

MORRISS MATH AND ENGINEERING ELEMENTARY SCHOOL:
A Case Study of K-5 STEM Education Program Development



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Background and Introduction

The Martha and Josh Morriss Math and Engineering Elementary (MMEE) School was designed and implemented as a Science, Technology, Engineering and Math (STEM) school program through the efforts of the Texarkana Independent School District (TISD) in Texarkana, Texas. The TISD STEM program developers describe their process for creating their first STEM school as one supported by a small, close-knit network established in partnership between the TISD and Texas A&M University at Texarkana (TAMUT). Their focus on K-5 grade levels presents a unique approach to initiating STEM education within a K-12 system, and offers an important perspective to our growing understanding of approaches to STEM design based upon the small number of programs that have been successfully launched across the country.

The TISD is now preparing to initiate STEM education at the middle school and high school grade levels, and is facing new challenges to expand their network within the community as well as outside the community to reach out to other STEM programs. Their need to collaborate with others at this time offers the opportunity to gain understanding of their efforts to date that may serve to benefit design and development of K-5 programs in other communities. This report briefly describes their experience in program development, including the institutional network that provided essential support for design and implementation of the MMEE School.

The following discussion is based upon a set of five interview sessions conducted over three days with two lead members of the TISD School Improvement Program team. These two individuals were part of the initial core MMEE team engaged in program design and implementation beginning in fall 2006. A sixth interview session was conducted as follow-up with a former member of the TISD School Improvement Program who participated in planning and development of the MMEE School from 2006-2008. Interviews were conducted in an open-ended format, tape recorded and transcribed for review. See Appendix A and Appendix B for the schedule of questions.

Morriss Math and Engineering Elementary School Program Development

In the following discussion, sections (1) thru (3) address overall design and implementation of the MMEE School. Sections (4) and (5) focus on the professional development and curriculum design. Section (6) presents conclusions and recommended actions.

The format for each section includes an overview of key findings which are presented at the top of each section as a bullet list of essential program attributes and characteristics. The narrative that follows provides more descriptive information and details on the network partnership and the process that was pursued at various stages of program development and implementation.

1. How did the TISD design and implement the Morriss Elementary STEM Program?

There are six main components that supported program design and development:

- TISD commitment to establishing Teacher Professional Development (TPD) as the key to increasing quality of instruction and student performance district wide provided a stable platform for de-

sign and implementation of a new school program lead by the TISD School Improvement Program team.

- The TISD worked collaboratively with TAMUT through a formal partnership initially formed to support joint development of TPD for TISD faculty, including creating the Professional Development School and the Curriculum and Instruction Graduate Program (master's degree) established in 2004.
- The MMEE project network was formed among participants of the existing TISD/TAMUT TPD partnership, and included individuals who could play a role in building a vertically aligned K-16 engineering education program. The MMEE focus on K-5 was led by the TISD School Improvement Program team which included administrative staff as well as curriculum coordinators and K-5 curriculum and instruction (C&I) specialists; TAMUT's network participants included the Provost, the Deans of the School of Arts and Science and Education, the School of Engineering and the School of Math, as well as two liaison staff.
- The TISD superintendent and upper level administrative staff, including assistant superintendents and associate superintendents (informally called the "cabinet"), were key decision-makers in planning for design and implementation of the new MMEE school with the necessary authority to absorb the majority of the costs for design and implementation, including facility construction, and early formation of the core program development team (the building project was formally initiated in 1/06, the curriculum/PD development in 8/06, and the school opened in fall 07).
- Strong community acceptance was evident in achieving initial enrollment and persisted through Year 1 (2007-2008) and Year 2 (2008-2009) enrollments supported by the community's high expectations, and reinforced by Y1/Y2 student performance
- Teacher acceptance was developed through intensive STEM education training and required graduate education (TAMUT Curriculum and Instruction Masters Degree) and strong ongoing faculty support for curriculum development

How did they get their program up and running?

The agenda for improving the quality of education within the TISD was developed and coordinated through the leadership of the administrative team of the district, directed by the district superintendent, and supported by the top administrative echelon of the school through weekly administrative meetings that provided immediate review and decision making by key district staff as needed. This included a small group of assistant and associate superintendents informally called "the cabinet." This was also supported by the TISD Board of Education, who had also established a priority for improved student performance aimed at growing enrollments for the TISD in the future. This vision was also shared by the Provost of TAMUT, who together with the TISD superintendent, committed their institutions to creating a K-16 engineering education program, the purpose of which was to build a "21st century workforce" to support and sustain Texarkana's future economic viability.

The opportunity to act on these shared goals occurred with the donation of privately owned land to the school district, allowing the district to move forward with plans to design and implement the MMEE K-5 STEM School. The first project meeting was held in January 2006 launching core team efforts to begin design and construction of the facility. Hiring and training of the K-5 faculty began in December, 2006. Curriculum design and teacher application process began in August, 2006. This effort culminated in fall 2007 with 100% of the enrollment goal achieved for grades K-4, and 97% for grade 5 enrollment, falling just short of their total enrollment goal of 396 in MMEE's first year, with a total Y1 enrollment of 394.

The TISD/TAMUT partnership consisted of a small but effective group who were able to utilize existing relationships and effectively extend the professional development framework to incorporate the specific design for STEM education faculty instruction. Planning and design for faculty training and curriculum

development was primarily lead by the TISD School Improvement Program team, directed by the SIP assistant superintendent working closely with a district curriculum coordinator and a newly hired curriculum and instruction specialist. The school's principal was also hired early in the program's planning year (2006-2007) to oversee the facility construction, to work directly with the curriculum development team, and to conduct the teacher selection and enrollment process. TAMUT partners were most active during the early phases of program development, and included the Deans of the School of Arts and Sciences and Education, the School of Engineering, and the School of Math. The TAMUT group was augmented by the addition of a university liaison tasked with facilitating university graduate program and curriculum course approvals. Communication among the various network participants occurred on an ad hoc basis during the planning phase, and included joint university/TISD team field site visits to gather first-hand information for program design.

Initial efforts were focused on concurrent tracks to support development of the various components of the program that frequently involved active engagement of the TISD/TAMUT network. Facilities design and development initially grew out of the superintendent's vision for the STEM facility, and was carried out with involvement of the MMEE School principal, the SIP assistant superintendent, and the TAMUT Dean of Arts and Sciences and Education. Their efforts included site visits to other schools, including private and public schools both in Texas and elsewhere to identify essential design elements of the new STEM school. Design concepts that support the engineering theme of the school include clear panel views of the building's infrastructure revealing utilities and other construction features and "pathways" within the physical framework of the building. Equipment for the school was designed with transparent housing also revealing the inner structure and operation of classroom tools including computers and other technical classroom accessories. Classroom design is arranged to support grade-level interaction in a "pod" configuration that allows flexible movement between classrooms for teachers as well as for individual students, and also allows entire classes engaged in project-based team learning to share work space. The central meeting space for the school is the auditorium designed as a multiple-function area that can serve daily art physical education instruction, as well as provide the central meeting space for school functions that include the MMEE "Engineering Encounters," a series of community events designed to showcase student projects and activities.

The curriculum development effort pursued two overlapping tracks: curriculum for K-5 STEM classroom instruction, and curriculum for teacher professional development focused on building content expertise in engineering, math and science. In both cases, the process was driven by identification and evaluation of existing programs and materials, as well as by primary research of subjects conducted by the TISD team. This is especially true of the engineering component which derived from both research of the literature and through primary investigation of professional training needs from the perspective of career engineers informally interviewed by the curriculum design team at various stages of curriculum development. The curriculum team was supported through a series of regular meetings among the TISD staff that included weekly meetings with the MMEE principal, and with the assistant superintendent. The assistant superintendent facilitated ad hoc meetings among TISD staff and included university staff as needed to support the curriculum team's efforts. The assistant superintendent also provided the link to administrative review and decision making with the district's "cabinet" level group of superintendents through the district's normal weekly superintendent's meeting.

