Journal of Mathematics Education at Teachers College

Spring – Summer 2010
Inaugural Issue

A Century of Leadership in Mathematics and its Teaching

TABLE OF CONTENTS

Foreword

v **Honoring the Past—Anticipating the Future**
Bruce R. Vogeli, J. Philip Smith, Erica Walker

Preface

vi **Addressing Critical Issues in the Preparation of Teachers of Mathematics**
Stuart Weinberg, Director of Field Experience, Teachers College, Columbia University

Articles

1 **Examining What Teachers Do When They Display Their Best Practice: Teaching Mathematics for Understanding**
Edward Silver, University of Michigan

7 **Current and Needed Research on Alternative Certification Programs**
Edward Ham, Ph.D. Candidate, Teachers College, Columbia University

12 **Inside the UTeach Program: Implications for Research in Mathematics Teacher Education**
Nicholas H. Wasserman, Ph.D. Candidate, Teachers College, Columbia University

17 **Improving Preservice Field Placements in Secondary Mathematics: A Residency Model for Student Teaching Through Lesson Study**
Theresa Gurl, Queens College of the City University of New York

21 **A Study of the Relationship Between Student Teachers' Expectations of Pupil Success and the Management of Classroom Discourse**
Stuart Weinberg, Teachers College, Columbia University

25 **Increasing Perceived Efficacy for Teaching Mathematics: An Exploratory Study**
Deborah Rosenfeld, Teachers College, Columbia University

36 **An Analysis of a Misconception of Probability among Future Mathematics Teachers**
Patricia Jendraszek, Mercy College

46 **Slideware Strategies for Mathematics Educators**
Christian Stryker, United Arab Emirates University

TABLE OF CONTENTS, continued

Notes from the Classroom

51 **Ideas for Middle School Mathematics**
Amanda Giambruno
Heidi Li

52 **Innovative Instruction in High School Mathematics**
Cindy Cheung
Meredith Klein
Kitty Yang
Meredith Brown
David Liang

54 **Student Research in Community College Calculus**
Sofya Nayer and Toni Kasper, Borough of Manhattan Community College

Other

56 **ABOUT THE AUTHORS**

The *Journal of Mathematics Education at Teachers College* is a publication of the Program in Mathematics and Education at Teachers College Columbia University in the City of New York.

This issue's cover and those of future issues will honor past and current contributors to the Teachers College Program in Mathematics and Education. Photographs are drawn from the Teachers College archives and personal collections.

This issue honors NCTM 2010 Lifetime Achievement Medalist, Dr. Henry O. Pollak, who has completed 22 years as a member of the Program in Mathematics and Education at Teachers College. Dr. Pollak has contributed so much to the mathematical preparation of the Program's graduates and to the communities of mathematics and mathematics education professionals in the United States and throughout the world.

David Eugene Smith, also pictured on the front cover, was the founding professor of the Teachers College Program in Mathematics and Education. Like Dr. Pollak, Professor Smith was widely respected by both mathematicians and educators.

Aims and Scope

The *JMETC* is a re-creation of an earlier publication by the Teachers College Columbia University Program in Mathematics and Education. As a peer reviewed, semi-annual journal, it is intended to provide dissemination opportunities for writers of practice-based or research contributions to the general field of Mathematics Education. Each issue of the *JMETC* will focus upon an educational theme. Themes planned for the 2010-2011 issues are: *Teacher Education, International Education, Curriculum, Technology, and Equity*—all centered upon mathematics and its teaching. The *JMETC* will have a distinctive niche in the world of education publishing. Our readers are educators from pre K-12 and college and university levels, and from many different disciplines and job positions—teachers, principals, superintendents, professors of education, and other leaders in education.

Manuscript Submission

We seek conversational manuscripts (2500-3000 words in length) that are insightful and helpful to mathematics educators. Articles should contain fresh information, possibly research-based, that gives practical guidance readers can use to improve practice. Examples from classroom experience are encouraged. Articles must not have been accepted for publication elsewhere. All manuscripts may be submitted electronically at www.tc.edu/jmetc. This system will help keep the submission and review process as efficient as possible.

