Concentration in Mathematics Education for the Interdisciplinary Ph.D. Degree Program in Curriculum and Instruction

Proposal approved by the Executive Committee of the Interdisciplinary Ph.D. Degree Program in Curriculum and Instruction, and presented by

Dr. Marilyn P. Carlson, Department of Mathematics
Dr. Alfinio Flores, Curriculum & Instruction
Dr. Philip A. Leonard, Department of Mathematics
Dr. James A. Middleton, Curriculum & Instruction
Dr. Dennis L. Young, Department of Mathematics
Dr. Michelle J. Zandieh, Department of Mathematics

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Concentration in Mathematics Education for the Interdisciplinary Ph.D. Degree Program in Curriculum and Instruction

A. Description of current degree program and how the proposed concentration fits in

The Concentration in Mathematics Education would be an additional concentration area of the existing Interdisciplinary Ph.D. Degree Program in Curriculum and Instruction (IPDPCI). There are currently eleven concentration areas in this program, and the concentration in mathematics education would be the 12th. As such, the bylaws for the concentration in mathematics education will be the same as for the IPDPCI. Once approved, the concentration in mathematics education will have its own representation to the Executive Committee of the IPDPCI.

The courses and learning experiences in the current concentrations in the Interdisciplinary Ph.D. Degree Program in Curriculum and Instruction are divided into four areas: Core requirements, Professional Focus, Cognate Study, Dissertation and Individual Research. Each concentration requires a minimum of 90 - 93 semester hours beyond the bachelor's degree. The proposed concentration in mathematics education is also divided into the same four areas and requires a minimum of 90 semester areas beyond the bachelor’s degree.

The structure of the new concentration follows exactly the same structure as the other concentrations. For mathematics education the core consists of six hours, the same core courses that are required for the other concentration areas. The professional focus includes at least 15 hours of inquiry and analysis, at least 27 hours of concentration in mathematics education and related areas, and at least 6 hours of internship. Like other concentration areas in the Ph.D. program in Curriculum and Instruction, the proposed concentration in Mathematics Education requires at least 12 hours of cognate study. The new concentration also requires at least 24 hours of independent research and dissertation.

Admission procedures are consistent with the other concentrations in the IPDPCI program. Students must submit evidence of an appropriate degree, transcripts, GRE scores, letters of recommendation, sample writing, a statement of interest and intent, and evidence of teaching experience, along with the application.

B. Need for proposed concentration in Mathematics Education

The proposed concentration is needed to satisfy both structural and theoretical demands of the field of mathematics education. Mathematics educators research issues of knowing, learning and teaching mathematics at the pre-kindergarten to university level; perform supervision of student teachers; develop curricular materials for K-16 students; prepare prospective and in-service teachers of K-12 mathematics; teach undergraduate mathematics; and teach graduate mathematics and mathematics education courses at institutions of higher education.
There is a currently a tremendous need for qualified people in this area, both at the state and national levels. In recent years, the numbers of positions open in mathematics education is greater than the number of doctoral students completing their program of study. Arizona State University is currently positioned to prepare professionals to work in these areas, and consequently contribute to responding to the existing shortages at the state and national levels.

Presently, Arizona State University does not offer a broad, comprehensive, and coordinated effort in mathematics education, although individual faculty members in both the department of mathematics and the college of education have experience and expertise in mathematics education research.

Collaboration between mathematics educators in the mathematics department and the college of education will benefit both groups. Faculty involved in this concentration have already collaborated by serving on doctoral committees and participating in joint grants such as ACEPT. The concentration would provide an institutional framework to further promote this collaboration.

The concentration is interdisciplinary, involving faculty with different backgrounds to provide diverse perspectives to the experience of the concentration. This collaboration will enrich the research programs of the faculty involved in the concentration and provide a common focus for joint research and cooperation in the development of graduate courses in mathematics education.

A concentration in mathematics education would attract students from across the nation who have interest in studying in mathematics education. This would contribute to the research and scholarly culture of the faculty and the doctoral students in both the Department of Mathematics and the College of Education.

The concentration would provide ASU the opportunity to cover the entire spectrum (in conjunction with the other programs that are already established, see D) from early childhood, to upper elementary and middle grades, to secondary and college level mathematics education.

