THE FSU CUNEIFORM TABLET COLLECTION

Using mathematics of the past to inform teaching in the future

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ABSTRACT

This presentation describes the rediscovery of a collection of 25 cuneiform tablets sold to Florida State University in 1922 by Edgar J. Banks, the work to translate and publish the text of the tablets (with Eleanor Robson), and the development of instructional materials based upon two tablets, whose text provides accounts of agricultural labor.

The current work on the project is being conducted with a secondary mathematics education graduate student. Goals of the project include creating experiences (for prospective and in-service teachers and K – 16 students) to engage with artifacts that represent arithmetical processes used by people for daily life and that will strengthen the view that mathematics is a human construction. The development of instructional materials based upon the wage and labor information documented in FSU 22 and FSU 23 is aimed at creating examples of how to incorporate humanistic perspectives when teachers, secondary and post-secondary students examine artifacts from ancient civilizations that contain evidence of arithmetical or mathematical processes. The presentation intends to focus on the progress and process of developing instructional materials based upon FSU 22 and FSU 23. Descriptions of a graduate student's participation in key project activities are also included.

1 Introduction

As may be expected, those who create and deliver courses in the history of mathematics are often drawn to not only the mathematical topics of focus but also the humanistic orientations that enable both students and instructor to consider cultural, historical, and pedagogical influences on the development of mathematics over time. Of particular interest to us is modeling for prospective and practicing teachers how a humanistic perspective can positively impact mathematical instruction. We echo Philip Davis's (1993) concern when he observed:

> If mathematics is taught simply as the learning of procedures, then none of the humanistic elements can be grasped. It is rare that the teaching of mathematics, elementary or advanced, conveys or fosters the humanistic aspects of the subject. (10)

One goal of undergraduate mathematics teacher preparation courses in how to use the history of mathematics in teaching is to motivate prospective teachers toward challenging the notion of teaching of mathematics as merely "the learning of procedures".

Courses with this as a goal provide the first author, a mathematics teacher educator, the opportunity to introduce important humanistic aspects of learning and doing mathematics. For example, while embracing the history of either a problem or the mathematics behind a problem, we create space in the classroom to debunk dangerous myths with respect to problem solving. Including history of mathematics in teaching enables learners to see that axioms “were not handed down in a Mt. Sinai sort of way” (Brown 1996: 1293) nor were important mathematical results “created in a way that involved no labor pains” (Brown 1293). And, in choosing problems for their historical identity or highlighting the history related to the mathematics of a problem, the notion that problems (and problem solving) are intimately connected with human events provides another means to assist students in identifying alternate ways of thinking and how the habits of persistence and curiosity have stood the test of time.

David Pimm (1983) observed that, “the beauty of the study of the history of mathematics is that it can give a sense of place…from which to learn mathematics, rather than merely acquiring a set of disembodied concepts” (14). Thus, in the *Using History in the Teaching of Mathematics* course taught at Florida State University (FSU), the first author seeks to challenge prospective teachers’ view of teaching mathematics, which they have predominantly formed from years of “apprenticeship of observation” (Lortie 1975: 61). Instead, prospective teachers taking the *Using History* course begin to consider how “history can convey the notion of a culturally-based and culturally-bound mathematics which is open-ended and changing, a challenge to a more prevalent view of mathematics as a static list of accumulated truths” (Pimm 14).

One experience, however, that has not been a strong influence in the history of mathematics course at FSU is providing prospective teachers with opportunities to create instructional materials from either primary sources in mathematics or cultural artifacts. Tzanakis and Arcavi (2000) noted that “ways of integrating history into mathematics education clearly involved the use of sources of reference material” (212). Further, they encouraged “teachers of mathematics and mathematics educators…to develop, individually, or, in collaboration, their own [didactic source materials] and to make it available to a wider community” (212). When the cuneiform tablet collection was re-discovered at FSU, the opportunity to participate in such work was welcomed from both of our perspectives: as a mathematics teacher educator (Clark) in order to create similar tasks for prospective teachers and as a prospective mathematics teacher (Dickey) investigating methods for creating classroom experiences “inspired by history” (Tzanakis and Arcavi 2000: 212).

1.1 Perspectives guiding the project work

The project work we describe here is an effort we approached from three main perspectives. First, we planned to engage with human artifacts (cuneiform tablets from approximately 2040 BCE) to determine if creating instructional materials based upon the contexts found within the tablets was possible. If meaningful instructional materials could be created by a team consisting of an experienced user of mathematics history in teaching (Clark) and a novice user (Dickey), then we considered future work with prospective and in-service teachers as a viable next step. Second, we wanted to pursue a classroom audience for our materials construction in which the use of humanistic and historical perspectives may be under-utilized. We believe a need exists to motivate the inclusion of humanistic orientations into opportunities to learn mathematics. Thus, we examined local benchmarks for student mathematics learning

(Florida Sunshine State Standards) and found six different benchmarks that can be addressed through problems based upon the context of FSU 22 and FSU 23 (described in the next section). It is our belief that many, if not all of the identified benchmarks apply to pupils (aged 8 – 11) in other locations as well. Examples of the benchmarks include:

From grade 3:

- Identify, describe, and apply division and multiplication as inverse operations.