Abstract and keywords. All manuscripts must include an abstract with keywords. Abstracts describing the essence of the manuscript should not exceed 150 words. All inquiries should be sent to Ms. Krystle Hecker, P.O. Box 210, Teachers College Columbia University, 525 W. 120th St., New York, NY 10027.

More Information available online
www.tc.edu/jmetc

Call for Papers

The "theme" of the fall issue of the *Journal of Mathematics Education at Teachers College* will be *International Mathematics Education*. This "call for papers" is an invitation to mathematics education professionals, especially Teachers College students, alumni and friends, to submit articles of approximately 2500-3000 words describing research, experiments, projects, innovations, or practices related to international or comparative mathematics education. Articles should be submitted to www.tc.edu/jmetc by September 1, 2010. The fall issue's guest editor, Dr. Juliana Connelly, will send contributed articles to editorial panels for "blind review." Reviews will be completed by October 1, 2010, and final drafts of selected papers are to be submitted by November 1, 2010. Publication is expected in late November, 2010.

Call for Volunteers

This *Call for Volunteers* is an invitation to mathematics educators with experience in reading/writing professional papers to join the editorial/review panels for the Fall 2010 and subsequent issues of *JMETC*. Reviewers are expected to complete assigned reviews no later than 3 weeks from receipt of the blind manuscripts in order to expedite the publication process. Reviewers are responsible for editorial suggestions, fact and citation checking, and identification of similar works that may be helpful to contributors whose submissions seem appropriate for publication. Neither authors' nor reviewers' names and affiliations will be shared; however, editors'/reviewers' comments may be sent to contributors of manuscripts to guide further submissions without identifying the editor/reviewer.

If you wish to be considered for review assignments, please request a *Reviewer Information Form* from Ms. Hecker. Return the completed form to Ms. Krystle Hecker at JMETC@tc.columbia.edu or Teachers College, Columbia University, 525 W 120th St., Box 210, New York, NY 10027.

Looking Ahead

Anticipated themes for future issues are:

Spring 2011	Curriculum
Fall 2011	Technology
Spring 2012	Equity
Fall 2012	Leadership
Spring 2013	Psychology

TO OBTAIN COPIES OF JMETC

To obtain additional copies of *JMETC*, please visit the Journal's website www.tc.edu/jmetc.

Journal of Mathematics Education at Teachers College
Spring–Summer 2010, Volume 1

Slideware Strategies for Mathematics Educators

Christian Stryker
United Arab Emirates University

Programs like PowerPoint and Keynote have become standard tools for teaching. Despite their ubiquity, an increasing number of educators blame them for both a deskilling of teachers and a dumbing down of students. This article examines some of the concerns that surround slideware-assisted teaching and offers guidelines and heuristics concerned mathematics teachers can use to re-energize and re-intellectualize their use of presentation software products. Special emphasis is placed on slideware's use in the mathematics classroom.

Presentation software packages like Microsoft PowerPoint and Apple's "Keynote" have become standard classroom tools for teachers and students alike. Properly used, these applications can simplify teaching and enrich learning, but pitfalls often confront the inexperienced or unwary, and, used improperly, they can dramatically decrease an educator's effectiveness.

Originally designed for boardrooms and meetings, computer-based presentation tools first appeared in the mid 1980s and have spread far beyond their original business-oriented audiences. Indeed, it is now nearly impossible to find a classroom at any grade level that does not utilize "slideware" (as presentation graphics have come to be known) in some, usually central, capacity. Despite their ubiquity, slideware-facilitated classes are often ridiculed by students as boring, non-interactive, and non-educational. Derogatory epithets like "Death by PowerPoint" and "PowerPointlessness" highlight these frustrations.

Teachers at any level, but especially novice educators just beginning to develop their classroom demeanors and teaching styles, need to learn how to use slideware properly. Stories of misuse and abuse by poorly prepared teachers and concomitant concerns about the role(s) presentation software should play in classrooms make slideware skills an essential for modern educators.