Graduates from the concentration in mathematics education will be hired by mathematics departments to perform research in mathematics education, prepare secondary teachers of mathematics, and teach graduate courses in mathematics education; by colleges of education, to perform research in mathematics education, prepare elementary and middle school teachers, and teach graduate courses in mathematics education; by institutions of higher education to prepare mathematics educators; by research and development organizations to participate in curriculum projects in mathematics; by school districts to do research and staff development in mathematics teaching and learning; and by institutions of higher education to prepare teachers. Typically, some of the students in a doctoral program in mathematics education are already faculty at local institutions of higher education. Completion of the proposed
program will prepare these teaching professionals to incorporate research into their activities.

C. A description of the unit’s strengths in relation to the proposed concentration.

Arizona State University has a cadre of nationally recognized experts in mathematics education, housed either in the Division of Curriculum and Instruction or the Department of Mathematics. The major faculty involved in the concentration of mathematics education are

- Dr. Marilyn P. Carlson  Assistant Professor, Department of Mathematics
- Dr. Alfinio Flores  Professor, Curriculum & Instruction
- Dr. Philip A. Leonard  Professor, Department of Mathematics
- Dr. James A. Middleton  Associate Professor, Curriculum & Instruction
- Dr. Dennis L. Young  Professor, Department of Mathematics
- Dr. Michelle J. Zandieh  Assistant Professor, Department of Mathematics

The field of specialization of Drs. Flores and Middleton is mathematics education. They have their individual active programs of research and scholarly production in this field. In addition, they have collaborated in common projects and publications in the past. The proposed concentration would provide a structure to make their collaboration more systematic. The concentration would also facilitate attracting outstanding graduate students to participate in their research projects.

Dr. Carlson and Dr. Zandieh are faculty in the mathematics department and have an active research program in mathematics education at the college level. This concentration would broaden their research programs by allowing them to extend their influence to mathematics education for the secondary grades. Some of the research topics they currently study are also common to college and secondary mathematics. Dr. Leonard and Dr. Young are faculty in the mathematics department who have a high interest in mathematics education, expressed through their active involvement in issues related to this field.

The concentration would also provide a way to facilitate and institutionalize the collaboration between mathematics educators that are housed in the math department with those housed in curriculum and instruction. Five of the six major faculty have been approved to serve as chairs of dissertation committees. The major faculty are enough to provide a program in mathematics education at the same level of quality as other nationally recognized programs.

An additional benefit of the program is that it would provide highly qualified instructors for undergraduate methods courses, which would permit the major faculty to have a more balanced graduate-undergraduate teaching load, without sacrificing the quality of courses for prospective teachers.

Of the faculty who are mainly responsible for this concentration, Drs. Carlson, Flores,
and Middleton will initially be the faculty who will chair dissertation committees. Dr. Zandieh, as a new faculty member, would initially be part of the committees, and once she has established her research program, will also chair committees. Drs. Leonard and Young will also be part of the dissertation committees.

For faculty who are already mentoring doctoral students in other concentrations of the Interdisciplinary Ph. D. Degree Program in Curriculum and Instruction, the new students in mathematics education will replace students being mentored by them as they finish other concentrations. The faculty responsible for this concentration, together with the supporting faculty, forms a critical mass to offer doctoral students a stimulating research environment in mathematics education.

Other faculty in the College of Education and the Department of Mathematics will also provide support for the concentration. Dr. Knaupp is an experienced mathematics educator in Curriculum and Instruction. He is active in various programs and has developed a network of teachers, schools, and districts through direct involvement in the field. In addition, he has mentored doctoral students who have an interest in mathematics education.

Dr. Bitter, also in the College of Education, has an active program of funded research and development in educational media and computers, with a focus in mathematics education. The collaboration with Dr. Bitter is consistent with the emphasis on integration of technology in mathematics education, an interest also shared by the major mathematics education faculty in the college of education.

Dr. Kawski in the Department of Mathematics also has interest in mathematics education. He has attained national recognition by developing new approaches to the teaching mathematics using technology. He also supports this new concentration, and has served in the past on dissertation committees for students with a focus in mathematics education. Dr. Sharon Lohr from the statistics group in the mathematics department would also provide support and serve as dissertation committee member.