From grade 4:

- Multiply multi-digit whole numbers through four digits fluently, demonstrating understanding of the standard algorithm, and checking for reasonableness of results, including solving real-world problems.
- Select and use appropriate units, both customary and metric, strategies, and measuring tools to estimate and solve real-world area problems.

From grade 5:

- Interpret solutions to division situations including those with remainders depending on the context of the problem.
- Divide multi-digit whole numbers fluently, including solving real-world problems, demonstrating understanding of the standard algorithm and checking the reasonableness of results.
- Compare, contrast, and convert units of measure within the same dimension (length, mass, or time) to solve problems.

Lastly, we recognize that our work may be less about the history of a mathematical idea than it is about the history of a human construction. Indeed, Morris Kline (1964) observed, "mathematics has played a predominant role in the formation of modern culture" (453). We believe, however, that creating opportunities for pupils and teachers to examine and appreciate origins of computational skills (e.g., multiplication, division, unit conversion) – and the very practical needs that promoted the development of such skills – is an important task to participate in. It is our hope that this humanistic inclusion will challenge traditional methods that instill in young students the perception that mathematics class is simply "a haphazard collection of definitions, theorems and problems that are beyond intuitive understanding" (White 1983: 40). Instead, we hope creating examples of viable classroom materials from actual human objects may serve to restore some of the importance of context and thrill of the development of even the simplest (from our modern view) arithmetic processes that is often devoid of emphasis in elementary classrooms. The work we have begun is an effort to put materials in the hands of younger students (aged 8 – 11) for the purpose of humanizing rote applications of arithmetic operations. In this work we hope to introduce pupils to the idea that "history can convey the notion of a culturally-based and culturally-bound mathematics" (Pimm 1983: 14).

2 The FSU tablet collection

In February 2007, the first author re-discovered a collection of 25 cuneiform tablets that FSU has owned since 1922. (FSU was known then as Florida State College for Women, FSCW.) The tablet collection was purchased from Edgar J. Banks by Professor Josiah B. Game of the FSCW Classics department. Although copies of some of the correspondence between Game and Banks exist, it is not completely clear who contacted whom first nor whether Game purchased the small collection (25 tablets for $50 in 1922) with his own money or the college's funds. What is clear from other available documentation is that Game was well-respected and beloved at FSCW and he had a personal and professional interest in making such artifacts available to the young women attending FSCW at the time.

The tablet collection contains nineteen tablets from the Ur III period (mostly from Umma); five from the Old Babylonian period; and one illegible Neo-Babylonian tablet. The publication of the tablets, including transliterations, translations, and interpretation is currently ongoing with Eleanor Robson. Though several tablets are undated, they range in date from 2058 BC to 1788 BC. The tablets contain everything from accounts of delivery or lists of sheep, goats, and cattle to lists of rations, beer, grain, and garments. Two tablets contain royal inscriptions, one notes the annual summary of regular offerings, and two tablets list accounts of agricultural labor. The tablets containing accounts of agricultural labor, known as FSU 22 and FSU 23, are the tablets we took interest in for our project.

3 Initial work: Informing teaching

Lydia Dickey is pursuing a master's degree in mathematics education at Florida State University. Before her work on this project, Lydia's experience with cuneiform text was limited to working a few problems from line drawings of Babylonian tablets (multiplication tables) and translated geometry problems while a student in the *Using History* course in Fall 2006. Thus, her participation in this project is similar to the experience that classroom teachers will have when participating in the work described in the following subsections. Lydia's work has been three-fold during the project:

- Working with the FSU tablet collection, including the tablets, photographs, and translations;
- Conducting research to provide context for the development of the instructional materials; and
- Creating sample mathematical problems corresponding to the tablet text for FSU 22 and FSU 23. (Note: Only examples of problems derived from FSU 23 are discussed here.)

In the remainder of this section we elaborate on Lydia's research and problem creation.