> At its worst, PowerPoint can be viewed as part of the deskilling of teachers and the dumbing down of students. Teachers, under great pressures to deliver on research and administration, under constant email bombardment, and faced with endless deadlines and obligations, rationalize and simplify their teaching by becoming commentators on slide shows, often considerately provided by the publishers and authors of textbooks. (Gabriel & Griffiths, 2005, p. 372)

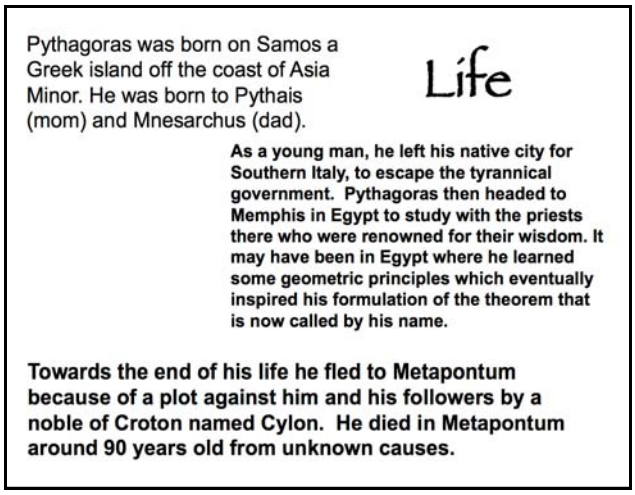
In practice, things are not quite as dire as the passage above might suggest, and neither slideware products, nor the educators who use them, are fatally flawed. The problem is simply a lack of information. This article outlines essential skills and competencies educators need in order to craft effective educational experiences using slideware.

As a first step, teachers actively should minimize the information their slideware contains. This likely sounds somewhat counterintuitive. How could more information possibly detract from an educational experience? How could less information produce something more powerful? I submit that, to be most potent, slideware presentations explicitly should exclude, or at least temporarily conceal, key details and information. Let us call this first heuristic "Temporary Information Obfuscation," or TIO.

Consider your class from your students' perspective. What are they expected to do when presented with slides that are chock full of content? Is the information to be transcribed painstakingly into waiting notebooks? Alternatively, if your slideware materials will be made available to your students before, during, or after the lesson, how should they occupy their time during class? If your presentations are so thorough that they include every bit of relevant information on a topic, why do students need to be in the audience at all? Could they not more easily digest the content on their own outside of class? Finally, what is the teacher's role during an exhaustively thorough slideware-based lesson? In a worst-case scenario, it could be little more than that of a passive projectionist and occasional "color" commentator—a teacher effectively marginalized by his or her own good intentions and overly rich slideware.

Using TIO design metrics for their presentations, educators can avoid becoming glorified peripherals, invigorate their course content, and regain control over educational technology gone astray. The trick is simply to minimize, temporarily, the information presented in your slideware. Distilling information and ideas reduces the number and complexity of the visuals in your presentation. The limited number of key points that remain will serve as talking points—springboards into more elaborate details, discussions, or activities that require your direct involvement (and ideally the students' as well) to de-obfuscate. In effect, you will have transformed the passive content of an information-rich visual into a more active-learning tool.

Consider the following slide about Pythagoras. It was found, exactly as is, on a website distributing free teacher-developed presentations. It presents an overwhelming amount of text and detail in an unattractive format. It also raises several questions. What information is important? How will the teacher interact with the content? Is the audience expected to read the entire slide silently to themselves? If not, it would seem the presenter has little choice but to read it to the audience verbatim or, worse, attempt to gloss over the content.



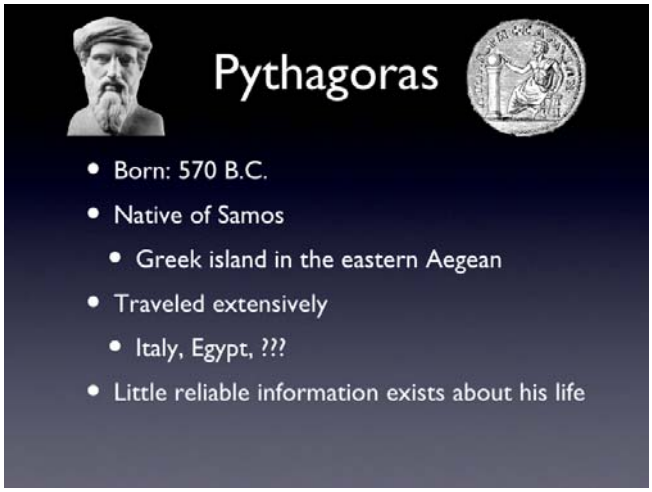
Upon closer examination, this slide also proves to be a prime example of a troubling trend in modern classrooms—"Cut-and-Paste Scholarship." The allure of readily available information can prove problematic for students *and* teachers who attempt to assemble educational materials out of scraps found here and there on websites like Wikipedia and others—where much of this slide's content can be found. Apart from standard concerns about plagiarism and proper citation, the amount of information available and the ease at which it can be repurposed into slideware directly contributes to the bloated content that TIO urges you to avoid.

