Articulating Computer Graphics with High Schools

Douglas Acheson, Willard D. Bostwick, Kenneth Rennels, Brian Copes

Indiana University Purdue University Indianapolis (IUPUI) / Mooresville High School

Abstract

The Purdue School of Engineering and Technology, Department of Mechanical Engineering Technology (MET), at IUPUI and the Mooresville Consolidated School Corporation, Mooresville, Indiana have formed a unique program articulation. A potential for continuous interactive approach between participating partners is the key. Provisions of the agreement permit Mooresville High School graduates to obtain college credit upon matriculating at IUPUI without additional cost for the Computer Design and Production course offered at their school. This paper outlines the background, procedures, and outcomes resulting from this model and explores possibilities for future articulation agreements with other courses and institutions.

School Background

The Purdue School of Engineering and Technology is located on the Indiana University-Purdue University at Indianapolis (IUPUI) campus. The school offers undergraduate associate and/or baccalaureate degree programs in: Mechanical Engineering Technology (MET), Electrical Engineering Technology (EET), Biomedical Electronics Technology (BMET), Computer Integrated Manufacturing Technology (CIMT), Computer Graphics Technology (CGT), Civil Engineering Technology (CET), Architectural Technology (ART), Construction Technology (CNT), Interior Design (INTR), Computer Technology (CPT), and Organizational Leadership and Supervision (OLS). The school also offers undergraduate and graduate degree programs in Mechanical Engineering (ME) and Electrical Engineering (EE) and graduate degrees in Biomedical Engineering (BME). The school has an enrollment of 2207 full and part time students (fall 2000). IUPUI has an enrollment of 27,525 students (fall 2000) in 18 schools and is the third largest university in Indiana.

Introduction

Engineering design graphics instruction at both the high school and collegiate levels has evolved by necessity to include the use of digital tools such as AutoCAD®. With this evolution, the emphasis on required skill sets often must include more "tool" oriented instruction in contrast to "rule" (theory) instruction. In the days of old, an instructor would spend less than a minute showing students the proper way to hold a pencil, use a compass, or align a template. Then it was off to the meat of the course, the theoretical when and where's to logically apply these tools.

With digitally automated drawing still in its infancy (in relation to the origin of the pencil, scribe or stick), the necessary tools now are buried within menus, “hot keys”, and obscure icons. In time, the human computer interface will become much more intuitive, perhaps even to the point of the simplistic example of a toddler scribbling with a crayon. Messy, yes, but predictable. Though the scribbling is void of coherency and reason, it has in the simplest form performed a tangible action – made a mark. Until that time arrives though, educational efforts must continue to prepare students in the efficient and productive use of digital “tools”.

Computers and CAD have been increasingly integrated into graphic curricula to the point of near complete adoption at the collegiate, high school and even junior high levels. Due to this early adoption, many high school students entering college engineering graphics courses have already been exposed to as many as four or five years of CAD instruction. By this point they are at ease with computers and familiar (sometimes proficient) with the “tools”. These students are often bored and unmotivated when required to endure repetitive course work while others require basic instruction in using the computer interface. When continuing their education in engineering graphics at the college level, they will more often times than not be in the same classroom environment with students experiencing CAD for the first time. For example, at an urban campus such as IUPUI, many older, “non-traditional” students are enrolling in order to learn new skill sets ushered in by modern technology. Many students who return to continue their education at IUPUI as well as other urban campuses have been in a work environment that has exposed them to the “rules” already. A machinist, quality control technician, or maintenance person with ten or fifteen years of experience reading blueprints to create, test or repair mechanisms isn’t seeking the knowledge to understand the engineering graphics language. Rather, their desire is to learn the new digital tools that *create* that language. The instructional pace in the classroom becomes disproportionate when combining these “non-traditional” students with younger, less computer-apprehensive students. To help remedy this situation, this articulation agreement was designed to ensure thorough coverage of the “rule” portion of basic engineering graphic communication at the high school level. In this way, high school students are adequately prepared to enroll and continue their engineering graphics education at IUPUI.