Of the three TAMUT deans, the Dean of Arts and Sciences and Education was instrumental in guiding graduate level course design through identifying exemplar existing university-level programs from around the state and elsewhere as models for the new TAMUT STEM faculty graduate courses. The Dean of Arts and Sciences and Education was also responsible for providing the necessary support for creating TISD faculty courses taught not by university professors, but by the course designers (SIP curriculum co-

ordinator and specialist), both of whom were given adjunct status in order to qualify to teach the Morriss STEM curriculum and instruction courses first offered in June 2007. This was accomplished despite initial resistance to non-university faculty as instructors by the university curriculum review committee.

The Dean of Engineering has also played a key role in meeting the broader set of goals for K-16 vertical curriculum alignment working collaboratively with the TISD to create dual credit courses in 11th-12th grade engineering. To accomplish this, the Dean of Engineering was given a K-12 teaching credential to permit the Dean to conduct 11th-12th grade engineering instruction, forming the bridge between the TISD and the university's undergraduate engineering program. (Note: TISD already had existing dual credit math courses in place).

Further discussion of the TISD faculty STEM graduate level professional development and the K-5 curriculum design and development will be explored in more detail in sections 5 and 6 of this report. However, it is important to note that the team's efforts during the planning phase of 2006-2007 were guided by the team's development of a set of what they referred to as "non-negotiables," components of the MMEE K-5 program that forms the core framework for design of the program. The "non-negotiables" were developed collaboratively by the TISD curriculum team working with the MMEE principal to guide teacher professional development, as well as C&I design district wide, and include:

- Hands-on learning
- Constructivism
- Leadership and articulation
- Daily engineering instruction
- Accelerated math instruction
- Concept-based instruction
- Algebraic thinking
- Cooperative learning
- Alternative forms of assessment
- Technological Literacy

In the view of the MMEE core team, STEM education offered the perfect vehicle for the district to implement essential changes in the K-5 curriculum and instruction framework to meet long-term goals developed under the leadership and direction of the district's superintendent. Fundamental changes within the district were also supported by a strong university partnership and shared goals to work jointly on long-term planning and development of the K-16 engineering program. While the number of TISD/TAMUT network participants involved in development and implementation of MMEE was relatively small, the nature of interaction among network participants allowed for open and flexible engagement during different phases of effort that included open access and flexible communication, and shared decision-making. The group's effectiveness was evident in their ability to meet the district's time table for opening the school by fall 2007. The MMEE partnership was also successful in providing a framework for professional development and K-5 curriculum development that met expectations of teachers as well as parents demonstrated by student performance during its first year (2007-2008) and in its second year (2008-2009). This in turn has generated buy-in of both faculty and parents, with different benefits and outcomes for the MMEE School. These aspects of the MMEE program development and others relating to community engagement and support are explored further in sections 2-4 of this report.

2. What are the sustaining mechanisms that have resulted in the success of the MMEE Program?

There are six sustaining mechanisms that have contributed to the MMEE program:

- TISD philosophy / cultural values support ongoing investment in TPD assuring growth and development of teachers' STEM expertise and teaching skills.
- Active development and support of a team culture that values leadership and risk taking, open and flexible communication, and shared vision for improved quality of education is promoted by the TISD Administrative Team
- Emphasis on a willingness to change the way students learn and the way teachers teach has "spillover" effects vertically and horizontally within the TISD, validates STEM curriculum and instruction, and increases STEM teacher job satisfaction.
- Systematic TISD improvements to address quality of education including new district-wide program development (Direct Reading Program, SciTech Lab) and vertical/horizontal curriculum alignment implemented prior to launching the MMEE School program, has resulted in creating a stable platform for the introduction of STEM education during all phases of MMEE implementation (program design/development, Y1 and Y2).
- Team-based curriculum development is scheduled daily and is structured to foster systematic self-evaluation of teaching effectiveness and curriculum effectiveness supported by daily, weekly and annual review by the MMEE curriculum coach and principal.
- Acceptance/buy-in of the program provides essential validation from across network participants and supports continued engagement in sustaining the program and its future needs.

How has the TISD effectively supported implementation and maintenance of the new STEM school?

As the program completes its second year (2008-09), the success of the program has been impressive for a number of reasons. These include the ability of the TISD to marshal the necessary resources, including absorbing all the costs of the start-up of the new school and facility construction, staffing, and pursuing K-5 STEM education curriculum with little outside support. At this time, student performance is meeting expectations with 3rd and 5th grade Texas Essential Knowledge and Skills (TAKS) reading scores at 100. Other measures of performance include the school-year series of five "Engineering Encounters," that brings the parents, community members, and middle-school and high-school faculty, to the school to share in celebrating student-conducted project-based achievements. Enrollment in the second year of the program has met program goals, with waiting lists for kindergarten and first grade now extending to year three (Y3, 2009-10) of the program. The reasons for the success of the MMEE STEM school are varied and complex, and are in part framed by the leadership and risk-taking approach to improving the quality of education that fosters going beyond familiar and ready-made solutions, to support a culture of exploration that is exhibited by the MMEE network partners.

A major component of the TISD philosophy has been cultivated through the professional development of its administrative and teaching staff, creating a shared cultural priority for the value and importance of curriculum development and evaluation. A fundamental element of this shared cultural outlook is derived through a certified training program in curriculum evaluation and auditing offered by Curriculum Management Services International (CMSI) that was initially recommended by the Dean of the School of Arts and Sciences and Education. All school improvement staff and curriculum coaches are encouraged to take at least the Level 1 course. The result has been to create a common language and team culture that has improved the quality of communication, and has also enhanced the ability of TISD staff to work collaboratively to achieve TISD goals and objectives. Additionally, TISD faculty professional development is offered year-round through district-wide, after-school, weekend and summer session workshops and programs. Within this cultural milieu of ongoing professional development, the STEM education program has been nurtured through a design process that meets the TISD/TAMUT standards for rigorous instructional quality.

Another important dynamic that provides a different sort of gauge for measuring the success of the program is best described as the “spillover effect,” that includes several different important components. Initial benefits to the new MMEE School program accrued from the existing commitment to professional development and goals to improve the quality of education which were suited to the introduction of STEM education, creating a rich environment in which to design and implement STEM education. These include SIP support in development of the Direct Reading Program, and the SciTech Lab, a mobile lab facility that serves school campuses district wide. Additionally, the school district has undergone a two-year process to achieve vertical and horizontal curriculum alignment to reduce effects associated with student mobility, as well as to assure that campuses with higher levels of low SES are receiving instruction that will support meeting educational TAKS state standards. These district-wide program changes have all contributed to establishing expectations across campuses. Systematic changes in the TISD framework for education are now considered fundamental to meeting educational goals, effectively creating the right environment for introduction and the overall acceptance of STEM education. With the completion of its second year, MMEE has set the bar high, fostering the perception across the district that teaching and learning should be changed in order to be successful. This has ramifications for faculty as well as for students which will be explored further in this report.

With regard to selection of MMEE faculty, faculty interviews included recitation of the school’s non-negotiables as a way to assess an individual’s ability to accept change, including highly flexible and collaborative classroom instruction. The MMEE criteria were also viewed as a way to determine potential for accepting the premise of professional growth not just as a one-time PD event, but as an ongoing aspect of STEM education. As the program began its first year, initial fears that STEM would be too difficult for students have given way to teacher confidence and job satisfaction in spite of the intense effort required for the MMEE faculty to establish the STEM curriculum and instruction framework. Those teachers who cannot accommodate change at this pace are not expected to stay with the program and ultimately with the district as STEM instruction expands. This is viewed as the best option to seek the type of people who can grow and change in the way they teach that is essential to STEM education.