One special strength of the faculty involved in this concentration, is that their backgrounds and expertise permit a balanced program in terms of the distribution of mathematics and mathematics education courses between the Department of Mathematics and the Division of Curriculum and Instruction. In addition to the mathematics courses offered at the Department of Mathematics, courses rich in content in mathematics are taught by the mathematics educators at the College of Education. On the other hand, research courses in mathematics education are offered both at the Division of Curriculum and the Department of Mathematics.

D. Description of related ASU programs.

There are two existing doctoral programs at ASU that currently prepare students with an interest in mathematics education. One is the Ed. D. program at the College of Education,
where one of the areas is mathematics education. The other is the Ph. D. in mathematics in the Department of Mathematics. They are good choices for people interested in either end of a wide continuum. The new concentration would complement and share resources with these two programs, rather than duplicate and compete with them, as will be clear from the following discussion.

On one end of the spectrum the mathematics education option for the Ph.D. in the Department of Mathematics is intended to prepare students to do research in more mathematically advanced areas of undergraduate mathematics education. Consequently, preparation for this research will require a great deal of study of advanced mathematical topics. The student's interest and ability in mathematics will need to be sufficiently strong to compete mathematically with someone intending to do research in mathematics. This program requires a very strong background in mathematics, equivalent in terms of course work and comprehensive exams to that of the other Ph. D. students in mathematics.

The interdisciplinary program will appeal to students who also have a strong background in mathematics, but have mathematics education as their primary interest. Although a substantial amount of mathematics will be required for the program, the program offers a more balanced focus between mathematics and education coursework. The students applying for admission to this program will likely be individuals who have completed a master's in either mathematics or C&I, teaching faculty from community colleges, or talented school teachers from across the nation. Whereas, the students who pursue the mathematics research option in the Department of Mathematics will most likely be graduate students in mathematics who elect mathematics education as their research option. In conclusion, these programs compose a different mix of mathematics and mathematics education coursework, target different audiences and prepare students to conduct educational research on different mathematical levels.

One of the areas of the Ph. D. in Mathematics is research in college mathematics education Drs. Carlson and Zandieh are presently involved with this program, and they would continue to contribute to this program and also to the new concentration. Some of the courses presently offered in the Department of Mathematics for this program would be appropriate for students in the new concentration.

Another opportunity to share experiences between students in both programs and enrich their preparation is through the Preparing Future Faculty Program. This program is housed at ASU, and has other institutions of higher education as partners, including ASU-West, ASU-East, Grand Canyon University, and the Maricopa Community Colleges. This program would offer students in the new concentration the opportunity to interact with doctoral students pursuing a Ph. D. in mathematics and other areas, as well as with faculty in the participating institutions. This would potentially promote research collaborations with the faculty of these institutions.

On the other end of the spectrum, students with interest in mathematics education in the elementary grades can choose such option in the Ed. D. program in Elementary
Education. At present, faculty with expertise in mathematics education have been working with such students through this program, as well as related concentrations in the IDPDPCI, such as Elementary Education or Educational Media and Computers. The mathematics education faculty would continue to work with students in those concentrations who have a focus in mathematics education. Some of the courses of the new concentration in mathematics education would be of interest to those students. On the other hand, courses that are presently part of the concentrations of elementary education or educational media and computers with an emphasis in mathematics will also be of interest to students in the new concentration.

The proposed concentration of mathematics education is a natural extension to cover mathematics education for all grade levels in a coherent way. The main focus of this concentration will be for students who have an interest in pursuing research issues in middle grades mathematics, secondary mathematics, or college mathematics.

E. Description of the degree requirements for this concentration.
A total of 90 semester hours are required for the program. At least 54 semester hours must be taken at ASU subsequent to the master’s degree.