3.1 Researching the past

In order for Lydia to participate in creating problems from the text found in FSU 22 and FSU 23, she needed to investigate the needs and uses of the metrology found within the text of the tablets. To do this, she read Chapter 2 (Robson 2007) of *The Mathematics of Egypt, Mesopotamia, China, India, and Islam: a Sourcebook*. While doing so, she found that examining the pages of translated problems from the tablets became somewhat tedious. Her experience with needing to refer to tables outlining the various metrologies referenced in Mesopotamian texts influenced how she designed the problems. Additionally, Lydia noticed that tablets exist that contain many problems nearly identical to one another. For example, one tablet may contain several problems pertaining to a wall of baked bricks and on another tablet, multiple questions about the areas of circles appear. In her design of problems based upon the agricultural and labor accounts found in FSU 22 and FSU 23, Lydia decided to re-create the effect of multiple problems of the same type.

3.2 Creating the context

To situate the construction of instructional materials based upon FSU 22 and FSU 23, we committed to adhere to our humanistic orientations. In addition, we wanted to provide an example of what teachers could both learn from (with regard to implementing humanistic and historical perspectives in teaching) and that could be used in the classroom. To this end, Lydia created the following introduction that is appropriate to use with both pupils and teachers.

> In Babylon in the twenty-first century BCE (before the common era), knowing how to read and write Sumerian was not a necessity. Those who did have this skill were known as scribes. Scribes were taught as children about Sumerian literature and metrology (their numbering and measurement system). These children attended a school which probably taught very few students, perhaps only two or three, and their main method of education was rote learning, or learning by repetition (Robson 64).
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> The goal of a scribal education was to learn to read and write, but also to record. The writing was done on clay tablets that were subsequently dried in the sun or baked, and the students had to learn the proper method of making marks in the clay. These clay tablets, once dried, resulted in a long lasting record. Since writing, and ultimately recording, was a special skill not everyone had, records would be made when something was important and worth remembering. The most used mathematical principles of the day were length and area, so scribes needed to be familiar with applications of these; however, mathematical problem solving was not the only intent of a scribe’s schooling, so mathematical problems of this nature would often be used as an interlude to break up the rote learning which normally took place (Robson 64).
>
> Students in scribal schools were essentially working on word problems, very similar to those found in mathematics curriculum today. These word problems were practical applications of the mathematics needed daily for land owners and laborers. Imagine being a child in a scribal school in 2000 BCE: the problems recorded on these tablets could have been an afternoon activity used to increase your skills in writing *and* in the practical application of mathematics. How would you have fared as a student in a scribal school?

3.3 Sample problems

Lydia’s reading of the translated problems from other tablets enabled her to put the agricultural labor and wage information found on FSU 22 and FSU 23 into contextual word problems that were analogous to problems found on other cuneiform tablets. To begin the task of converting from cuneiform tablet text to a mathematical problem based upon the text, Lydia created a division problem about the area of a field, as is the case in problem FSU 23.01 (Table 2). Since the information used to create this problem was similar to other lines of text on the tablet, it was easy to create several problems with similar contexts and content, simulating the nearly identical pattern of problems appearing on many other translated tablets.

FSU 23.02 is a problem that involves multiplication to determine the area of a field. The base of this problem is similar to FSU 23.01, but Lydia created supplemental questions that can be used to extend the application of the tablet's content. In creating the extension questions, Lydia saw that not only could the information be developed into a traditional area problem, but the content could also be used to engage pupils in tasks involving conversions of units of measure. Problems FSU 23.02a, b, and c require the students to convert between *sar*, *cubits*, and *meters*. In this regard, pupils will convert between not only ancient measures of area – one of which pupils may be familiar with (cubits) – but with a modern unit of measure as well. Lydia found creating the two base problems (FSU 23.01 and FSU 23.02) particularly captivating because information on the tablet, such as the name of the fields, provided a richer context for the problems and emphasized the humanistic orientation of the material.

A final note about the problems: by creating word problems from the tablet text, we achieved two goals. First, the problems possess a human context, as we have already noted. Secondly, real-world mathematics applications that pupils encounter outside of school are not often found as ready-to-solve numerical exercises. Instead, determining the actual problem and how to solve it must be deciphered from a context, often in the form of a word problem, given in either oral or written form. We believe that students should practice the ability to interpret problems and determine appropriate solution methods early and often to enhance their ability to make practical application of their mathematical knowledge.

4 Next Steps

To date, five problems have been created and revised as described above. An additional five base problems have been constructed and aligned with school mathematics benchmarks that are in use by the teachers who will pilot the instructional unit. In the immediate future we will continue to revise the five new base problems and will complete the instructional unit based upon FSU 22 and FSU 23 with two additional problems, making a total of twelve problems.