Across the district, principals of other elementary campuses, including six K-5 campuses, one 3-5 campus, and one K-2 campus, are remarking on the need to gain new teaching skills and are asking for similar professional development opportunities for their faculty. One of the most important spillover effects is occurring now among the middle-school and high-school faculty who are exposed to the STEM K-5 student performance through state test standing, as well as by attending the MMEE “Engineering Encounters.” Struck with the prospect of teaching STEM students as they move up from the elementary school program, middle- and high-school instructors are confronted by the realization that they too will need to shift gears in preparation to teach STEM students. The TISD system has initiated planning and implementation of the middle-school and high-school program, with completion of training for 6th grade instructors in the summer of 2008, and 7th grade instructors about to take their training course in preparation for the STEM Middle School Academy during the spring of 2009.

An essential component of the MMEE Program is the team-based curriculum design process inculcated in the curriculum and instruction STEM graduate coursework. Teachers are guided through processes designed to build skills in research and application of new knowledge to improve curriculum design, and are instructed in methods to conduct self-evaluation to assess curriculum and instructional effectiveness. The courses are also designed to model collaborative, facilitated learning that is the fundamental premise of STEM education. Teachers are supported in building these skills through various essential mechanisms that include a school-day schedule that incorporates a daily block of time for team-based curriculum development. Campus-based curriculum coaches dedicated to classroom support initiated by the MMEE

program model have been added to all elementary campuses within the district providing on-campus teacher support through observation and evaluation on a weekly basis.

The student STEM educational experience is not only creating a new approach to learning and a new skill set to support this type of learning, but is also aimed at producing students who are critical thinkers and problem solvers. The STEM experience is also engaging students and their families in new ways that create a sense of community. Perhaps because the STEM focus on math and engineering attracts parents who are innately seeking the best education they can access for their child, or because the student's performance is dramatically higher for their grade level, the community has shown strong support for the STEM education program. The TISD reports that enrollments in local private schools have dropped as parents recognize the quality of public education is improving and is available to their child, another factor in the increased enrollment in TISD public education. This broad scale acceptance of the MMEE program has added to the sense of achievement and commitment to the STEM program by the MMEE network partners assuring that the strengths of the program will continue to grow as STEM education expands across the district.

3. What are the main challenges for growing and sustaining the MMEE Program and related challenges for STEM education within the TISD? Are there mechanisms to meet those challenges?

There are five central challenges that the TISD has identified as priorities to be addressed that can contribute to the continuing success of the MMEE Program and sustaining STEM education in the future:

- The political/social context of introducing change through STEM education requires constant negotiation by network participants as the success of the MMEE program grows (e.g., competition for students, quality of instructional materials, effective instructional approach, high student test scores and other measures of student performance, etc.).
- Student body diversity at MMEE should be increased to include enrollment of low SES students from across the district. This may be gained with Y4 effort to shift to lottery selection, and implementation of a Y3 district-wide busing program.
- Consistency of curriculum across the TISD requires administrative coordination between the MMEE program and the other elementary campuses. Administrative coordination requires active review from year to year among curriculum coordinators, curriculum coaches, and teachers to evaluate and modify curriculum design district wide.
- There is uncertainty regarding changes that may occur as the 11th-12th grade dual credit engineering courses shift from the TISD high school campus to the new university campus in order to increase high school enrollments from other districts.
- Future STEM teacher training must be supported by TAMUT; the university should take ownership and grow the graduate level program to meet the need for trained STEM teachers as TISD and others institute STEM education programs.

What actions has the district taken to address key challenges associated with the MMEE School program and the development of STEM education?

Success of the MMEE Program has occurred from the onset of the program beginning with faculty hiring and first-year student enrollments, followed by demonstrated student performance in Y1 and Y2. The early dynamics associated with the new school coming online, as well as from the ongoing success of the program, have contributed to a fluctuating tension between the new MMEE School and the other seven elementary TISD campuses. For example, 12 of the 18 teachers hired for the MMEE program were selected from within the district, with a smaller number of new hires coming from surrounding school districts or local private schools. Concerns voiced by TISD principals, as well as by those outside the district

stemmed from fear that the MMEE School would continue to draw the best and brightest to the new STEM program. Similarly, first-year MMEE student enrollments consisted of approximately 50% student transfers from within the district, with the remainder drawing from outside the district, including a few students from the nearby areas in the state of Arkansas. Again, principals were vocal in their concerns that reduced enrollments at the other elementary campuses would impact their school programs. Also, as Y1 and Y2 student performance met or exceeded student achievement goals, the response from other campuses has ranged from requests for the same materials, TPD, and instructional strategies afforded the MMEE teachers, to interest in the MMEE math and engineering models.-

The response from the school district typifies the coordinated efforts of the TISD administrative staff to provide leadership and support for the district as a whole related to the series of broad scale changes that have occurred over several years. In this approach, district-level administrators both recognize the nature of the problem, and also offer steps in order to shift the focus from a fixation on the problem to the proactive changes necessary to achieve the solution. Regarding the concerns voiced by TISD elementary principals, the district launched a structured effort that provided information to TISD school principals on changing demographics and enrollment trends in education, and specifically considered issues related to low SES demographics and long-term trends and challenges related to meeting educational needs of low SES students. The principals were given the opportunity to gain in their understanding of the problem through a global perspective in which to consider how the resources and goals of the district were in place to support a strategy to grow district-wide student enrollment through improved quality of education at all campuses, not just at the MMEE School. By Y2 of the MMEE School Program, district-wide enrollments were indeed restored through new student enrollments coming from outside the district as well as from local private schools. The TISD enrollment trends demonstrate the district's strategy for growing student enrollments is an effective one, and instills confidence shared by staff and faculty that short-term changes and long-term benefits are likely to occur as a result of the TISD commitment to improving the quality of education across all school campuses.

A related issue for MMEE concerns the need to increase student diversity in coming years, and again touches on meeting low SES student needs. The MMEE program will in Y4 (2010-11) shift from a first-come, first-served student selection process, to a lottery system. Additionally the district will implement a district-wide busing service that will increase access of low SES students to the MMEE campus, which may be a factor in the current demographics of the MMEE student population. Other student selection issues that have been considered for Y3 include the issue of admitting siblings of current MMEE students in order to reduce the stress on families that could occur with children attending different campuses. On-going administrative support for these types of small and large adjustments continues to provide necessary resources from within the district to maintain the district's capacity to grow and sustain the level of quality necessary to attract new students.

Another important district challenge occurred as a result of the desire for flexibility among MMEE instructors. This included the scope and sequencing of the science curriculum to support the MMEE engineering curriculum, combined with the district's concern for maintaining consistency across the elementary campuses. The fact that the district had successfully completed a two-year effort to achieve horizontal and vertical curriculum alignment prior to developing the MMEE curriculum created a significant dilemma requiring coordination across the district. Finding a solution required that the district would allow MMEE to maintain their core program goals for supporting the engineering curriculum, while avoiding setbacks to the district as a whole. Utilizing the annual year-end, district-wide curriculum evaluation process, and lead by the SIP Elementary Curriculum Coordinator, the district was able to introduce the MMEE curriculum model into the curriculum review process, and the outcome of the coordinated action was the adoption of curriculum documents which were in alignment with the MMEE model. The solution

attained in this effort provided for standards consistent across grade levels, and assured that testing and student assessments could be conducted across the district using the same instruments. This is another example of how leadership of the SIP staff engaged faculty, district wide, through established mechanisms that support self-evaluation and the introduction of change. These outcomes suggest that the district's processes for curriculum development, and the approach to TPD, have inculcated a culture of growth and development that can sustain the essential elements of STEM education. These issues are further explored in the following sections on teacher professional development and STEM curriculum development.