CORE REQUIREMENTS (total of 6 hours)

DCI 701 Curriculum Theory and Practice
DCI 791 Interdisciplinary Research Seminar

PROFESSIONAL FOCUS

Inquiry and analysis (at least 15 hours from the following)

COE 503 Introduction to qualitative research in education
EDP 552 Quantitative data analysis in education 1 (or equivalent)
EDP 554 Quantitative data analysis in education 2
EDP 556 Data processing techniques in measurement and research
EDP 651 Methods and practices of qualitative research
EDP 652 Multivariate procedures in data analysis 1
EDP 654 Multivariate procedures in data analysis 2
DCI 598 The teacher as a researcher
STP 530 Applied regression analysis
STP 531 Applied analysis of variance
STP 532 Applied nonparametric statistics
STP 533 Applied multivariate analysis
STP 534 Applied discrete data analysis
STP 535 Applied sampling methodology
QBA 527 Categorical data analysis
Other statistics / research methodology courses approved by program committee
Major area of concentration (at least 27 hours)

(At least 15 hours required from among the following)

EED 537 Mathematics in the elementary school (research based)
EED/SED 594 Mathematics in the middle school
EED 598 Children’s mathematical thinking
MAT 598 Research in undergraduate mathematics education 1
MAT 598 Research in undergraduate mathematics education 2
MAT 598 Research in undergraduate mathematics education 3
MAT 598 Research in undergraduate mathematics education 4
EED/SED 791 Research in mathematics education 1
EED/SED 791 Research in mathematics education 2
EED/SED 791 Professional Publication

(At least 12 hours of electives, including 6 hours from the College of Education and 6 from the Department of Mathematics. Electives may be additional courses from the above list or courses from the following list.)

BLE 598 Teaching mathematics for Spanish speakers
EMC/EED 598 Technology in teaching and learning mathematics
EED/SED 598 Geometry for elementary and middle grades teachers
MTE 585 Modern geometry for teachers
MTE 583 Abstract algebra for teachers
MTE 587 Analysis for teachers
MTE 588 Analysis for teachers
EED 529 Science in the elementary school
SED/EED 594 Integrated mathematics, science, and technology
EED 581 Diagnosis and remediation in mathematics
EED 598 Special topics: The teaching of number and operations
EED/SED 598 Special topics: The teaching of geometry
SED 598 Special topics: The teaching of algebra
SED 598 Special topics: The teaching of calculus
EED/SED 598 Special topics: The teaching of probability
EED/SED 598 Special topics: The teaching of statistics
MAT 423 Numerical analysis 1
MAT 425 Numerical analysis 2
MAT 442 Advanced linear algebra
MAT 444 Intermediate abstract algebra
MAT 475 Differential equations
MAT 476 Partial differential equations
MAT 472 Intermediate real analysis
MAT 445 Theory of numbers
MAT 494 Scientific computing
MAT 454 Introduction to Chaos
MAT 570 Real analysis
STP 421 Probability
STP 427 Mathematical Statistics
MAT 543 Abstract algebra
Other electives approved by program committee

Internship (6 hours)

EED/SED 784 Internship in teaching mathematics
EED/SED 784 Internship in research in mathematics education
MAT 784 Internship in teaching undergraduate mathematics

COGNATE STUDY (at least 12 hours)

To broaden their understanding of the conceptual base and issues underlying the study of curriculum and instruction, students take related work outside mathematics education. Students are expected to choose courses that have a clear link to their dissertation efforts. Students who need to deepen their understanding of the conceptual bases of mathematics education, may take related courses in mathematics, statistics, or related fields. Courses for cognate study are selected in consultation with the student’s program committee.

DISSERTATION AND INDEPENDENT RESEARCH (a total of 24 hours)

EED/SED 792 Research
EED/SED 799 Dissertation

Other requirements

The mathematical background of students in this concentration should be well beyond the grade band that they are interested in pursuing. For the three different levels of interest, namely, college mathematics, secondary mathematics, and middle grades mathematics, the following are the requirements. A person interested in college level mathematics education should have the equivalent of a master’s degree in mathematics or a related field at the time of applying. For secondary mathematics education, the equivalent of a major in mathematics or a related field to enter, and take some graduate level courses in mathematics as part of their program. For the middle grades, a person needs at least one year of calculus, and a transition course to advanced mathematics, equivalent to MAT 300 Mathematical structures. In extraordinary cases, K - 8 certified teachers with strong potential in mathematics who do not have the transition course may be admitted, but will have to take it during their first year of their studies.

Residency

The student must spend at least two consecutive semesters (not including summer sessions) as a full time student at Arizona State University.