In contrast, my retooled version on the right contains critical cosmetic changes that make the content easier to read and more appealing overall. It presents far fewer concepts, and the majority of what remains must be expanded by the teacher, students, or both in order to be understood. The open-ended nature of the content also may create opportunities for the class to engage in some higher-order thinking. Rather than simply transcribing or memorizing content, students could be compelled to engage Bloom's Analysis, Synthesis, or Evaluation skills in order to comprehend the meaning behind the scant information available. For example, discussions about how Pythagoras's travels may have affected his education or what problems the lack of first-hand information about him may create are possible.

Without examining the entire presentation in detail or being present in the class where it was used, it is difficult (and potentially misleading) to attempt to draw conclusions from a single slide. It is clear, however, that the first slide reflects a more haphazard, cut-and-paste approach to teaching something about Pythagoras's life and does so in an aesthetically unappealing way. It resembles an entry from an encyclopedia, and its authoritative appearance and wording may limit opportunities for debate or discussion. For the university professor, presenting lesson content in this manner also may have the unintended side effect of legitimizing the practice of cut-and-paste scholarship in the eyes of his or her students.

Another, less obvious, benefit to employing TIO practices is that they address fundamental concerns about attendance. With the advent of so-called "open courseware" initiatives from leading institutions like Columbia University, MIT, and others, enthusiasm for making course-related resources available on line is increasing. In addition to predictable questions concerning copyrights and ownership, attention is also being focused on if and how open courseware might affect on-campus students. Some studies appear to indicate that attendance suffers when course materials are distributed. "The availability of [course] webcasts negatively impacted student attendance but the availability of other online resources such as PowerPoint slides had a greater negative impact on attendance" (Traphagan, Kucsera, & Kishi, 2010, p. 1).

This problem could be minimized effectively if an instructor's slideware were created using TIO principles. If students review publicly available course materials after a class, those who attended should easily recognize and remember the condensed concept "cues" that were discussed. Conversely, those who did not attend likely will experience considerable difficulty attempting to intuit



meaning from abbreviated materials that were designed from the outset to require extra information and discussion in order to be understood.

Just how much information could be obfuscated and exactly when and where to do it varies by topic, class, and educator. Trial, error, and continuous fine-tuning are, of course, required. In order to utilize TIO optimally, teachers must also employ some easily-mastered design principles that help make what information is presented clear and visually appealing. The guiding force behind most of these heuristics can be summarized by the acronym KISS.

KISS is an oft-repeated abbreviation for "Keep It Simple, Stupid." When preparing slideware content, this notion is especially true. If there are too many extraneous items to attend to during a presentation, students may become distracted or focus on unimportant elements. While there are doubtlessly teaching situations that mandate visual extravaganzas, most mathematics teachers need to focus more on clarity and simplicity than on novelty.

The so-called "Joy of Six" helps reinforce slideware simplicity. Comically named, this maxim reminds teachers to use:

- About six bulleted items per slide
- Each with about six words per bullet

Rules are meant to be broken, and there are times when the Joy of Six simply cannot be applied. For example, quotations are generally longer than six words. In most presentations and on most slides, though, this heuristic works very well.

Effective slides must feature legible text. Unfortunately, many standard slideware "templates" do not use the right *fonts* and/or the right font *sizes*, and mathematics teachers who use them end up with less-than-satisfactory materials. As general rules:

- Slide title text should be set in 36-point size or larger font sizes.
- Body, bullet, and paragraph text should be set in 24-point or larger sizes.