Future challenges that relate to the role of the university and the long-term plan for building a K-16 engineering program concern the commitment of the university to providing the necessary framework for STEM education. The two key components of this effort to date include the critical link provided by the Dean of Engineering, who has systematically built the bridge between high school engineering coursework, and the university lower division engineering program. Additionally, the university must now assume ownership of the STEM graduate program now that the Morriss cohort of teachers is completing the necessary requirements for their degrees, including attaining the Master Math Teacher Certificate (state certified standing). These challenges are yet to be fully addressed; however, the channels of communication established through the TISD/TAMUT partnership remain viable despite the fact that several of the leading positions, including the Provost and the School of Education Dean, as well as the TISD Superintendent's position, are now held by different individuals. The TISD is pursuing these components in similar fashion to early stages of the partnership, with confidence that the university's interests remain consistent with a shared vision for creating an improved quality of education that contributes to building a new workforce with 21st century skills and abilities.

4. How was the teacher professional development (TPD) program created and what are the primary goals and characteristics of the program?

There are six aspects of the TAMUT Program that are essential to STEM TPD for the MMEE School:

- The existing TISD/University partnership provided the context for joint development of formal STEM training coursework that focuses on a rigorous approach to attaining content expertise (e.g., formation of the PDS, existing framework of the master's degree in C&I).
- The TISD role was to develop the syllabus and instruction plan for a 5-week course (later condensed to a total of 80 hours conducted over a 4-week period).
- The university role was to review and guide final course design and approvals, including granting adjunct status to TISD staff to conduct the course (i.e., it is more effective for teachers to teach other teachers, than for Ph.D.s to teach them).
- The TPD course emphasizes and models team-based (grade level) curriculum development.
- TPD begins with building a "buy-in" process for teachers by establishing the context and rationale for choosing STEM focus for K-5 education through research and attainment of new information to support program development.
- TPD coursework emphasizes and models self-evaluation of teaching effectiveness and curriculum effectiveness as an ongoing aspect of curriculum development (curriculum mapping and revisions occur daily, weekly, annually).

How was the TPD program designed and implemented?

The essential foundation and approach to professional development within the district has been established through a district led commitment to seeking methods and strategies to support changing the way students learn, and to producing students who possess critical thinking and problem solving skills and

abilities. Utilizing STEM education to promote this shift in teaching values and methods has provided the district with the necessary framework for implementing a dramatically different approach to teaching, and has resulted in creating a school culture that embraces teachers as facilitators, and learning as a life-long endeavor. The result has been the acceptance of STEM education and an expectation of achievement and renewed commitment to educational excellence shared by experienced and new teachers alike. The TISD framework for this transformation was developed in partnership with the university and continues to grow as the TISD program expands. Currently, the Morriss cohort of 18 teachers is near to completing the Curriculum and Instruction graduate master's degree program, and the Master Math Teacher Certification. The first 6th grade STEM training has already occurred, and the 7th grade STEM training will be conducted during the spring of 2009. Additional middle-school and high-school courses are also in development and will continue to meet TISD goals to open the middle school and high school STEM academies.

The ability of the TISD to launch the plan for the MMEE School, opening its doors within 18 months from the first planning session, was in part facilitated by the existing TPD program established in 2004 in partnership with the TAMUT. The original graduate level program was designed to build teacher skills in curriculum and instruction, as well as to improve content expertise developed through 18 hours of elective course work. The modifications that were introduced for the Morriss teachers included a rigorous research and curriculum development model designed to build skills and experience with a collaborative team work process, and utilized the 18 hours of required electives to add the focus on STEM content coursework in engineering, math and science. The Morriss teachers are also required to complete the Master Math Teacher Certification, meeting state standards for certification. Achieving the Master's Degree in C&I is a requirement of employment in the MMEE K-5 program. Although these same standards will not be required of the middle school STEM Academy faculty (largely because the middle school academy will not be developed through new hires), the C & I Masters degree will be required of all STEM faculty in grades 9-12. Middle-school teachers will be offered opportunities to participate in the university courses, and it is anticipated that teachers will voluntarily take the courses both as a result of peer pressure (resulting from enthusiastic voluntary participation of some faculty), as well as from pressure to prepare for STEM students coming up from the K-5 program.

Design of the Morriss STEM training program was jointly conducted by the university and the TISD, with the TISD curriculum team focused on generating the syllabus for the two C&I courses, and the university taking on the necessary university and state review and approvals for the new courses. The process was informed by primary research conducted by the TISD team that included the Curriculum Coordinator and Curriculum Specialist, and was guided by the Dean of the School and Arts and Sciences Education who was instrumental in the decision and approval for the courses to be taught by the TISD team. This action was highly controversial and initially caused major discussion among university faculty who felt strongly that the courses should be taught by university instructors. However, the Dean successfully argued that, based on observation of other programs, the courses would more effectively be taught by teachers with classroom experience, and also permitted the courses to be taught off the university campus, offering the Morriss cohort to complete their coursework in the more familiar location of the TISD middle school.

The syllabus for each course (see Appendix A) presented new STEM faculty with a robust set of tasks and exercises that include research and information gathering, exploration of curriculum and instruction methods, project-based classroom instruction, and self-evaluation. The courses have been team taught, utilizing the expertise and standing of the Curriculum Coordinator who is a former secondary mathematics teacher, along with the Curriculum Specialist who is a former elementary math teacher who brings experience and knowledge from outside the district to support the curriculum and instruction design

process. The 4-week coursework is also structured to foster team-work and collaborative curriculum development through the project-based outcomes designed for the course, and through modeling of these practices by the course instructors.

Emphasis on research and self-evaluation as a method for constant improvement are also an important dimension of the C&I coursework that prepare teachers to actively use technology in the classroom to access new information and ideas (the course is taught in a middle-school library, which includes a full computer lab). Additionally, the course instructors built the course upon the combined experience of both instructors in classroom teaching, together with their experiences in providing TPD to a broad range of teachers over a number of years, essentially fostering an approach that relied on the course instructors “to think like a classroom teacher.” Utilizing a research-based approach, course instructors were able to provide answers and information to support the premise of STEM education, and also provided modeling of this approach through the method of instruction. The resulting buy-in of the new teaching methods, and of the premise of STEM’s focus on engineering and math, provided a solid foundation for effective curriculum development during the first year of the MMEE program. In fact, during the summer session of June-July 2007, the Morriss faculty completed nearly half the curriculum needed for the 2007-08 school year, and were ready to launch the team-based process even as the school doors were opening for the first time.

5. What are the essential characteristics of curriculum development?

There are seven essential aspects of the MMEE curriculum development framework:

- Curriculum development is ongoing and requires highly structured teacher support provided by the principal working closely with an on-campus curriculum coach, who will facilitate team curriculum design on a daily basis.
- MMEE STEM program “non-negotiables” are inherent in the TISD STEM culture developed by the TISD core MMEE team and based upon established principles that guide TPD, curriculum design and curriculum delivery district wide and include:
 - Hands on learning
 - Constructivism
 - Leadership and articulation
 - Daily engineering instruction
 - Alternative forms of assessment
 - Concept-based instruction
 - Algebraic thinking
 - Cooperative learning
 - Accelerated mathematics
- School facility and equipment are designed to maximize STEM learning experience.
- Once teachers were selected, TPD was designed to prepare them to become the main curriculum designers with necessary skills to assess and revise the curriculum through research of new and existing resources, (e.g., addition of EIE instructional materials in Y2).
- Engineering curriculum was initially developed through research and review of content as well as through input from professional engineers as to essential skills and abilities (e.g., communication skills created “leadership and articulation” non-negotiable).
- Accelerated K-5 math curriculum mapped out to teach three years of math over two years through a “link, learn, extend” classroom method (see Appendix A). The accelerated math supports essential goals for students to take Algebra 1 in 7th grade and pre-calculus in 10th grade in

order for 11th and 12th grade students to have the necessary pre-requisites for dual credit engineering and math courses offered by the TAMUT School of Engineering.

