfully completing English 101 is a barrier to fully participating in a college education at CCP, it is unsuccessfully completing Math 118 that is the barrier to completing a credential for many students. Students who struggle with Math 118 tend to reach this barrier near the end of their career at CCP and this proximity to graduation casts disproportionate emphasis on the exigency of reforming developmental mathematics. Struggling with English 101, being nearer the beginning of one's studies, creates much less angst in this regard. I have not yet seen an analysis to determine how much of the College's graduation rate is affected by not successfully completing English 101 in contrast to Math 118.

The Mathematics Department is currently working on new revisions of Math 016 and 017, incorporating what the department has learned from the two years that the current version has been used, as well as being aligned with national research and best practices.[2] Additionally it is developing new courses that meet the math General Education requirement to serve as alternatives to Math 118. Members of the department are exploring new pathways for each student to complete his or her

developmental math education in the most appropriate fashion. We expect this exploration to lead to new curriculum development, much of it adapting and modifying various successful models to the needs of CCP students. Through these efforts we hope to increase the number of developmental math students that reach college-readiness.

All of this effort is clear evidence of "concerted, focused attention." More than half of the full-time faculty members teach more elementary courses than higher level courses. On average, the portion of a full-time faculty member's load that is elementary is 54.5%. Several faculty members teach nothing but elementary courses. The vast majority of the adjunct faculty members teach exclusively elementary courses. The belief that a typical faculty member is aloof to the issues in developmental mathematics would be absurd. Mathematicians discuss mathematics at all levels and see little distinction between elementary mathematics and more advanced topics and understand the deep importance of the foundational knowledge one needs to progress in one's mathematical studies. Results at higher levels inform the teaching at lower levels. Without a clear perspective of the discipline from the highest and most abstract to the lowest and most simple, it would be very difficult to construct the appropriate scaffolding of knowledge needed on which to build future understanding. Removing the discussion of developmental mathematics from the greater context and relegating it to a separate department is at best short-sighted and at worst, disastrous.

Potential Issues

Creating a new department poses multiple challenges beyond the mere logistics of selecting a new department head, forming hiring and lateral transfer criteria, seeking new faculty, and allocating resources. There are also issues of what impact the separation of a student's mathematical experience across two departments will have, the coordination between the two mathematics departments, the delicate and potentially problematic decisions about the fate of current faculty and how courses controlled by a developmental department may be viewed by transfer institutions or accrediting organizations.

A significant concern that the Mathematics Department has regarding the formation of a new department is the potential disarticulation of standards between the two departments. There are two great pressures experienced in developmental education – the need to increase successful completion and persistence rates and the desire for high standards. Although ideally these pressures are managed jointly, compromise of the integrity of the program by altering learning outcomes, easing on assessment or inflating grades is an ever present temptation. Even with great vigilance, lowering of standards may occur incrementally and unnoticed when the department is primarily concerned with getting students to the end of their developmental sequence with little thought to more advanced study. This potential decay of integrity is more severely arrested when overseen by a department that sees the elementary courses as steps along a longer path as would be true in a decentralized model.

Although members of the Mathematics Department of Camden County College, which has two departments, have great respect for their colleagues in the Academic Skills Math (ASM) Department, relations between the two have been strained much of the time owing to the dissatisfaction with the

ability of students who come through their developmental math at the college and are concerned with the standards set by the AMS program. There has been some talk of instituting an entrance exam to the upper level courses, but the problem of students passing their last developmental course but not being able to pass the entrance exam has proven to be a sticking point.[12] This discord of developmental objectives and non-developmental expectations is epitomized by the frequently frustrating gap between high-school exit criteria and college entrance requirements. It is entirely possible that eventually students could pass Math 118 and not have sufficient knowledge to succeed in subsequent courses. The Mathematics Department does not wish for this sort of dysfunction ever to be possible in the mathematics curriculum.