I strongly suggest that you preview some sample slides before any class or presentation in a new venue. When you cannot prepare and test your presentations in advance, the 36/24-point guideline works well. Another quick test is to print out a full-size sample slide on an 8x10 sheet of paper, place it on the ground at your feet, and stand up. If you can read the text comfortably, then your class should be able to read it when it's projected on a screen.

Font size is not the only factor that affects readability. A font's shape is important also. Many teachers are not aware of the differences between serif and sans-serif font families and do not know when or why to use a specific type of font.

As you see below, serif text features small embellishments on the corners of the letterforms. Those extra "strokes" are serifs. In contrast, sans-serif fonts are smooth, featuring straight lines and simple curves.

Serif Sans-Serif

Sans-serif fonts are dramatic and demand the eye's attention. That is one reason why headlines on newspapers and tabloids are generally set in large, sans-serif typefaces. The very thing that makes sans-serif fonts so forceful also makes them difficult to read if the font size is small. That is why small type in newspapers, magazines, and books invariably is set in a serif font. Like script handwriting, serifs on letterforms help create a visual "flow" to the text. This provides a sort of "shock absorber" for your eye—enabling you to read more easily and for longer intervals.

Unfortunately, the names given to typefaces and fonts rarely indicate whether they feature serifs or not. Arial and Helvetica are two of the most frequently used sans-serif fonts, while Times and New Century SchoolBook are standard serif fonts. When in doubt, a quick visual check should resolve any uncertainties.

In most slide presentations, people tend to use sans-serif fonts. This enables the words on the slides to stand out—even from the back row. Since your slides will generally be Joy of Six compliant, there should not be very much sustained reading for students to do, and eyestrain is not an issue.

Other heuristics for using text on slides are summarized as follows:

- Limit the number of different fonts and font sizes you use.
- Prefer Sans-Serif fonts like Arial or Helvetica.
- Use font size and indenting to organize information.
- Use fonts and font sizes consistently throughout your slides.
- Choose standard fonts (like Arial or Times), especially if you need to use someone else's computer—they will not likely have exactly the same fonts you have on your own computer, and problems can result.

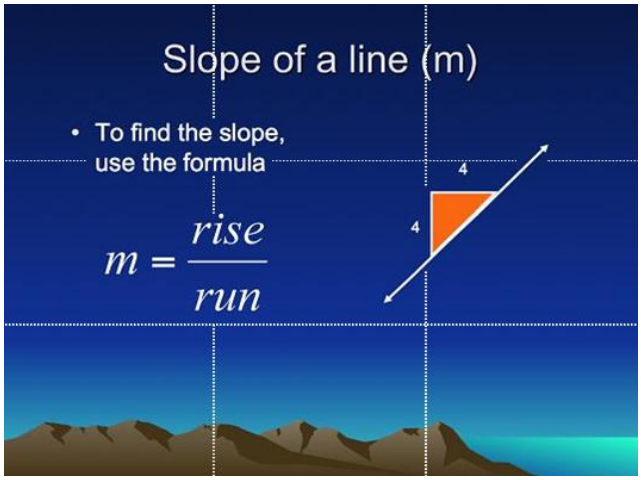
Above all, slideware is a graphical medium. Yet, mathematics teachers may fail to take full advantage of graphics to help them convey information and ideas—preferring more text-driven slides instead (consider again that first example slide).

Useful heuristics exist for graphical slideware content, including:

- Avoid unusual graphics and/or unrelated special effects that do not contribute directly to the main idea(s) or concept(s) of the slide.
- Design slides to follow natural eye movements—flow information from top left to bottom right.
- Place slide elements consistently. Graphics and text should appear in relatively the same locations from slide to slide.

To maximize the visual appeal of your graphics, I suggest you employ a technique from photography known as the "Rule of Thirds."

1. Mentally "draw" two, equally spaced vertical lines and two horizontal ones over the top of an image (or slide). These lines will superimpose a Tic-Tac-Toe grid on the picture, dividing it into thirds.
2. Note the 4 points where these lines intersect and place items of interest on or near those intersections.
3. Off-center placement is more compelling than eye-centered items.