- Vertical and horizontal consistency of MMEE curriculum within the TISD system is coordinated at the administrative level to assure the STEM program meets standard state assessment testing (Texas Assessment of Knowledge and Skills).

How has the STEM curriculum design for the MMEE School been developed and implemented?

The initial design for the STEM K-5 curriculum was developed by the TISD Curriculum team including the TISD Curriculum Coordinator, the curriculum and instruction specialist, and the MMEE principal with input and review by the TISD assistant-superintendent, and the TAMUT Deans of the School of Arts and Sciences and Education, School of Engineering, and the School of Math. The first stages of curriculum development focused on the science curriculum because this was the most familiar and available, and was followed by significant effort to begin the process of developing the engineering and math components. The curriculum team reports their efforts at this stage could best be described as an “engineering immersion” in which the team researched engineering concepts and approaches to teaching engineering, and also identified existing instructional material. Additional information was developed through input from career engineers regarding essential skills and career preparation.

The initial STEM curriculum template has continued to evolve, first as part of the Morriss faculty graduate coursework conducted in summer 2007, and since then as a feature of the ongoing TISD curriculum review and evaluation process described in earlier sections of this report. The role of MMEE teachers in curriculum development is primary in that teachers are engaged in a constant curriculum and instruction self-evaluation process which offers teachers the potential to improve content as well as delivery and instruction in an ongoing basis. Similar to the teacher at the Metro Early College High School (Columbus, Ohio) who described the process as “flying the plane while you are building it,” the TISD team commented that the MMEE process was like “building the ship at sea.” In both cases, the sense that curriculum development is a perpetual *work-in-progress*, supported by an essential functioning framework which requires constant finishing work, embellishments, repairs and improvements to get it right.

An early contribution of the Morriss faculty was their charge to determine how best to “spiral” the engineering taught first thing each school day in each grade level to infuse engineering concepts throughout the day’s instruction. The engineering design process was also incorporated into C&I to frame specific phases of project development that include: **Imagine, Plan, Design, Improve, and Share** (see Appendix A). The process of utilizing concepts to overlap and link one subject to another allows the teacher to more easily integrate subjects, rather than blocking out siloed content instruction typical of traditional direct instruction methods. An essential tool for curriculum content development was also established through the curriculum design process in which teachers were encouraged to utilize research strategies to improve content and instruction, engaging them in building skills to support development of innovative solutions to address gaps or ineffective instructional strategies experienced in the classroom. This process was designed for teachers to gain confidence in their ability to tackle and master STEM content, including the tools to design necessary changes required for STEM instruction.

While the STEM curriculum design is intended to provide a flexible and constant evaluation process, the need for systematic modification of coursework is approached through the TISD yearly curriculum review process that occurs during June of each year. This generally offers a period of several days in which the curriculum coaches and curriculum coordinators work with grade-level teachers to assess district “curriculum maps” notated by teachers during the course of the school year with problems and ideas for changing content and instruction. Grade-level review leads to curriculum modifications that are then

considered as the foundation for the following school year. The engineering curriculum evaluation also resulted in fundamental program changes to addresses gaps in the curriculum identified during Y1, leading to adoption of new curriculum materials for Y2 that included a combination of new teacher-designed curriculum, as well as incorporating some materials from the *Engineering is Elementary* (EIE) and from other existing engineering curriculum. Y2 changes also included reducing the number of *Engineering Encounters* from six to five per year, changing the pace of project-based student instruction throughout the school year. Additionally, the curriculum review process also assures that curriculum modifications meet vertical and horizontal consistency through oversight of the district's curriculum coordinators, maintaining grade-level standards district wide, from one year to the next.

The accelerated math curriculum has probably been the most challenging component of the MMEE School program, both in terms of the challenge for the pace of instruction, as well as for the content expertise required by teachers. The latter has been addressed by requiring Morriss teachers to complete the Master Math Teacher Certification, which will conclude in August of 2009 when the Morriss cohort will complete their training and sit for the state exam. The challenge of teaching three years of instruction in two years' time is approached through the "link, learn, extend" mode where teachers provide instruction that begins with building on concepts from the previous grade level, and links to introducing current grade-level concepts, and as students master those concepts, extends to the next grade level. Through this approach students are accelerated at a pace that builds upon what they know and understand to provide the foundation for the introduction of new concepts as soon as they are ready to move on to the next level. Curriculum evaluation for the accelerated math was conducted continuously to monitor grade-level progress throughout the school year. During Y1, a few teachers struggled with full acceleration in some areas. As the end of the school year approached, teachers across grade levels felt pressured to switch back to direct instruction, to the familiar "drill and kill" mode of preparing for the state test. This was immediately addressed by the curriculum coach who was able to work one-on-one with individual teachers to assist them with regaining the STEM instruction mode, and to encourage them to stick with the new approach.

In summary, the essential aspects of the MMEE model for curriculum development includes several key components: 1) a structured daily block of time that is part of the school-day schedule for Morriss faculty to conduct coordinated and collaborative team-based curriculum development; 2) technical support that is reinforced by staffing that includes the principal as well as a campus-based curriculum coach; and, 3) a district-wide curriculum review process that incorporates curriculum and instruction self-evaluation based upon the daily, weekly and annual review process.

CONCLUSIONS AND RECOMMENDED ACTIONS

This report was developed for the purpose of identifying fundamental characteristics and strengths of the Texarkana Independent School District's process for designing and implementing the MMEE K-5 School including the TISD teacher professional development component for STEM education. In the final section of this report, conclusions and recommended actions for STEM teacher professional development and curriculum instruction are provided based upon insights and experience gained by the TISD.

Recommendations for STEM Teacher Professional Development:

- *Teacher Professional Development for STEM education should be designed as an ongoing process, not just a one-time event, requiring intensive formal technical assistance and formal development of STEM content expertise in math, engineering and science.*

- STEM education is best approached as a collaborative learning experience and requires building a team culture and modeling of team-based interaction through TPD, and in the STEM C&I utilized in the classroom. STEM teachers should be supported by a structured daily period of time during the school day for team-based, grade-level curriculum development to support ongoing development of STEM curriculum and instructional approaches throughout the school year.
- There are short-term and long-term components to STEM Teacher Professional Development that require a network partnership between the K-12 school district and the university in order to meet staff preparation needs for a specific school program opening in the short term, and in the long term, to meet the need to build competent STEM K-12 faculty to meet staffing needs in the future as STEM education expands.

Recommendations for the Texarkana Independent School District:

- Teacher Professional Development should be as carefully scaffolded for high school as it was for the Morriss Elementary School. The scaffold will be different, but should retain the concept that the cohort of teachers will require ongoing TPD that can lead to earning a graduate degree in a STEM content area.
- The collaborative partnerships for high school should be expanded into the community-at-large, bringing opportunity and expertise to partner with teachers, as well as internship possibilities for students.
- The TPD program should be marketed to students entering the teaching profession as well as scientists so they can effectively partner with teachers.