A justification to adopt this type of articulation at traditional colleges and universities can be made as well. At residential campuses, inconsistent entry level skills in engineering graphics courses are often the result of students choosing to pursue computer graphics with little or no prior experience in CAD at the high school level. Pairing these students with those having extensive CAD experience in high school often discourages both parties as some will feel overwhelmed while others feel unchallenged. By providing well-planned articulation to students possessing a solid foundation of both the “rules” and the “tools”, college educators can create a more congruent learning environment in their classrooms.

Background

Fall semester 1997, the MET department decided to change and modernize the focus of an existing Mechanical Design Drafting Technology (MDDT) associate degree program. To better serve broader industry demands for well-rounded digital content creators, 3D CAD, Desktop Publishing, Raster and Vector Imaging and Multimedia Authoring replaced courses such as Applied Statics, Tool and Fixture Design, and Manufacturing Processes. With the adoption of these new technologies and the change of instructional focus, the name of the program was also changed to Technical Graphics (TG) to more accurately describe the program while at the same time reflecting industry trends.

That same semester, area high school instructor Brian Copes was asked to teach a drafting course at his institution using AutoCAD® software. Having never used AutoCAD®, Mr. Copes enrolled in one of the new TG courses (TG106 - Technical Graphics I) at IUPUI. While using Web-based TG106 course material as a student enrolled at IUPUI, he also used it as a guide for his course organization and instructional delivery at Mooresville HS. His relationship with the TG program at IUPUI was strengthened while enrolled in a graduate level multimedia course being offered by the MET department in the summer of 1998. While completing this course and conversing with the instructors, Mr. Copes learned more about degree opportunities offered in the MET department's Technical Graphics program and the rapidly expanding job market for its graduates. His enthusiasm for these new digital technologies was contagious as he returned to Mooresville that fall. During academic year 1998-99, Mr. Copes once again utilized the Web-based TG106 course material. After successfully implementing this curriculum with his students for the second year, and realizing potential redundancy should his students pursue the TG degree option at IUPUI, he approached the TG Program Chair to inquire about the potential for college credit for graduates who had now completing an almost identical High School course. It was through this relationship that the dialogue first began in connecting these two educational institutions through this unique articulation agreement.

Note: On June 9, 2000, the Indiana Commission for Higher Education approved the four-year Bachelor of Science degree program in Computer Graphics Technology (CGT) at IUPUI. All references throughout this document are that of the former Technical Graphics (TG) program. To reflect the program name change, course prefixes were revised to CGT. Course renumbering also occurred. The articulated course outlined in this paper (TG106) is now CGT116.

Although articulation programs are becoming more commonplace between high school and postsecondary institutions, the outline and delivery of the instructional content make this IUPUI model different from most. Uniqueness results from the proactive approach selected by the MET department to develop a foundation and selectively support curriculum design for the secondary schools program to the maximum extent. There is also another uncommon feature. All textbooks to be used by the high school students were selected and purchased by the university thereby ensuring continuity with those used at IUPUI. Actual lecture notes and assignments are maintained by a course director on campus and delivered via comprehensive Web pages.

Procedures

Figure 1 shows the opening Web portal from which this articulated course is disseminated. Serving as the official syllabus for the course, it (and all links spawned from the page) ensures that all sections being delivered are congruent in content, objectives, delivery and assessment. Contact information is listed for the course director and all faculty members currently teaching sections of the course. The course director can instantly update new faculty, assisting TA's or changed phone numbers. Required equipment, books and even a link to print out orthographic and isometric grid paper are included on this page.

TG 106 *Technical Graphics 1*

Fall 2000

Course Director: Professor Doug Acheson / 274-4186 / **Office:** ET301F / acheson@engr.iupui.edu

Evening Instructor: Professor R.E. Tharp / 274-7192 **/ Office:** ET301D / tharp@engr.iupui.edu

Saturday Instructor: Don Strack **W** 579-8352 **/ H** 888-3688 dstrack@kroger.com

Mooresville Instructor: Brian Copes **W** 831-9203 ext. 143 **/ H** 885-8327 copes@on-net.com

Technical Graphics 106 is an introductory course in graphics communication for engineering technologists. This course is designed as an introduction to the *standard* practices used to graphically communicate technical ideas using sketching and CAD (Computer-Aided Drafting). You will learn how to graphically communicate three-dimensional objects. Topics to be covered include: sketching, pictorial & multiview drawings, auxiliary and section views, working drawings with dimensioning and tolerance practices applied.