Nationally, there is a trend away from centralized developmental math models. In 1997, Bucks County Community College moved the Basic Algebra course that had been controlled by the developmental education program into the regular math department because it "would allow for continuity in the mathematical curriculum and consequently a smoother transition for students to higher levels of mathematics. In order to best prepare students, it is essential for instructors to have a full view of 'what comes later.' By isolating this course into its own sphere, students are often deprived of this wider view since none of the instructors in Developmental Education teach higher level courses and consequently do not have this view of the sequence of math courses."[13] The two math departments of Salt Lake Community College recently merged, allowing the combined faculty to address the huge chasm between the developmental and regular math courses as well as break down barriers resulting from the silo effect.[12]

Working on improving the elementary mathematics experience at CCP is of great interest to the math faculty. Not wishing to lose connection with the full spectrum of math courses, many math faculty members may not laterally transfer into a new developmental mathematics department. Such faculty members will have greater difficulty participating in the developmental math conversation and may be viewed as interlopers. Not long ago, the Biology Department of the University of Pennsylvania chose not to split into separate departments in order to preserve cross-disciplinary interaction and curriculum development. Other biology departments that have split are now facing communication and integration challenges stemming from increasing interconnectedness of the sub-disciplines. Coordinating developmental math efforts across departments is at best inelegant and more likely unnecessarily Byzantine. Forming a new department creates a wasteful impediment to joint curricular innovation.

There has been some discussion in the past of hiring new faculty with credentials in Math Education as a way of introducing new thinking and perspectives into the developmental math conversation. The department has participated in four years' worth of hiring cycles for such faculty and although some candidates met the mathematical standards of the search committees and were recommended, the experience was disappointing overall. Potential candidates with a thorough understanding of all levels of mathematics may be more likely to apply for a developmental position within a larger math department than for a position within a department devoted to basic skills because they are leery of the downward slide of standards that plagues remedial programs or wish to teach some advanced courses. This aversion can create a self-fulfilling prophecy when such programs are staffed entirely by faculty who are unacquainted with all levels of mathematics. Very few of the candidates

recommended by the hiring committees were approved by the administration and only one accepted a position. Candidates that had experience in curriculum development, expertise in teaching developmental mathematics and what Dr. Liping Ma calls "a profound understanding of fundamental mathematics"[14] expected by the department were few and far between. The necessary perspective to comprehensively instill lasting mastery through promoting understanding of mathematical principles requires a deep exposure to higher-level mathematics – an exposure that in the experience of the department faculty has been unfortunately rare in the Math Education field. The department would welcome the opportunity to interview such candidates and regrets not having had more opportunity to do so. While we understand that only a few students will becomes mathematicians, engineers or physicists, we believe students should have a solid foundation in the basic mathematics one needs to be an effective and competent citizen. Creating a department that does not value a deep mathematical perspective would lead to the formation of a curricular community with an incomplete vision of what developmental mathematics students need – a situation that may achieve short-term success but fosters little long-term success.

The department employs roughly 30 full-time, 5 or 6 visiting lecturer and about 100 adjunct faculty. It offers approximately 300 math sections, of which close to 240 are elementary. Assuming all elementary sections are moved to a new developmental department, there would then be 60 or so non-elementary sections remaining in the regular department. This is barely sufficient to support the 30 full-time faculty even providing that half their load is elementary. This sharing of load would of course need the approval of the new department. Some full-time faculty might choose to laterally transfer into the new department, but many would not. Almost all of the adjunct faculty would need to request work in the new department and the fate of visiting lectureships is unclear. Details as to how all of these faculty management issues are to be handled are absent from the proposal and would have to be dealt with carefully as there are sensitive contractual issues involved. Even with some new developmental math faculty, the majority of the course sections would most likely be taught by the same faculty who are teaching them now. If for the most part the same faculty teach the elementary courses and limitations to effective innovation manifest, one might ask what educationally significant difference one expects from creating the new department – a decision that would affect the college experience of up to12,000 students a year.