Comprehensive examination (written and oral defense)
Dissertation proposal (written and oral presentation)
Dissertation (written and oral defense)
The dissertation will prepare the candidate to perform independent research at the level of scholarship required by the profession. Although several of the courses are currently listed using the omnibus number 598, most are courses that have been offered. In addition, several will be given a 700 level number to reflect that the courses are doctoral level.

F. The administration of the new concentration

The new concentration will be part of the Interdisciplinary Ph. D. Degree Program in Curriculum and Instruction. It will have the same governance structure as the other concentrations. A faculty member of mathematics education concentration will be elected by the other faculty in this concentration to represent it in the Executive Committee.

Students can be admitted the semester after the concentration is approved. The number of students will be limited to the number that major faculty in mathematics education can mentor. Most of the courses for this program are already being offered by the university. The two research seminars in mathematics education will be developed jointly by Drs. Flores and Middleton, with the input of the other major faculty in the program. These course will be taught by the faculty on a rotating basis. The special topics courses will be developed as the need arises.

The budgetary implications of this new concentration are minimal. There is no need to hire additional faculty for this program. Doctoral students can participate directly in funded research projects conducted by the faculty in this concentration. Support for students would be provided through graduate assistantships, associated to grants of the faculty involved in this concentration. Doctoral students in their second year in the program can teach the undergraduate methods courses in Curriculum and Instruction. Depending on their background, doctoral students can also teach undergraduate courses in mathematics. At present, both the Department of Mathematics and the Division of Curriculum and Instruction use non-permanent faculty associates and graduate students to teach such courses, and the students in the doctoral program would be highly competitive for these positions.

With respect to books, the university library has an adequate collection in mathematics education. The University already carries the major journals in mathematics education. The library has been very receptive in the past for suggestions of books acquisitions, and the collection can be kept up-to-date. With respect to curriculum materials, the Science/Social Studies/Mathematics lab in Curriculum and Instruction has a basic collection. The College of Education also has site licenses for most of the exemplary computer and other technology programs for mathematics education. The collection can be up-dated on a yearly basis.
There is no need for additional space. The College of Education and the Department of Mathematics have the necessary space for class and laboratories. There is no need for additional personnel specific for this concentration. Students will be recruited through the personnel presently assigned to the doctoral program.

G. Vitae of faculty members who are mainly responsible for the concentration in mathematics education follow.

CURRICULUM VITAE

Marilyn P. Carlson, Assistant Professor
Department of Mathematics
Arizona State University

Education
Ph.D. in Mathematics Education (July, 1995)
University of Kansas, Lawrence, KS

Current Position
Assistant professor, Department of Mathematics, Arizona State University.

Publications


Minor Publications:


Select Presentations

"Undergraduate Mathematics Education Graduate Programs"; RUME (Research in Undergraduate Mathematics Education) Conference (invited panel discussion, Sept. 1998).


"Views About Mathematics Survey"; RUME (Research in Undergraduate Mathematics Education) Conference; Sept., 1996.


"What Do High Performing College Algebra Students Know About Functions?"; Maricopa Math Chairs Retreat (invited presentation); June, 1996.
"An Update of First Year Mathematics at Arizona State University"; 1996 Joint Spring Meeting (State); Flagstaff, AZ; April, 1996.


Grants

PI: Undergraduate Mathematics for Elementary Teachers: A Collaborative Reform. Funding Agency: Eisenhower; amount awarded; $42,000.

Co-PI: ACEPT grant (Arizona Collaborative for the Excellence in the Preparation of Teachers). Funding Agency: NSF.


Co-PI: Maricopa Mathematics Consortium: Advanced Technological Education Project. Funding Agency: NSF.

Recent Curriculum Development Activities
Developed two new graduate courses in research in undergraduate mathematics education.
Directed workshop for revising preservice secondary curriculum; summer, 1998.
Directed numerous ACEPT related curriculum development activities for first year mathematics at ASU; 1995-1998.

