Week 1

Reviewed by Hua Chen.

Accepted with some minor revisions

This paper introduces a new method that can be applied in teaching undergraduate Geomorphology, that is, by constructing concept sketches to improve both teaching and learning. As one of the most integrative course, Geomorphology has many sections hard for students to understand. The author provided the process of concept sketches for students to organize disparate pieces of information and understand them.

I am not familiar in Geoscience education. However, I did learn Geomorphology when I was an undergraduate. In this geological course, a lot of concepts were out of my imagination. I felt very interested when I read this paper as a new method by using concept sketches were applied in University of Vermont and get effective feedback. I found this to be a very useful and valuable paper for geological educators and students. Generally, this paper can be accepted.

This paper is clear and well-written, including detailed description of methods and applications. The examples of concept sketches finished by students are vivid and easy to understand. Here, I have some suggestions.

(1) In the introduction, the author states that Geomorphology is one of the most integrative Geological course. It's usually difficult for students to conceptually and deeply understand. I totally agree. I have one question. What kinds of methods have been used in teaching Geomorphology in the history? Is it the first time for people to employ concept sketches in the geosciences teaching? Or is there any similar method used in this field? I feel it will better if the author could give more background about this method.

(2) I think the author shows the definition and description of the method of concept sketching here. Is it better to move it to the next section, that is, Methods and Background?

(3) If I am a reader to this paper, I will feel interested to see how to evaluate the effectiveness of this new method. The final purpose for the course is that the students can capture the knowledge in Geomorphology. One way to see how well students understand this course is dependent on the professor and teaching assistants; an important way, in my opinion, is how students feel about themselves in this course. The author mentioned students' feedback in the last paragraph of third section. I think it's will be more persuasive if more detailed student feed back could be provided.

(4) I highly agreed the refinement in the last paragraph. Using concept sketches to understand the geological phenomena is definitely a effective method to learn this course. However, students need to memorize and understand some details for this course, as I think. The exams combined with concept sketching might not be enough for students to fully grasp this course. Several refinements provided by the author at the end makes me very convinced of this paper.

Joe Bartlett
1/21/09

Review: Incorporating Concept Sketching into Teaching Undergraduate Geomorphology

The purpose of this article is to describe the use of concept sketches for an undergraduate level geomorphology course at the University of Vermont. Concept sketches are annotated diagrams produced by the students that demonstrate an understanding of geomorphic forms, processes, and interactions. Students were asked to make these sketches at a variety of scales and levels of effort ranging from a first class ice-breaker to the mid-term and final projects. The sketches were also used to bridge the gap between classroom learning and field laboratory observations. The students responded positively to the concept sketches and they were beneficial in improving understanding and retention of the relatively complex concepts present in the course.

Overall the paper does a good job of documenting the success of teaching undergraduate geomorphology through the use of concept sketches. The goals, implementation, and responses to the concept sketches are clear. The figures are excellent and clearly show the range of understanding required by the concept sketching process. The article is in need of some basic editing, and while it may be personal preference, the writing style could be much more concise throughout. Some of the sections are somewhat choppy and/or redundant and could benefit from reorganization. The abstract is well written and is a good summary of the article. The introduction and methods/background sections are in need of moderate editing and would greatly benefit from a more thorough literature review. The application and conclusion sections are very good.

This article should be accepted with major revisions. Beyond basic editing and some reorganization there are few key sections that could be added to strengthen the article. The conclusion is abrupt and lacks impact but all of the appropriate ideas are present in the preceding section. More effort in literature review will strengthen the purpose and background of this article. Specific recommendations for improvement are as follows:

- P2 L24 If this is your purpose statement it needs to be clearer
- P3 The description of the course format should be reorganized
    - Also, how was the course taught before? Pros, Cons?
- P3 L24 Elaborate more on Blooms taxonomy unless this is common knowledge for journal audience
- Either in the Intro or the background section you should give some history on the use of concept sketches in education, specifically geosciences.
- P4 L3 This is redundant with P3 L 13, the two could be combined and possibly moved to the front of the section
- P8 L14These sentences might be better in the conclusion. I really like the memorize regurgitate line, that could be used in the conclusion again
- P9 L30 Abrupt ending, consider adding a concluding line about how concept sketches are an improvement or a good addition to traditional teaching methods and therefore should be included in geomorphology curriculums.
- P10 L1 Consider moving the refinements paragraph up to P9 L20 so you end with an actual concluding paragraph.
- Consider adding a statement of the instructor's opinion of concept sketches in the conclusion. Was it fun? More work? Inspiring? Etc.