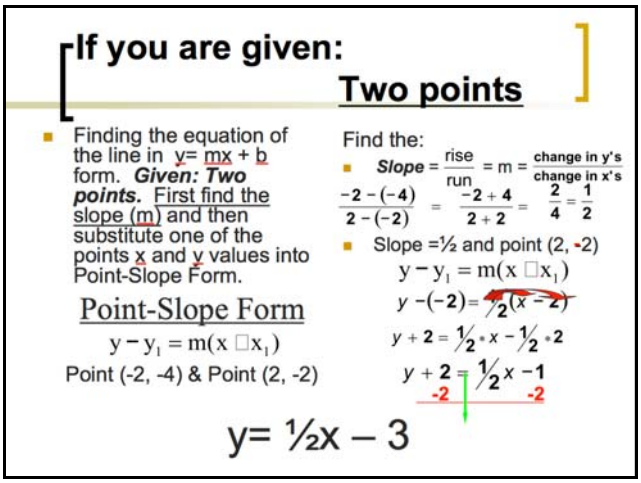
Examine the sample image above and note how the teacher composed the picture so that the principal contents are near the intersections. This creates a more appealing and dynamic visual.

The Rule of Thirds helps you format graphs and illustrations and displays better images on your slides, but it will help you format more visually compelling slides, too. Just consider the entire slide to be your "viewfinder" and place graphics, text, and other content items as close to those intersections as possible.

Proper use of color is also essential for effective presentations. Like text placement and formatting, the colors you use on slides should be as consistent as possible, and the more judiciously they are used, the better. Some rules that will help you use color appropriately are:

- Limit the number of colors on a slide from 3 to no more than 5.
  - 1 background color or simple gradient blend
  - 1-2 text colors
  - 1-2 special accent colors (if needed)
- Use contrasting colors like black, dark gray, or dark blue backgrounds with yellow or white text or a white, light gray, or light yellow background with black or blue text.
- When in doubt, white text on a dark background is an excellent "default" choice.
- Dark text on a white background can be stressful to the eyes—especially when viewed in a dark room. Try to avoid this combination for classroom use.
- Use color consistently from element to element and from slide to slide.
- Be careful with gradient backgrounds—they sometimes make text hard to read as the gradient changes.
- Avoid red text, except for accenting or highlighting—red is hard to read.
- The human eye has fewer blue receptors compared to other colors and cannot distinguish the blue boundaries as well. Bluish text on a bluish background is a very bad combination.

In order to practice your new slideware design skills, consider the problems presented by the following slide, which was, again, extracted from an actual mathematics materials "depot" website.



Clearly, this slide was created using the "more is better" approach rather than with TIO principles in mind. It also violates many of the guidelines for proper use of fonts and more than a few common-sense aspects of clarity and layout. I selected it for other reasons, however. It typifies the formulaic, sequential nature of much of mathematics, and hence it presents additional important issues for consideration. Now that you know more about designing appealing and educationally potent slideware, it should be easier to envision approaches for creating slides that help students learn important information and encourage them to consider and discuss concepts like slopes and intercepts; but how can mathematics teachers use slideware to help teach the associated procedural mathematics concepts?

The answer is that quite likely it is not appropriate to attempt to teach students procedural concepts in mathematics using slideware. Students need to experience the sequential nature of deriving solutions to mathematical

problems by seeing their teachers performing the required steps and explaining them in context. Learners need to complete, in numerous iterations, these same procedures themselves in order to master their form and function. As this visual illustrates, presenting a complete solution to a problem on a single slide is challenging. Such a presentation may also lead some students to believe they can understand mathematics by observation alone and that the far messier process of actually doing the work may not be required. That would be the most egregious slideware error one could commit!

You have been exposed to a number of useful guidelines for creating effective slideware. I urge you to reflect on and evaluate critically the educational materials you use in your classrooms. Judge how effective they are when you use them—not how much time they took you to create or how much you may like the way they look. Then, continue to refine your mathematics teaching materials and technique until you and your students are satisfied with the results they produce.

References

Gabriel, Y., & Griffiths, D. S. (2005). Against the tyranny of PowerPoint: New avenues for passionate learning? The passion for learning and knowing: Proceedings of the 6th International Conference on Organizational Learning and Knowledge, University of Trento (Vol. 2, pp. 371-378).

Traphagan, T., Kucsera, J. V., & Kishi, K. (2010). Impact of class lecture webcasting on attendance and learning. *Educational Technology Research and Development, 58*(1).