Abbreviated Vita

Alfinio Flores

Present position: Professor, Curriculum & Instruction, Arizona State University

Education
1985 Ohio State University. Ph. D. Mathematics Education
1978 National University of Mexico M. Sc. Mathematics
1976 National University of Mexico B. Sc. Mathematics

Work experience
1998 - Professor, Arizona State University
1992 - 1998 Associate Professor, Arizona State University
1989 - 1992 Associate Professor, San Diego State University
1984 - 1989 Associate Researcher, Centro de Investigación en Matemáticas
1982 - 1984 Teaching Associate, Ohio State University
1980 - 1982 Research Assistant, Centro de Investigación en Matemáticas
1978 - 1980 Curriculum Development (Mathematics), Ministry of Education of Mexico

Funded projects

Selected publications
Flores, A. (Accepted). The law of cosines: Connections for future teachers. PRIMUS.
mixtures, batting averages, and speeds. School Science and Mathematics, 95, 423-430.

Presentations (Selection):
1997  Sí se puede. It can be done: Quality mathematics in two languages. NCTM Annual Meeting. Minneapolis, MN.
1996  A science/mathematics classroom/laboratory for authentic integration of technology. NSTA Western Area, Phoenix, AZ (with Staley, Middleton, & Knaupp)
1994  Hands on geometry. NCTM Regional Meeting, Phoenix, AZ.
1992  Exploration of iterative processes and functions with a graphing calculator. 7th International congress on Mathematical Education. Québec, Canada
1986  Using computers to teach better mathematics. NCTM Annual Meeting, Washington

Others

VITA

James A. Middleton, Ph.D.
Arizona State University

Education:
Ph.D. University of Wisconsin, Madison 1990-1992, Educational Psychology
M.S. University of Wisconsin, Madison 1988-1990, Educational Psychology
B.A. California State University, Chico, 1984-1987, Honors Psychology

Work:
1998 - Present Associate Professor of Mathematics Education, Division of Curriculum and Instruction, Arizona State University.
1994 - 1998 Assistant Professor of Mathematics Education, Division of Curriculum and Instruction, Arizona State University
1991 Associate Lecturer, University of Wisconsin Madison, Educational Psychology.

Current Funded Projects:

Co-PI, Cognitively Guided Instruction/ Director of Research Component. Three-year (Fall, 1996-Fall, 1999), $1 million National Science Foundation project.

Technology Coordinator for the TEAMS project, the College of Education component of the Arizona Collaborative for the Educational Preparation of Teachers, a 5 million dollar project sponsored by the National Science Foundation.

Journal Articles:


VITA

NAME: Dennis L. Young

EDUCATION:

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<td>1967-70</td>
<td>Ph.D. (Statistics)</td>
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<td>Purdue University</td>
<td>1965-67</td>
<td>M.S. (Statistics)</td>
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<td>St. Louis University</td>
<td>1961-65</td>
<td>B.S. (Mathematics)</td>
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ACADEMIC EXPERIENCE:

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<tr>
<td>New Mexico State University</td>
<td>1970-75</td>
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<tr>
<td>Stanford University</td>
<td>1974, 75 Summers</td>
<td>Visiting Assistant Professor</td>
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<td>Arizona State University</td>
<td>1975-1984</td>
<td>Associate Professor</td>
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<td>1984-Present</td>
<td>Professor</td>
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GRANTS:

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<td>ASU Faculty Grant-in-Aid 1976</td>
<td>Summer Multivariate Analysis</td>
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<td>ASU Faculty Grant-in-Aid 1977</td>
<td>Summer Linear Nearest Neighbor Statistic</td>
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<td>ASU Faculty Grant-in-Aid 1980</td>
<td>Summer Monotone Processes</td>
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<td>ASU Faculty Grant-in-Aid 1981</td>
<td>Summer Goodness of Fit Test</td>
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<td>Department of Energy 1981-83</td>
<td>Quantification of Ecological Responses to Perturbations</td>
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<td>(Co-Principal Investigator)</td>
<td>Internship in Statistics</td>
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EXTERNAL CONSULTING EXPERIENCE:

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<tr>
<td>Arizona Attorney General’s Office</td>
<td>1980, 82, 83, 87, 98 Pyramid Schemes</td>
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<tr>
<td>Arizona Blood Services 1981</td>
<td>ALT Levels</td>
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<td>Motorola 1983-1996</td>
<td>IC Data Analysis</td>
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ADMINISTRATIVE EXPERIENCE:
Associate Chair, Director of Graduate Studies, Department of Mathematics, 1991-1995
Director of the Committee on Statistics, 1996-present

AWARDS, SCHOLARSHIPS, HONOR SOCIETIES:
NASA Fellowship—Purdue University 1965-68
Arizona Chapter of the American Statistical Association: Outstanding Member Award 1989
ASU Department of Mathematics Wexler Teaching Award 1991

SELECTED PUBLICATION:


  Weight gain in captive chimpanzee infants: comparisons by sex, rearing and
colony (with M. Marzke and J. Fritz), American Journal of Primatology 38: 133-144 (1996).