Universal Notes in the Emergence of STEM Culture:

- STEM is a vehicle for delivering educational content, not an end game of specialized content. This makes it educational reform not an educational fad.
- There are universal facets that underlie strong STEM organization such as shared habits; collaboration across community, industry and education; curriculum and instruction based upon the scientific method; inter- and trans- disciplinary problem-based learning; and, commitment to ongoing teacher development. The overlying components of region, distinctive partnerships and distinguishing cultural and economic factors, give each STEM school its own unique signature.
- Common habits and shared goals are integral to success. "Buy-in" across STEM partners is essential to building and maintaining a shared vision and commitment to enable a strong organization.
- STEM programs must be fluid and able to recognize needs, assess weaknesses and strategize proactive change to keep the underlying organization strong and successful.
- STEM reform must benefit students, faculty and the community as a whole, if it is to change the way that teachers teach and the way that students learn.

APPENDIX A - C



Texas A & M University – Texarkana
ED 597 – Interdisciplinary Curriculum Design
Credits: 3SCR

Course Syllabus
Summer 2007

Course Description

This course provides teachers with the knowledge and skills needed to design an interdisciplinary curriculum. Emphasis will be placed on the mechanics of developing interdisciplinary units which focus on guiding questions and universal concepts. This course will lay a foundation which guides teachers in introducing students to the broad world of engineering, the math and science knowledge needed for engineering understanding, the questions engineers answer, and the changes which engineers bring. Integration of engineering, science, and math concepts will be a primary focus of the curriculum design.

Required Texts

Jacobs, H. ed. (1989) *Interdisciplinary Curriculum Design and Implementation*. Alexandria: Association for Supervision and Curriculum Development.

Erickson, H. (2002) *Concept-Based Curriculum and Instruction: Teaching Beyond the Facts*. Thousand Oaks, California: Corwin Press, Inc.

Recommended Texts

Allen, R. (2006) *Priorities in Practice: The Essentials of Science, Grades K – 6: Effective Curriculum, Instruction, and Assessment*. Alexandria: Association for Supervision and Curriculum Development.

Checkley, K. (2006) *Priorities in Practice: The Essentials of Mathematics K-6: Effective Curriculum, Instruction, and Assessment*. Alexandria: Association for Supervision and Curriculum Development.

Course Objectives

Participants will:

1. Apply facilitation techniques and strategies to support the development of students who are innovative, critical thinkers, and who are able to analyze information, evaluate other's ideas, and think independently.
2. Analyze and plan concept-based curricula built upon conceptual themes which are timeless, universal, and which stimulate higher-level thinking skills.

3. Discuss and design practical, hands-on engineering, math, and science units of instruction which will stimulate intellectual curiosity and challenge both advanced and emerging engineering students.
4. Discuss and design creative, hands-on, inquiry-based interdisciplinary classroom units of instruction which span the subject areas and equip students to use knowledge to help them solve new problems.

Course Outline: Design

Class	Topic	Points of Discussion
Class 1 <i>June 4</i>	Curriculum Framework	<ul style="list-style-type: none"> • Introductions and Course Material Distribution • Types of Curriculum Design (PPT) • Morriss Elementary Curriculum Framework (PPT)
Class 2 <i>June 6</i>	Concept-Based Instruction	<ul style="list-style-type: none"> • Concept-based Curriculum Design (PPT)
Class 3 <i>June 11 AM</i>	Interdisciplinary Lessons and Units	<ul style="list-style-type: none"> • Interdisciplinary Lessons and Units (PPT) • Activity: Interdisciplinary Unit Mapping • Activity: Interdisciplinary Lesson Planning
Class 4 <i>June 11 PM</i>	Exam I	<ul style="list-style-type: none"> • Engineering Symposium Planning (PPT) • Activity: Symposium Planning - Discussion and Role Assignments • Exam I
Class 5 <i>June 13</i>	Horizontal and Vertical Alignment and Acceleration of Math Standards	<ul style="list-style-type: none"> • Horizontal and Vertical Alignment (PPT) • Acceleration of Math Objectives and Standards • Morriss Mathematics Process • Activity: Vertical Alignment Documents: Review and Discuss
Class 6 <i>June 18</i>	Engineering Curriculum	<ul style="list-style-type: none"> • Engineering Immersion (PPT) • The Engineering Curriculum (PPT) • The Engineering Process • Activity: Designing Engineering Units
Class 7 <i>June 20</i>	Designing Engineering Units	<ul style="list-style-type: none"> • Activity: Designing Engineering Units
Class 8 <i>June 25 PM</i>	Engineering Symposium	<ul style="list-style-type: none"> • Engineering Symposium
Class 9 <i>June 26</i>	Project Work Class Exam II	<ul style="list-style-type: none"> • Activity: Designing Units • Exam II

Class 10 June 28	Portfolio Submission and Roundtable Discussion	<ul style="list-style-type: none"> • Portfolio Submission • Designing Units • Roundtable Discussion
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Methods of Instruction

Methods of instruction will include lectures, presentations, large and small group discussions, group work, collaboration, independent inquiry, and reflection.

Course Requirements and Means of Evaluation

Written assignments must follow the American Psychological Association (APA) format for text and references. All text should be double-spaced in 12 point font with a one-inch margin on all sides.

1. Professional Article Reviews (2)

Students will submit two professional article reviews. The articles students will review are limited to those authors and/or subjects listed in the literature review/reference section of the course workbook or those which are approved by the instructor. The article reviews will serve several purposes:

- To ensure the perusal of contemporary research related to the design of a math, science, and engineering curriculum.
- To ensure mastery level proficiency in writing skill, as well as the ability to write reflectively.
- To permit the student to demonstrate mastery of the use of the APA writing guidelines.

Evaluation of professional article reviews will be based on the comprehensiveness of the summary and on a brief presentation to the class. Written reviews should include key points of the article as well as a paragraph of how the article relates to the teaching practice. One of the professional article reviews will be completed on the topic of engineering in the elementary classroom and will be based upon current research in the field of engineering. The length of each article summary should be no more than two pages in length. Each professional article summaries will be worth 10% of the final grade.

2. Exams

Two exams will be administered to evaluate the concepts discussed in class. The exams will be comprehensive evaluations of all material covered in the course. Each examination will be worth 10% of the final grade.

3. Reflections of Class Topics (10)

Students will reflect upon daily topics of discussion by completing a written reflection following each class. Reflections should include thoughts on how daily topics of discussion relate to personal classroom teaching styles. Additional points may include opinions, questions, current research findings, and changes in thought as a result of classroom topics and activities. Daily reflections should be written in first person point of view. Reflections will be worth 10% of the final grade.

4. Field-Based Activity

Students will plan and organize an engineering symposium to occur at the end of the course. The class, as a group, will be required to secure professional participants from one of the five engineering disciplines listed below to participate in a panel discussion of the engineering profession. None of the professionals can represent the same company or business. The group will be responsible for contacting and securing the panel members, selecting the questions to ask each panel member, arranging the format for the panel discussion, conducting the symposium, and writing thank you/appreciation notes to guests. Each student will research the engineering disciplines of participants and will prepare a base interview instrument prior

to the symposium based on this research. The interview questions will be selected from those submitted by each student.

Panel participants may work in the fields of:

- Mechanical engineering
- Chemical engineering
- Electrical engineering
- Network engineering
- Civil engineering

Students will write a 2-3 page symposium summary, citing research articles used to create the base interview instrument. The summary will also include a reflection of topics discussed during the symposium. The Engineering Symposium will be worth 20% (10% for symposium responsibilities, 10% for the summary) of the final grade.

5. Portfolio

The culminating project for this course will be a portfolio, consisting of products researched and designed within the scope of the class.

The portfolio components include:

- All lessons and units designed and developed throughout the course.
- Research and data used in the design and development of lessons and units.
- Daily reflections on class topics.
- Professional article reviews.
- Concept identification packets
- Field-based activities

Portfolios will be presented to classmates during a roundtable discussion. The portfolio will be worth 30% of the final grade.