Weekly Schedule **Your Grade** **Grids**

OBJECTIVES ______After this course, you will be able to:	**REQUIRED EQUIPMENT**
1. Create sketches of technical ideas / problem solutions.	1. Mechanical pencil: .5mm, H or HB lead w / Eraser
2. Create orthographic views of 3 dimensional objects.	2. (5) 3-1/2" high density computer disks (or 1 ZIP disk)
3. Create pictorial drawings of 3 dimensional objects.	3. Texts:
4. Extract section & auxiliary views from primary views.	***Fundamentals of Graphics Communication,** (2nd Edition) Bertoline et al, 1998. McGraw **-** Hill
5. Add dimensions and tolerances using standard practices.	****AutoCAD 2000 Companion**, James A. Leach, 2000. McGraw **-** Hill
6. Use AutoCAD to generate three-dimensional models.	4. Grid Paper (Available from this web page)

ATTENDANCE POLICY Attendance is *required* at all sessions.

GRADING

98%= A+	**90%= A**	**87%= A-**	**83%= B+**	**80%= B**	**77%= B-**	**73%= C+**	**70%= C**	**67%= C-**	**63%= D+**	**60%= D**	**57%= D-**

Course grades are based on a percentage of total accumulated points of the following items: Written Midterm Exam = 100 pts. / Midterm Lab Practical = 100 pts. / Final exam = 100 pts. / Sketching assignments = 10 pts. each / CAD lab problems = 10 pts. each. **All *lab problems* must be turned in the <u>following</u> week after they are assigned. <u>Prior notice must be given in the event of a time conflict with *test* times</u> and dates.** Upcoming lecture outlines and assignments are posted on this web. Compiling and reviewing these will assure success on tests and quizzes.

Figure 1

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Following the "Weekly Schedule" link from the initial opening page of the TG106 Web site, students are next presented with a weekly outline of topics to be covered in the course as seen in figure 2. The content for this Web page as well as all others within the TG106 site are carefully and intentionally designed to be quick loading, easy to read, and void of any extraneous information not pertaining to the subject matter at hand. Although some students reference this active Web site on an "as needed" basis, others choose to print out these materials for later viewing. Whether for reference when a computer and/or Web access is not available, or simply to as a means to tangibly hold course requirements within their possession, many have yet to buy into the "paperless" environment. With this in mind, each page was created and edited in such a way as to print out as a single page, having a continuous flow much like a conventional text would have. In this way, students can assemble their own "book" with a three ring binder and use it as a template for assimilating and organizing course work done throughout the semester.

Week 1 ***Engineering Graphics Overview***

Week 2 ***Sketching, Text, and Visualization***

Week 3 ***Multiview Drawings***

Week 4 ***Multiview Drawings - Continued***

Week 5 ***Auxiliary Views***

Week 6 ***Section Views***

Week 7 ***Dimensioning***

Week 8 ***Midterm Exam***

Week 9 ***Tolerancing Practices***

Week 10 ***Working Drawings***

Week 11 ***Pictorial Drawings***

Week 12 ***3D Modeling Basics***

Week 13 ***Solid Modeling***

Week 14 ***Solid Features***

Week 15 ***Advanced Solid Features***

Week 16 ***Final Exam***

Figure 2

As can be seen from the topics above, these are core competencies of the engineering graphics discipline. Laying these foundational skill sets at the high school level promotes further study.

As each weekly link is engaged, an outline of the week's activities is activated as seen in figure 3. The first week additional course details are given as well as instructions on how to proceed and use the next level of information provided.

TG106 - WEEK #1

Introduction to Course

There will be ***hand-sketched*** assignments from Fundamentals of Graphic Communication as the *Traditional Component* of this course. (10 points per assigned drawing set)

CAD generated drawings will be taken from the AutoCAD 2000 Companion book for the *AutoCAD Component.* (10 points per assigned drawing)

There will be 3 tests in this course worth 100 points each.

- A midterm requiring traditional sketching of engineering geometry & other drafting concepts.

- A CAD test requiring a drawing to be generated in AutoCAD within a given amount of time.

- A final exam that will consist of 100 multiple choice questions concerning drafting terminology, identifying geometry and CAD concepts.