MASTERS STUDENTS
F.K. Wang (1990), Confidence intervals for the mean after a fitted power transformation.
H. Shahriari (1991), Multivariate tests of normality based on angles.
S. Schulze (1992), On tests of symmetry about an unknown center.
S. Su (1993), Nonparametric modeling and comparison of chimpanzee growth curves.
F. Schineller (1994), High breakdown local regression smoothing.
J. Hui (1996), Robust analysis of variance: High breakdown F tests in the one-way ANOVA model.
K. Stout (1997), Comparison of tests for heteroscedasticity in multiple linear regression analysis

DOCTORAL STUDENTS

MICHELLE J. ZANDIEH
Department of Mathematics
Arizona State University

EDUCATION

August 1997

Ph.D. in Mathematics, Oregon State University, Corvallis, OR.
Research option in Mathematics Education.
Thesis title: The Evolution of Student Understanding of the Concept of Derivative.
Thesis advisor: Dr. Thomas P. Dick.

June 1989
M.S. in Mathematics, Oregon State University, Corvallis, OR.
Teaching emphasis.
Paper advisor: Dr. Thomas P. Dick.

June 1987
B.A. in Mathematics and Geology, Northwestern University, Evanston, IL.
Honors in Geology.

Professional Employment

9/97-present
Assistant Professor, Department of Mathematics, Arizona State University, Tempe, AZ.

9/95-8/97
Visiting Lecturer, Department of Mathematical and Computer Sciences, Loyola University of Chicago, Chicago, IL.
Nominated for Sujack Award for excellent teaching.

9/94-5/95
Part-time Instructor, Department of Mathematical and Computer Sciences, Loyola University of Chicago, Chicago, IL.

9/94-5/95
Part-time Instructor, Department of Mathematical Sciences, Roosevelt University, Chicago, IL.

6/92-9/94
Graduate Research Assistant, Department of Mathematics, Oregon State University, Corvallis, OR. Supervisor: Dr. Thomas P. Dick.
Calculus Connection Project Staff: curriculum development, in-service workshops for teachers, research on student understanding of derivative.

9/87-6/92
Graduate Teaching Assistant, Department of Mathematics, Oregon State University, Corvallis, OR.
Mathematics Department Graduate Student Teaching Award for excellent teaching.

Grants

1. PI: Student Understanding of Differential Equations. Faculty Grant in Aid (FGIA) through the Vice Provost for Research. 1/1/98-12/31/98. $7000.

Science Program.

Publications


4. Zandieh, M. "A theoretical framework for analyzing student understanding of the concept of derivative." (Submitted July 1998.)

5. Zandieh, M. " Developing an understanding of the concept of derivative: The case of Ingrid." (To be submitted.)

Selected Professional Presentations


"An Introduction to the HP38G." San Jacinto College Conference on Technology, Houston, TX, July 1995.

"Data Analysis Using Aplets and the HP38G." Eighth Annual International Conference on Technology in Collegiate Mathematics, Houston, TX, November 1995.


"The Concept of Derivative: A Variety of Understandings." Ninth Annual International
Conference on Technology in Collegiate Mathematics, Reno, NV, November 1996.

"What is the Role of the Definition in a Student's Understanding of the Concept of Derivative?" Research Conference in Collegiate Mathematics Education - Central Michigan University, Mount Pleasant, MI, September 1997.