Math 118 Intermediate Algebra currently earns students credit toward graduation and is consequently considered a "college" course. Although many colleges do not permit it to transfer and require students to fulfill college level mathematics requirements there, Math 118 is viewed as meeting some college requirement by other institutions and accrediting bodies. Assigning Math 118 to a developmental mathematics department risks losing this last veneer of credibility and it may cease to be viewed as meeting a college requirement elsewhere. This could ultimately lead to Math 118 losing its ability to earn graduation credit, directly threatening many students' ability to meet a math General Education requirement. It might also have detrimental effects in accredited programs that require a college-level math course. Math 118 losing its "college" level status would add significant barriers to students completing a credential and depress graduation rates.

Even if only a few of these consequences were to occur, they would have a serious negative impact on developmental mathematics at CCP. For many, the "path to possibilities" could become a railway to the educational burial ground.

Conclusion

The Vice President's proposal seems to imply that the "our current approach…is not working" because the current Mathematics Department is not engaging in the right activities to bring about the desired improvements. We contend that not only are we having some success but that our efforts are in alignment with current research and thinking in the field. The proposal implies that there is a lack of focus within the Mathematics Department. The fact that the department has been working diligently on a greater vision of developmental mathematics based on a comprehensive plan for the better part of eight years shows that we are clearly focused in our efforts. The proposal claims that forming the new department will engender the necessary focus to bring about improvement in student success and that in the absence of any compelling evidence, "reasonable" is somehow a sufficient criterion for implementing such a drastic and difficult to reverse change. It presupposes that the benefits of forming the new department outweigh any negative consequences caused by its formation and will not distract or detract from those efforts currently underway to improve student success. Creating a new department would also involve significant expenditure – funds that maybe be better spent elsewhere.

In light of the reasons described in this document, the CCP Mathematics Department believes that the formation of a new developmental mathematics department is an unwarranted and unwise course of action and strongly recommends that the proposal to form a new developmental mathematics department not be approved.

Respectfully.

Brenton A. Webber
Mathematics Department Head

6 December 2012

End Notes

[1] *Proposal for a Developmental Mathematics Department*, J. Gay (CCP, November 2012)

[2] *Thomas B. Fordham Foundation: The State of State Math Standards 2005* , Thomas B. Fordham Foundation, 2005.

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Developmental Education Policy Recommendation, Ohio Association of Community Colleges (2011)

Teaching and Learning Developmental Mathematics at Community College, F. Apfaltrer, M. Zyman (Borough of Manhattan Community College, 2008)

[3] http://faculty.ccp.edu/dept/math/developmental.html

[4] *Proposal Concerning Elementary Mathematics and Its Effects on the Curriculum*, CCP Mathematics Department (CCP, May 2005)

[5] *Report on the Pilot Project Spring and Fall 2007*, CEMEC, CCP Mathematics Department (CCP, October 2008)

[6] *Program Components and Their Relationship to Student Performance*, H.R. Boylan, L.B. Bliss, B.S. Bonham, Journal of Developmental Education, Vol. 20 Issue 3 (Spring 1997)

[7] *The Location of Developmental Education in Community Colleges: A Discussion of the Merits of Mainstreaming vs. Centralization*, D. Perin, Community College Review, Vol. 30, No. 1, p. 27 – 45 (2002)

[8] ibid, p. 40.

[9] *What Community College Developmental Mathematics Students Understand about Mathematics*, J.W. Stigler, K.B. Givvin, B.J. Thompson, p. 1. (University of CA, LA, Carnegie Foundation, 2010)

[10] Personal correspondence (2012).

[11] *National Community College Benchmark Project: National and Statewide Comparisons 2012, IR Report #230*, CCP Office of Institutional Research (CCP, October 2012)

[12] Personal correspondence (2012).

[13] Memo from Bucks County Community College Mathematics Department to Dr. Annette L. Conn, Vice President & Dean of Academic Affairs (BCCC, 1997)

[14] *Knowing and Teaching Elementary Mathematics*, Liping Ma (Routledge, 1999, 2010)