Color Coding Legend for Weekly Outlines:

What's RED needs to be read.
What's BLUE is what's due (the following week).
What's GREEN is what's seen (in the title block of your drawings and file names).
(Put *Assignment #*, *Page #*, and *Date* on every sheet).
Click on these icons to print lecture outlines before coming to class.

Traditional Component
Engineering Graphics Overview
(State importance of, applications used for, and general information about engineering graphics)
Engineering Geometry (Chapter 4 – Fundamentals of Graphic Communication)

AutoCAD Component

Applications of 3D CAD

(View VHS of 3D applications – Talk about power and uses of 3D databases.)

Figure 3

While this Web-delivered content could eventually serve as a stand-alone distance education resource, the intent is to use it as a supplement to instructor-lead learning. Items in parenthesis serve as instructor reminders and interest generating mechanisms to motivate students. More so, this type of documented course outline is a very viable means of bringing continuity to multiple sections or remotely located learning environments. Additionally, it aids students who miss a class session and stands as a defense against miscommunication of instructional objectives. As each “folder” icon is clicked, an outline is presented (figure 4) which states topical areas of study with corresponding figure numbers (in parenthesis) that reference the bound text accompanying this course. The instructor specifically covers these items during the lecture portion of the class period. If a student should miss a lecture, they can still reference the text with certainty to derive the important concepts intended. For example, in figure 4, next to the heading “Line Relationships” is (4.18). Upon looking up this figure in the text, students will find a graphic illustrating these relationships that will also include the explanatory labels “parallel, nonparallel, perpendicular, tangent, intersecting, and edge”. Space is also provided in order for students to sketch these conditions and entities to further solidify their learning process.

This is undoubtedly one of the most important elements in assuring adequate coverage of expected competencies that make this articulation environment successful. As long as desired outcomes have been carefully and adequately addressed through consensus, institutions have the opportunity to take a proactive role in shaping the entry level skill sets of their future students.

Engineering Geometry

Line Relationships (4.18)

1.	2.	3.
4.	5.	6.

Tangent Conditions (4.23 - 4.25)

Circle Features (4.35)

1.	2.	3.	4.
5.	6.	7.	8.
9.	10.	11.	12.

Parabola (4.43, 4.45)

Ellipse (4.50, 4.51)

Classification of Angles (4.68)

Quadrilaterals (4.75)

Polygons (4.79)

Figure 4

Students are also given assignment, page and figure numbers as well as naming conventions (fig. 5). These assignment numbers and titles appear on the instructors Excel® spreadsheet which is routed through a perl® script that allows students to input their id number (fig. 6) and see their current grade (fig. 7). This tool aids in the consistency of assessment throughout the system.

TG106 – WEEK 2

Traditional Component

Sketching, Text, and Visualization (Ch. 3 – Fundamentals of Graphic Communication)

Assignment # 1 · Page 356 (1, 10, 12, 15) (Sketch 1)

Assignment # 2 · Page 206 (42, 47, 69, 75) (Sketch 2)

AutoCAD Component

Basic Drawing Setup (Chapter 6 – AutoCAD 2000 Companion)

Object Snap (Chapter 7 – AutoCAD 2000 Companion)

Draw Commands I (Chapter 8 – AutoCAD 2000 Companion)

Assignment # 3 · "A-size" Prototype Dwg w/titleblock, etc. (Proto-A)

Assignment # 4 · Object Snap Exercise (OSNAPS)

Assignment # 5 · Page 116 #1 (LINK)

Assignment # 6 · Page 116 #2 (SLOTPLATE)