Next, the contextual introduction and the twelve problems will be edited and formatted into an instructional module for use with students (including suggestions for use and solutions for teachers). A student population has been chosen for piloting the module because of its connection to Edgar J. Banks. Banks retired to Eustis, Florida in 1916. He endeavored to remain a scholar of Assyriology after that time, by traveling throughout the United States giving lectures about the subject (and his experiences), creating two film companies concerned with producing films about Biblical stories, and selling his collection of tablets to various universities, libraries, and museums. Banks became somewhat of a prominent, if not eccentric resident of Eustis. The "Edgar J. Banks Room" in the headquarters of the Eustis Historical Museum and Preservation Society (The Clifford House in Eustis, Florida) is dedicated to Banks's prominence in the community. Each year, local public school children are required to conduct research and write reports on the history of the county. We intend to pilot our materials with the school children involved with this yearly history project. We believe the local interest in Banks and his connection to the FSU cuneiform tablet collection contributes additional historical and humanistic appeal to the module.

We anticipate three influential outcomes from piloting the instructional module created from FSU 22 and FSU23. First, using the materials with pupils and their teachers will provide valuable feedback for improving upon the contextual and mathematical content. Second, if successful, the module could serve as an example to distribute to other locations in the United States where cuneiform tablets exist. To this end, educators can replicate the module idea and construct similar instructional materials from the text of tablets that other university and state libraries and museums own. Many of these collections have been re-discovered in recent decades and have also been translated.

Lastly, outcomes from piloting the materials will allow us to address one of our original concerns. Many prospective teachers doubt the use of historical and humanistic perspectives in teaching. This may be due in large part because such perspectives manifest in radically different ways in the classroom than prospective teachers were accustomed to during their own primary and secondary school experience. Consequently, the notion that such alternative perspectives "won't work" is deeply rooted in many prospective teachers' belief systems. We propose that being able to share the module created from this project, along with anecdotes about its use with students, will serve as an effective way to introduce prospective teachers to creating classroom tasks and materials that are situated in humanistic and historical contexts.

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Table 1

FSU 23: Tablet Content

Tablet	Date	Content Description	Translated Text: Obverse	Translated Text: Reverse
FSU 23	2039 BC	Account of agricultural labor	1. 56 15 *sar*: 2. cutting thorn-weed at 15 *sar* (a day). 3. Its work is 3 45 days 4. in the Ninnudu Field. 5. 37 30 *sar*: 6. cutting grass at 15 *sar* (a day). 7. Its work is 2 30 days 8. in the Field of the Holy Mound 9. and Pusimu Field. 10. [x +?] 5 00 *sar*: (cutting down) thorn-bushes at 12 *sar* (a day). 11. Its [work is x] days (traces)	1. [Sealed by Inim]-Šara. 2. Year: the *en*-priestess of Eridug was appointed.

Note: [ ] : text missing due to tablet damage or illegibility; ( ) : inserted for coherence

Table 2
Catalog of Sample Problems: FSU 23

Index	**Problem**	**Solution**	**Notes**
FSU 23.01	If the Ninnudu Field of thorn weed has an area of (56·60 + 15) = 3375 sar, how many days will it take you to cut down all of the thorn weed if you can cut down 15 sar a day?	It will take 225 = (3·60 + 45) days.	FSU23.01 will involve simple multi-digit operations (multiplication and division). We can first give the value straight from the tablet as 56 15 (and we can explain in a "primer" introduction to base-60 notation what the "space" notation means and how to convert to base 10). Next, the problem requires two operations, from two different perspectives: multiplication and simplification to convert base-60 to base-10; and division. Lastly, we reverse the process to convert the base-10 answer to base-60.
FSU 23.02	If grass can be cut at 15 sar a day and it takes (2·60 + 30) = 150 days to cut down the grass at the Field of the Holy Mound and Pusimu Field combined, how many sar of grass are there?	The total area of grass is 2250 = (37·60 + 30) sar.	FSU23.02 involves the use of the same operations as FSU23.01.
FSU 23.02a	If each sar is 12 cubits by 12 cubits, how many total cubits are contained in the two fields (the Field of the Holy Mound and Pusimu Field)?	There are 324,000 square cubits of grass.	The solution requires students to perform compound multi-digit multiplication. Thus, there are (12)(12)(2250) square cubits of grass. Here, we might want to touch upon dimensional analysis. Thus, this solution would look something like: $(12 cubits)\cdot(12 cubits)\cdot\left(\frac{1}{1 sar}\right)(2250 sar)$ = 324,000 square cubits of grass. Thus, there are 324,000 square cubits of grass.
FSU 23.02b	If there are 36 square meters in one area sar, what is the relationship between the meter and the cubit?	A cubit is half a meter.	
FSU 23.02c	If each cubit is half a meter, how many square meters are contained in the two fields?	There are 81,000 meters squared.	

Figure 1
FSU 23: Obverse