Overall, the article needs minor adjustments to meet the JGE content guidelines outlined for an Instructional Approaches paper. A clear purpose statement needs to be written in the introduction

section. The context of concept sketches could be bolstered by a deeper literature review. How have they been used in other fields? Have they ever been used for geomorphology courses? The study population and the validity, reliability, and trustworthiness guidelines are covered very well.

Paper Title: **Incorporating concept sketching into teaching undergraduate geomorphology**
Paper Authors: L.J. Reusser, L.B. Corbett and P.R. Bierman

Reviewer: **Lance E. Besaw**
Date: 1/21/09

Summary
The authors use conceptual sketches and photo interpretation of historical aerial photographs in an undergraduate geomorphology course at the University of Vermont. They found the inclusion of these teaching techniques strengthen the students learning, understanding and synthesis of geomorphologic processes. By the end of the course, the authors found that the students had learned more about the temporal and spatial linkages between different processes/disciplines (*e.g.* geomorphology, geography, geology and landuse/landcover changes). In addition the students had improved their ability to professionally convey their knowledge and avoid regurgitating memorized material.

Evaluation
The authors' assimilation of information from different disciplines and fields for the students is very advantageous. By utilizing many methods of teaching (e.g. labs, field trips, GPS, class instruction), the students are learning via many avenues and so are experiencing a better-rounded education (as opposed to class instruction alone). Also included are important components of professional development (e.g. collaboration, clear communication and public speaking)

Regarding the data quality. I feel like all of the results and conclusions of this paper are arrived at subjectively. Lines 27-28 of page 8 state the dramatic benefit of the students learning through these sketches. It is assumed that this is in comparison with non-sketch teaching principles. However, there are no objective measures provided by the authors (e.g. standardized test scores based on the different teaching techniques). Can the authors investigate and explore using such metrics as a component of future research/work.

The illustrations and figures provide a lot of information to the reader. Is it possible for the authors to highlight in the text the major contributions of these figures? I think additional figure description in the text would be useful for the general readability and understandability of the manuscript.

Overall, I think the manuscript is well written. There are several places (marked in the annotated document) where the separation of ideas into different sentences will improve the readability of the manuscript.

Specific Comments
I feel like the section header "Applications and concept sketching in geomorphology" is rather ambiguous. Reading the text in this section, it appears the authors have made this analogous to a "results and discussion" section (which is fine). I would consider changing the section header to better document the "discussion" taking place in the section.

The left- and right-most edges of Figure 3 were chopped off when the document is printed. Authors should resize the figure accordingly.

Authors change verb tense throughout the document. In some cases they are using past and in others they are using present. The tense of verbs is a difficult thing to manage when merging “results and discussion”.

It was not presented in the document, but does the class stress written material as well (e.g. lab reports)? These are also a critical component in the professional development of undergraduate students.

January 21, 2009

UVM internal review of:

Incorporating Concept Sketching into Teaching Undergraduate Geomorphology

Authors: Lucas Reusser, Lee Corbet, and Paul Bierman

This particular paper focused on the use of concepts sketches (CS) in a learning environment. CSs were shown to have positive results for both the teachers and the students. Over a one semester course CSs were used in three separate applications and were shown to improve material synthesis in each application. Illustrations in the concept sketches allowed the teachers to easily identify areas where there was student confusion or misconception. This aspect of CSs provided the teachers with immediate feedback on their teaching; allowing for immediate stylistic adjustments to be tailored mid course. When the CSs were assigned as mid-term and final projects it was shown to aid in the student's ability to understand the interdependency of different processes. It was also proposed that students may rely on CSs during their professional careers to communicate complex processes to lay persons with ease. Over all the use of CSs were shown to be a valuable learning and professional development tool for students in the geosciences.

Due to the nature and use of teaching aids only qualitative results and conclusions could be made. However sound logic was used when interpretation student work and progression throughout the course. The author may aid the reader in understanding their though progression by including some additional detail of the teaching practices. Description and evaluations of the CSs were soundly reinforced by the author's use of clear figures and tables. Several points in the paper however could benefit from referencing the figures earlier on in the paper. The overall quality of the writing in this report was quite good with respects to sentence structure and grammar. The author's to use concise wording may work against the goal of this report, in places, by composing sentences that may need to be carefully reread to understand the author's intentions.