Figure 5

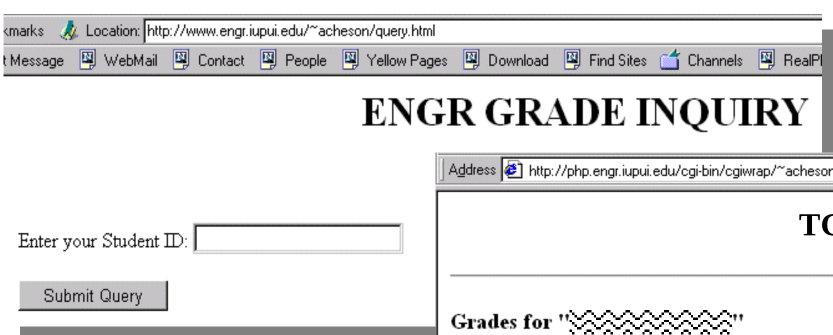

Figure 6

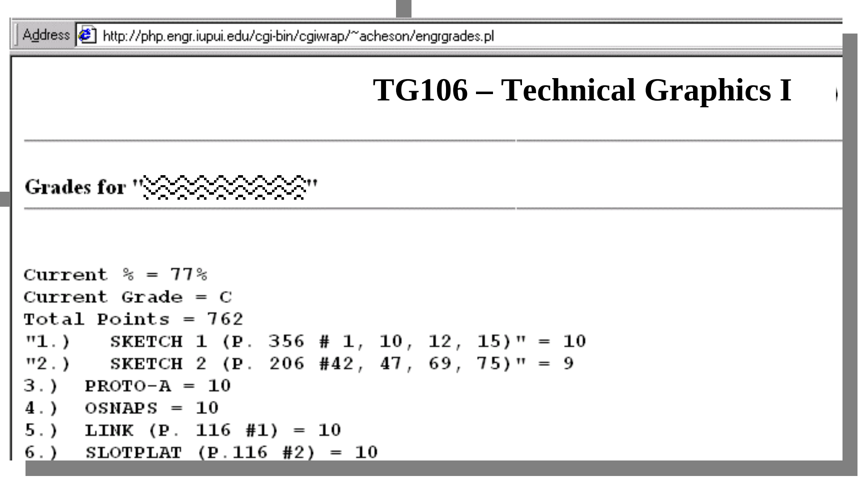

Figure 7

High School Instructor's Perspective

Having taught at the secondary level for the past ten years I have observed the students evolve from the traditional hands-on Industrial Arts to the highly technologically literate student of today. Because the students are being exposed to new technologies and its advances at an earlier age, I have found that traditional teaching strategies and programs are boring today's students. Through the foresight of faculty at the university, they have created a unique and innovative educational opportunity for the students at Mooresville High School. Many of the students whom expressed little desire and motivation to be successful in their educational endeavor have become excited and eager to learn. This program uses ambitious, uniform expectations to inspire students to achieve at higher levels. Through the assistance of IUPUI, Mooresville High School was able to obtain the licensing needed to instruct AutoCAD® 2000. Through Professor Acheson's personal commitment to education, he has invited me to attend several workshops and seminars that have exposed me to many other softwares and teaching techniques. Due to these seminars I have been able to acquire the software's Rhinoceros® and IronCAD®. These have been excellent support softwares to the articulated program already in place. I have been using Rhinoceros® at the freshman level to introduce them to 3D modeling and geometry. I have also pared my advanced level drafting students with Mechanical Engineers at local businesses to design parts for our Technology Education Department's electric car utilizing the 3D capabilities of Rhinoceros®. The students became excited as they saw the link between what they have learned in the classroom to how it relates to the real world. As the result of its relationship with the university, the Technology Education Department at Mooresville High School has recognized the need and been able to form an advisory committee consisting of college professors, community leaders, Mooresville Manufactures Association and school administrators. The goal of this committee is to link education with the needs of the community and industry. This program has given many of my students the feeling of self-worth and the desire to pursue higher education.

Outcomes

Already proving to be an effective recruitment tool, this agreement serves as a constant magnet to attract other Mooresville students who display an aptitude toward 3D and engineering documentation production into the high school program. These students can then be immediately challenged with expectations for higher-level competencies upon enrolling in college rather than expecting them to endure repetitive coursework for skill sets already attained.

This pilot articulation program has succeeded in establishing a viable and continual dynamic link between Mooresville high school and the Purdue School of Engineering and Technology at IUPUI. This linkage is evidenced by several joint activities involving faculty and students from both institutions. These activities include IUPUI faculty and student visits to Mooresville High School; School of Engineering and Technology laboratory tours and interactive demonstrations for Mooresville students; participation by IUPUI faculty and students in Mooresville's

Technology Club; and the employment of Brian Copes as an adjunct faculty in Computer Graphics Technology at IUPUI.