APPENDIX: Sample Programs of Study

Sample Program

Concentration in Mathematics Education emphasis in middle grades mathematics

CORE REQUIREMENTS (total of 6 hours)

DCI 701 Curriculum Theory and Practice
DCI 791 Interdisciplinary Research Seminar

PROFESSIONAL FOCUS

Inquiry and analysis (15 hours)

COE 503 Introduction to qualitative research in education
EDP 552 Quantitative data analysis in education 1
EDP 552 Intermediate statistical data analysis in education
EDP 556 Data processing techniques in measurement and research
EDP 651 Methods and practices of qualitative research

Major area of concentration (27 hours)

EED 537 Mathematics in the elementary school
EED/SED 594 Mathematics in the middle school
EED/SED 791 Research in mathematics education 1
EED/SED 791 Research in mathematics education 2
EED 598 Children’s mathematical thinking

BLE 598 Teaching mathematics for Spanish speakers
MAT 598 Research in undergraduate mathematics education 1
MTE 585 Modern geometry for teachers
EED 598 Teaching geometry K- 8
Internship (6 hours)

EED/SED 784 Internship in teaching mathematics
EED/SED 784 Internship in research in mathematics education

COGNATE STUDY (12 hours)

EMC 598 Technology in teaching and learning of mathematics
EMC 598 Internet for teachers
EED/SED 598 Integrated mathematics, science and technology
EMC 528 Advanced web production

DISSERTATION AND INDEPENDENT RESEARCH (a total of 24 hours)

EED/SED 792 Research
EED/SED 799 Dissertation
Sample Program

Concentration in Mathematics Education emphasis in secondary mathematics

CORE REQUIREMENTS (total of 6 hours)

DCI 701 Curriculum Theory and Practice
DCI 791 Interdisciplinary Research Seminar

PROFESSIONAL FOCUS

Inquiry and analysis (15 hours)

COE 503 Introduction to qualitative research in education
STP 530 Applied regression analysis
STP 531 Applied analysis of variance
STP 533 Applied multivariate analysis
EDP 651 Methods and practices of qualitative research

Major area of concentration (27 hours)

MAT 598 Research in undergraduate mathematics education 1
MAT 598 Research in undergraduate mathematics education 2
MAT 598 Research in undergraduate mathematics education 3
EED/SED 791 Research in mathematics education 1
EED/SED 791 Research in mathematics education 2

SED/ED 594 Integrated mathematics, science, and technology
EED/SED 594 Mathematics in the middle school
MAT 472 Intermediate real analysis
MAT 444 Intermediate abstract algebra

Internship (6 hours)

EED/SED 784 Internship in teaching mathematics
EED/SED 784 Internship in research in mathematics education

COGNATE STUDY (12 hours)

MAT 442 Advanced linear algebra
STP 421 Probability
MAT 543 Abstract algebra
MAT 570 Real analysis

DISSERTATION AND INDEPENDENT RESEARCH (a total of 24 hours)

EED/SED 792 Research
EED/SED 799 Dissertation
Sample Program

Concentration in Mathematics Education emphasis in College Mathematics

CORE REQUIREMENTS (total of 6 hours)

DCI 701 Curriculum Theory and Practice
DCI 791 Interdisciplinary Research Seminar

PROFESSIONAL FOCUS

Inquiry and analysis (15 hours)

COE 503 Introduction to qualitative research in education
EDP 552 Quantitative data analysis in education 1
STP 530 Applied regression analysis
STP 531 Applied analysis of variance
STP 533 Applied multivariate analysis

Major area of concentration (27 hours)

EED/SED 791 Research in mathematics education 1
MAT 598 Research in undergraduate mathematics education 1
MAT 598 Research in undergraduate mathematics education 2
MAT 598 Research in undergraduate mathematics education 3
MAT 598 Research in undergraduate mathematics education 4

EED/SED 791 Research in mathematics education 2
MAT 570 Real analysis
MAT 543 Abstract algebra
SED 791 Professional publication

Internship (6 hours)

MAT 784 Internship in teaching undergraduate mathematics
EED/SED 784 Internship in research in mathematics education

COGNATE STUDY (12 hours)

MAT 572 Complex analysis
MAT 573 Complex analysis
MAT 571 Real analysis
MAT 544 Abstract algebra

DISSEPTION AND INDEPENDENT RESEARCH (a total of 24 hours)

EED/SED 792 Research
EED/SED 799 Dissertation

Ph. D. Math Education
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of the experiment. These two observations together provide the basis for our assert

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