Grading

Each assignment will be graded using the following system. Specific grading criteria will be distributed prior to assignment due dates.

<i>Assignment</i>	<i>Points Per Assignment</i>	<i>Percent of Final Grade</i>
Professional Article Review 1	100	10%
Professional Article Review 2	100	10%
Exam 1	100	10%
Exam 2	100	10%
Reflections of Class Topics (10)	100	10%
Engineering Symposium	200	20%
Portfolio	300	30%
	<i>Total Points Possible:</i> 1000	<i>Total Percentage Possible:</i> 100%

Grading Scale

90 – 100% A
80 – 89% B
70 – 79% C

Below 70% F

***** The instructor reserves the right to make changes to assignments, the class schedule, or the syllabus if the need arises.**

Resources Needed

None

Bibliography

Allen, R. (2006) *Priorities in Practice: The Essentials of Science, Grades K – 6: Effective Curriculum, Instruction, and Assessment*. Alexandria: Association for Supervision and Curriculum Development.

Checkley, K. (2006) *Priorities in Practice: The Essentials of Mathematics K-6: Effective Curriculum, Instruction, and Assessment*. Alexandria: Association for Supervision and Curriculum Development.

Jacobs, H. ed. (1989) *Interdisciplinary Curriculum Design and Implementation*. Alexandria: Association for Supervision and Curriculum Development.

Technology Integration

Instructor will

- support instruction using a classroom presentation system.
- present material using PowerPoint presentations.
- utilize websites for current and supplemental information.

Students will

- use electronic resources to locate research literature.
- employ Web resources to format and submit papers.
- construct assignments in a variety of environments including word processing, spreadsheets, and publishing software.

Academic Honesty

Academic honesty is expected of students enrolled in this course. Cheating on examinations, unauthorized collaborations, falsification of research data, plagiarism, and copying or undocumented use of materials from any source constitute academic dishonesty, and may be grounds for a grade of “F” in the course and/or disciplinary action. The student is responsible for reading and understanding the University Policy on Academic Integrity.

Accommodations for Students with Disabilities

Accommodations can be provided for students with a disability only after the student requests an accommodation and provides the appropriate written documentation of a disability. To request accommodations for this course, students are responsible for the following:

1. Contact the A&M-Texarkana Student Services Office to request appropriate accommodations;
2. Provide documentation of a disability to the A&M-Texarkana Student Services Office and documentation must be less than 5 years old;
3. Contact the instructor to discuss implementation of accommodations for this course.

The Student Services Office is located in room 227 in the Aikin building or you can call 903-223-3062 for additional information.



Texas A & M University – Texarkana
Ed 597 – Interdisciplinary Curriculum Delivery
Credits: 3SCR

Course Syllabus
Summer 2007

Course Description

This course is designed to provide teachers with the knowledge and skills needed to facilitate concept-based instruction in a learner-centered classroom using an interdisciplinary approach. Cognition and innovation, as applied to the delivery of an interdisciplinary curriculum, will be examined as students explore contemporary research in instructional practice and curriculum delivery. Students will learn and develop alternative forms of assessment appropriate for the non-traditional, learner-centered classroom, as well as the delivery and integration of engineering and technology into classroom activities and concepts. Learners will develop a personal research-based instructional delivery model reflecting their educational philosophy and approach.

Required Texts

Costa, A. ed. (2001) *Developing Minds: A Resource Book for Teaching Thinking*, 3rd Ed. Alexandria: Association for Supervision and Curriculum Development.

Johnson, D., Johnson, R. & Holubec, E. (1994) *Cooperative Learning in the Classroom*. Alexandria: Association for Supervision and Curriculum Development.

Recommended Texts

Armstrong, T. (1998) *Awakening Genius in the Classroom*. Alexandria: Association for Supervision and Curriculum Development.

Harvey, S. & Goudvis, S. (2000) *Strategies That Work: Teaching Comprehension to Enhance Understanding*. Portland: Stenhouse Publishers.

Sprenger, M. (2005) *How To Teach So Students Remember*. Alexandria: Association for Supervision and Curriculum Development.

Course Objectives

Participants will:

1. Apply facilitation techniques and strategies to support the development of students who are innovative, critical thinkers, and who are able to analyze information, evaluate other's ideas, and think independently.
2. Examine effective integration of engineering and technology into classroom activities and concepts.
3. Organize and practice the guided discovery process as it relates to concept attainment and extension of learning.
4. Examine and practice curriculum delivery strategies such as scaffolding and modeling.
5. Analyze and develop alternative assessment tools which are authentic, continuous, and related to student learning.

Course Outline: Delivery

Class	Topic	Points of Discussion
Class 1 June 5	Constructivism	<ul style="list-style-type: none">• Constructivism (PPT)• Facilitation• Questioning Strategies
Class 2 June 7	Interdisciplinary Thinking	<ul style="list-style-type: none">• Planning for Interdisciplinary Learning (PPT)• Activity: Interdisciplinary Thinking Through Concept Identification• Interdisciplinary Units: Moving beyond the core subject areas (Guest Speakers)• Activity: Planning with Integration
Class 3 June 12 AM	Conceptual Understanding and Algebraic Thinking and Reasoning	<ul style="list-style-type: none">• Conceptual Understanding (PPT)• Algebraic Thinking and Reasoning (PPT)• Activity: Designing Units
Class 4 June 12 PM	Exam	<ul style="list-style-type: none">• Activity: Designing Units• Exam I
Class 5 June 14	Vertical Curriculum Delivery	<ul style="list-style-type: none">• Vertical Curriculum Delivery (PPT)• Accelerated Curriculum (PPT)• Activity: Plan and deliver a vertical, concept-based lesson on accelerated TEKS• Activity: Plan Math Units
Class 6 June 19	Genius and Cooperative Learning	<ul style="list-style-type: none">• Genius and Cooperative Learning (PPT)• Activities: Jigsaw and The Bull's Eye• Activity: Designing Units
Class 7 June 21	Expectations of Engineers	<ul style="list-style-type: none">• Student Leadership and Articulation of Findings (PPT)• Plan 4th 6 weeks Engineering Curriculum and Engineering Resources (PPT)• Activity: Designing Units

Class 8 June 25 AM	Engineering Encounters	<ul style="list-style-type: none"> • Engineering Encounters (PPT) • Activity: Delivery of Engineering Encounters • Activity: Designing Units
Class 9 June 27	Integrating Technology and Exam II	<ul style="list-style-type: none"> • Using Technology in the Classroom (Guest Speaker) (PPT) • Activities: United Streaming and Virtual Manipulatives • Exam II • Field-Based Activity Due
Class 10 July 2	Final Paper Due	<ul style="list-style-type: none"> • Project Work Class • Submission of Educational Philosophy

Methods of Instruction

Methods of instruction will include lectures, presentations, large and small group discussions, group work, collaboration, independent inquiry, and reflection.

Course Requirements and Means of Evaluation

Written assignments must follow the American Psychological Association (APA) format for text and references. All text should be double-spaced in 12 point font with a one-inch margin on all sides.

1. Exams

Two exams will be administered to evaluate the concepts discussed in class. The exams will be comprehensive evaluations of all material covered in the course. Each examination will be worth 10% of the final grade.

2. Reflections of Class Topics (10)

Students will reflect upon daily topics of discussion by completing a written reflection following each class. Reflections should include thoughts on how daily topics of discussion relate to personal classroom teaching styles. Additional points may include opinions, questions, current research findings, and changes in thought as a result of classroom topics and activities. Daily reflections should be written in first person point of view. Reflections will be worth 20% of the final grade.