The major benefit to Mooresville High School students is obviously establishing credit for the course at no additional cost to they or their parents. Additionally, anecdotal data indicates that Mooresville students who in the past did not normally consider continuing their education are now thinking more assuredly about a college career after having their interest sparked with computer graphics.

The School of Engineering and Technology has benefited from this agreement though the increased access to high school students that goes beyond presentations and tours. First and foremost, the school had to critically think through and devise a set of standards and guidelines that henceforth would be used for development of secondary school articulations (Appendix A). The school has also benefited by increased access to and input from high school instructors, guidance counselors and administrators at Mooresville. While only one student out of the first class covered by the articulation agreement established credit for the course at IUPUI, indications are that the program will grow as word spreads at the high school level.

The School of Engineering and Technology firmly believes this high school articulation program to be beneficial and is currently working to extend the program to other secondary schools in the central Indiana region.

Appendices

A. Purdue School of Engineering and Technology Guidelines for Establishing Secondary School Articulation Agreements

B. MEMORANDUM OF UNDERSTANDING between the Purdue School of Engineering and Technology (IUPUI) and Mooresville Consolidated School Corporation

DOUGLAS C. ACHESON
Douglas Acheson is Director and Assistant Professor of Computer Graphics Technology at IUPUI. He earned an A.A.S. in Industrial Illustration Technology, a B.S. in Technical Graphics, and a M.S. in Educational Computing from Purdue University. He teaches advanced CAD, parametric modeling other graphics courses within the School of Engineering and Technology. His research interests are in 3D applications and collaborative Web modeling.

WILLARD D. BOSTWICK
Dr. Bostwick, Director, Engineering Education Excellence Center (E^3C) and Professor of Organizational Leadership and Supervision at IUPUI. Areas of emphasis are behavior and strategy in organizations, economic development, data analysis and collection, and program articulation. He received B.S. and Ph.D. degrees, respectively, in mathematics from Northern Illinois University and in education/management science from the U of Kentucky.

BRIAN COPES
Brian Copes is an Instructor at Mooresville High School teaching drafting, CAD and digital imaging. He also serves as an Adjunct Faculty member in the Computer Graphics Technology program at IUPUI teaching Technical Sketching and CAD. He received an A.S. degree in Building Materials Technology from Vincennes University and a B.S. in Industrial Technology Education from Indiana State University.

KENNETH RENNELS
Professor Kenneth Rennels, P.E., Chair, Department of Mechanical Engineering Technology, Associate Professor CIMT. Degrees include a BS and MS Industrial Engineering, Purdue University and a MS Business Administration, Indiana University. He has eleven years industrial experience in the aerospace industry and has been on the IUPUI faculty for 14 years. He is a senior member of SAE, SME, ASME and ASEE.

APPENDIX A

PURDUE SCHOOL OF ENGINEERING AND TECHNOLOGY
GUIDELINES FOR ESTABLISHING
SECONDARY SCHOOL ARTICULATION AGREEMENTS
(ADOPTED JANUARY 24, 2000)

The School of Engineering and Technology will consider and enter into articulation agreements with area secondary schools where an opportunity exists for a productive working arrangement that will benefit deserving students. These agreements will be designed in order to enable a deserving high school graduate to enter either a specific major or a specific academic program at the level acknowledging various competencies attained while enrolled in high school. An agreement must identify specific course(s) where it can be pre-determined that completion allows the student to achieve and demonstrate attainments equivalent to an existing college level course taught within the School.

Articulation agreements between Purdue School of Engineering and Technology departments and area secondary schools will use the following format:

1. Written agreements must be developed and are to be made only after an appropriate review of all course related materials and objectives for a specific study program at the individual secondary school or School Corporation.

2. Agreements may not authorize blanket credit for any secondary school course. Dual credit cannot be awarded in any secondary school course unless previously approved as an Advanced College Project (ACP) course by Indiana University.

3. Individual competencies for each student must be pre-identified and measured or approved by the School of Engineering and Technology for credit or for a waiver to be considered.

4. Options for students may include waiver of courses, advanced standing in programs, special credit when authorized by an appropriate faculty member, or credit by examination.

5. Academic credit will be awarded only upon matriculation at IUPUI. It is an individual student's responsibility to notify the School upon reporting for the first day of classes at which time special credit will be authorized for the student's permanent academic record. Academic credit approved on the basis of an articulation agreement is a privilege reserved only for secondary school graduates.

6. Academic credit, when awarded, may be awarded only for courses normally applicable for inclusion in a degree program. Under no circumstances will college credit be granted for preparatory or campus based remedial level instruction.

7. Final agreements must be prepared in advance and will be written using a standard format (see example). The appropriate School of Engineering and Technology Department Chair and Dean will sign all agreements. It is expected that either the secondary school principal or

superintendent will also sign each agreement on behalf of the respective secondary school corporation. Agreements signed only by one or more individual high school teachers are not valid unless also approved by either the principal or superintendent.

8. Appropriate academic program managers are expected to ensure all articulation agreements are reviewed annually.

9. The Associate Dean for Academic Affairs at the School of Engineering and Technology has responsibility for assisting in the development of articulation agreements, maintaining records of all articulation agreements, and making sure all agreements are consistent with both University and School policies and procedures including the Office of Admissions. Periodically, the Associate Dean will ensure that an independent evaluation is completed for all articulation agreements that authorize credit for new students who enroll directly after high school graduation.

10. A public list of all articulation agreements, both secondary and postsecondary, will be maintained and available upon request.

APPENDIX B

MEMORANDUM OF UNDERSTANDING
between the
Purdue School of Engineering and Technology (IUPUI)
and
Mooresville Consolidated School Corporation

The Purdue School of Engineering and Technology, Indiana University Purdue University Indianapolis (IUPUI) and *Mooresville Consolidated School Corporation* hereby voluntarily enter into this articulation agreement effective *January 1, 2000* for students who have completed the following course(s) of instruction *Computer Design and Production* while attending secondary school.

The purpose of this agreement is to:

1. Encourage students who are attending *Mooresville High School* to further their careers by enrolling in an advanced course of study at the Purdue School of Engineering and Technology.

2. Eliminate repetition and unnecessary duplication of academic experiences already acquired while enrolled in their secondary school program and aid in more appropriate placement in an undergraduate curriculum of their choice.

3. Encourage increased dialogue between administrators, staff and teaching faculty of both institutions in order to promote academic and occupational awareness, information exchange, and understanding.

The agreement:

1. Upon graduation from *Mooresville High School*, the individual student must make application to Indiana University Purdue University Indianapolis and successfully fulfill all admission requirements for an academic program offered within the Purdue School of Engineering and Technology.

2. The student will complete all placement tests that may be required admission and enroll on campus as a new student. Enrollment may be on either a full time or part time basis as the student may determine. Under the terms of this agreement, matriculation at IUPUI must occur within a period of 27 months or less following high school graduation.

3. The student will furnish the Purdue School of Engineering and Technology an official high school transcript verifying completion of the secondary school course(s) identified above with a grade of “B” or above.

4. Upon completion of steps 1 through 3 above, the Purdue School of Engineering and Technology will notify the IUPUI Registrar that the student is to be awarded 3 hours of

academic credit for *TG 106 Technical Graphics I* without additional charge. This credit will be recorded as "Special Credit" on the academic transcript, without a specified grade, and will be excluded when calculating the student's grade point average. There will be no cost to the student for Special Credit obtained in this manner.

5. The Purdue School of Engineering and Technology will make available to students a description of all college level courses which are offered through an articulation agreement and identify how these courses will be considered in enabling a student to fulfill academic requirements for a degree.

6. *Mooresville High School* will identify and publicize this opportunity in an appropriate manner for all potentially eligible students.

7. *Mooresville High School* agrees each year to routinely coordinate and review the course syllabus with an appropriate Purdue School of Engineering and Technology representative. All parties understand it that any changes in the course syllabus, changes in instructional contact, or material changes in instructional equipment or laboratory experiences afforded to the student may result in immediate termination of this agreement.

   This agreement will become effective upon approval by the *Mooresville Consolidated School Corporation* and the Purdue School of Engineering and Technology for all students who are enrolled in the course noted above during academic year 1999-2000 and thereafter. The agreement will continue on an annual basis until one of the parties shall notify the other of its termination. Articulation agreements, however, are not retroactive prior to this time.

Effective Fall Semester 2000-2001