3. Field-Based Activity

Students will interview an engineer within the community regarding the engineering knowledge, skills, and training required for successful participation in and leadership within the profession. Students will prepare a base interview instrument prior to holding the interview. The base interview instrument will be prepared using recent research articles on the engineer's field of expertise. Students will write a 3-4 page interview summary, citing the recent research articles used to create the base interview instrument. The summary will also include a reflection of topics discussed. The field-based activity will be worth 30% of the final grade.

4. Educational Philosophy Paper

The culminating project for this course will be an educational philosophy paper. Each student will submit a 5-6 page descriptive, research-based paper on his/her views of interdisciplinary and integrated learning in the classroom. Students will use emerging research-based curriculum delivery methods and means of assessment to serve as a basis for the educational philosophy paper. Student educational philosophies should include how views of teaching and learning have changed as a result of the course topics and discussions. Students will reference a minimum of 3

research-based articles to support the educational philosophy. The educational philosophy paper will be worth 30% of the final grade.

Grading

Each assignment will be graded using the following system. Specific grading criteria will be distributed prior to assignment due dates.

<i>Assignment</i>	<i>Points Per Assignment</i>	<i>Percent of Final Grade</i>
Exam 1	100	10%
Exam 2	100	10%
Reflections of Class Topics (10)	200	20%
Field Based Activity	300	30%
Educational Philosophy Paper	300	30%
	<i>Total Points Possible:</i> 1000	<i>Total Percentage Possible:</i> 100%

Grading Scale

90 – 100% A
 80 – 89% B
 70 – 79% C
 Below 70% F

***** The instructor reserves the right to make changes to assignments, the class schedule, or the syllabus if the need arises.**

Resources Needed

None

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Technology Integration

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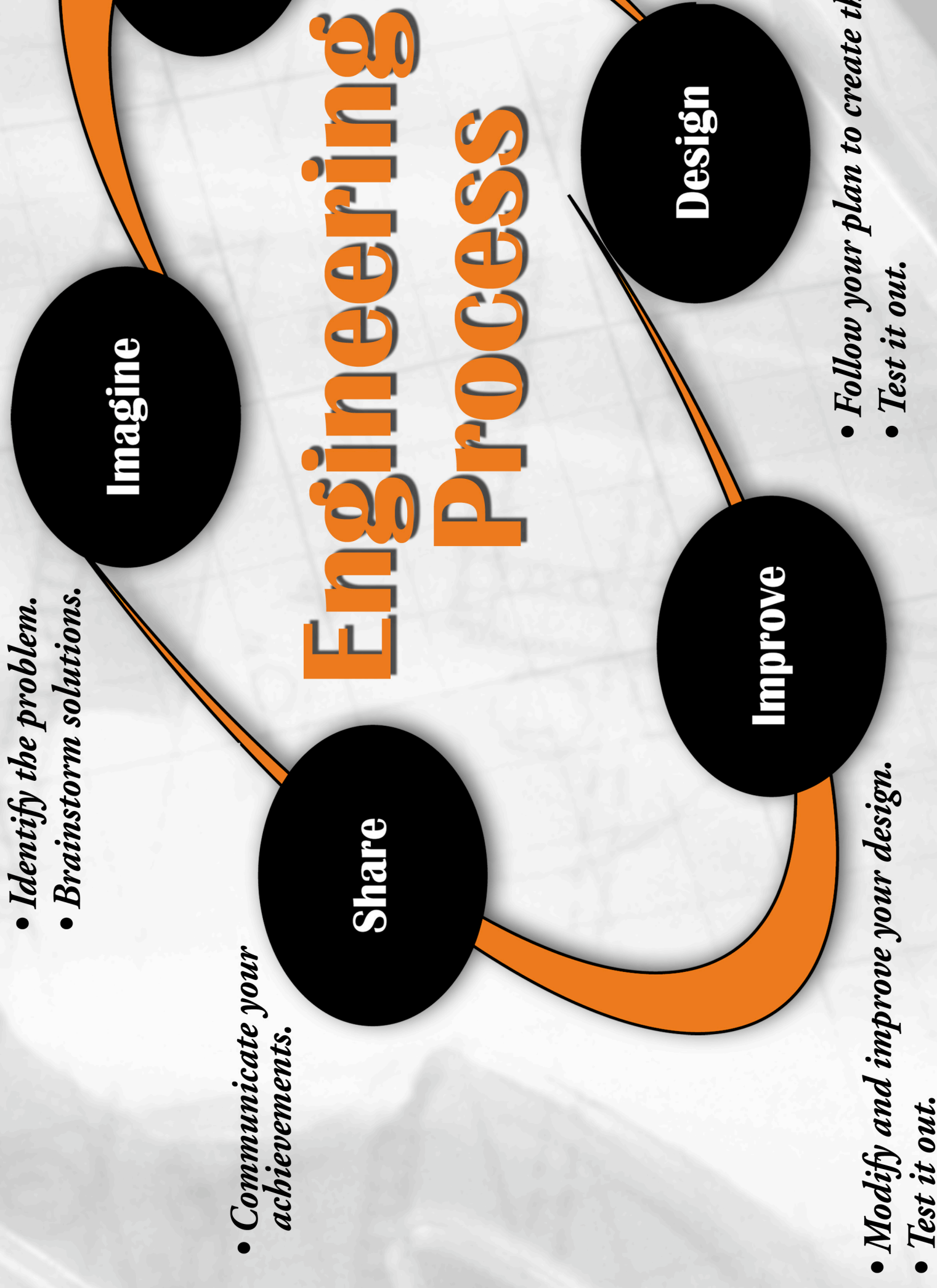
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Martha and Josh Morriss Mathematics & Engineering Elementary School



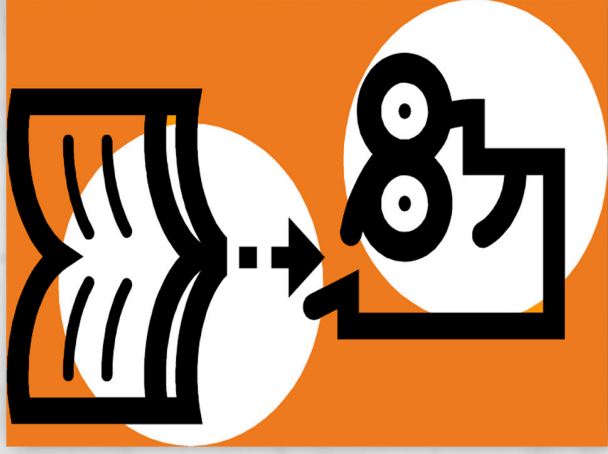
Texarkana
Independent School District

Martha and Josh Morriss Mathematics & Engineering Elementary School

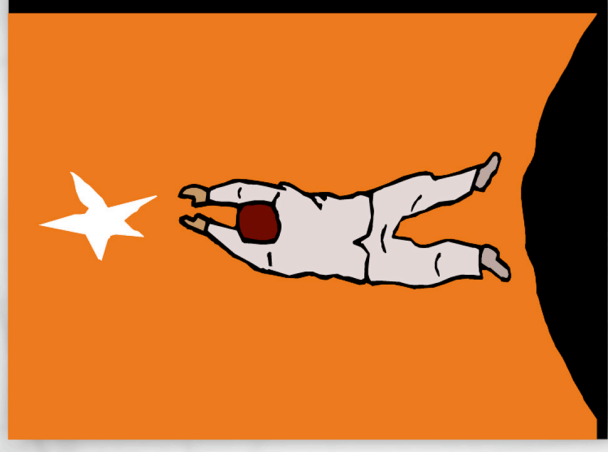
Mathematics Process



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Learn



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