Over all this is a quality paper that should be accepted with revisions. This paper is soundly written and provides the reader with numerous well conveyed qualitative observations. Throughout the paper the author keeps a good narrative of the teaching processes used in the classroom. It clearly demonstrates that the use of concept sketches and their potential benefits to both teachers and students.

- The details of the midterm and final assignments should be shown more in depth. The figure showing an example of one of the final sketches leaves the reader wondering how focused the questions to be answered were. The addition of this will help the reader understand how much information the students synthesized and pieced together. This thought was prompted after observing figure 4; if the cross sections and other details were not already highlighted the

combination of the fluvial and hillside processes would show the level of understanding of the students.

- The quantity of student and teacher interactions was talked about briefly in this paper. It showed that the class setting was fairly open and discussion based. The paper also notes that the mid-term and final sketch grades were handed out in face to face meetings, where general misconceptions were corrected. It would be nice to see this aspect of the class touched upon in the conclusions and future refinements section of the paper, as this uncommon style of teaching may have had a great impact on the students learning.
- The final portion of the class is of particular interest as it was comprehensive and included many aspects that they had worked on in the mid-term. The observations of improvement in design and layout of the final CS was nice to see. However little is said about the content of the final CSs. It would be nice to note if possible where student that had misconceptions on the midterm assignment and how they did on the final project. Although intuitively it is assumed that the material that they covered in the midterm would be greatly improved were differences seen in their ability to link concepts. Is it possible to say that as the ability to created professional concept sketches was improved so was the student's ability to integrate dissimilar concepts?
- The report structure remains quite organized for the introduction, methods, and applications allowing the reader to progress through the paper with little confusion. The end of the final and midterm application section as well as the conclusions and future refinements section could uses some restructuring. As most of the data is based on observations it would be nice to see a summary of the key observations made throughout the course at the beginning of, or just before the conclusions section. The paragraph on page 8 lines 9-23 could then be placed in this section as well as many of the observations made that are placed in the conclusions and future refinements section. . This will most likely act to reinforce the reader's own ideas and conclusions.

The structure and content of this report seem in order for submission to The Journal of Geoscience Education with two minor exceptions. The instructions for contributors states that each table caption should be below the table, it surprised me too. The second is that punctuation should be avoided in titles if possible and you may want to change the format for your application titles.

Jaron

Meredith C. Clayton
Geology 371
21 January, 2009

Review #1: Incorporating Concept Sketching into Teaching Undergraduate Morphology by Reusser et al.

This paper is about the use of concept sketches in a geomorphology course as an instructional and assessment tool for both the students and the teachers. Concept sketches were assigned in order to encourage the synthesis of material covered in class. The concept sketches were beneficial in a number of ways. The concept sketches were beneficial to the students in that they were able to synthesize class material, collaborate with their fellow students, improve their work throughout the semester, and have a visual representation of their education, as opposed to standard material "regurgitation". The concept sketches were useful to the instructors by highlighting the students that were, or were not, grasping and presenting the material properly. They allowed the instructors to provide frequent and timely feedback; and they allowed the instructors some insight into how best to administer these assignments both during the class, and in the future.

The quality of data in this paper is high. The explanations of how the concept sketches were administered, completed, reviewed, and revised were well thought out. The paper flows through the process in a fashion reminiscent of a college semester which is appropriate given the subject matter. The process begins with the labs and meanders through the concept sketch production, and then moves on to the review of the sketches and the benefits of this review. Then the paper explains how concept sketches were revised and touches on both what the students learned from this process and what the administrators learned from the students. The clarity of writing in this paper is, at times, inconsistent. The first three pages are somewhat choppy, and contain grammatical errors. The diction is mostly elevated, but there are several noted instances in which casual or awkward language could be revised. Beginning around page four, the pace and flow improve, grammatical and structural errors decrease, and the focus is refined. The figures provided are appropriate for the subject matter and provide an effective representation of the information explained in the text. Figures two, three, and four seem a little busy, but this is due to the fact that they are actual sketches completed by students. Figure five provides an appropriate connection to the students discussed in the paper, and what their poster looked like. Since this paper focuses on the visual connection to educational material, the figures are congruent with this focus.

This paper should be accepted with revisions. As was stated above, the paper is sound in both data quality and literary content. The author adequately explains the concept sketches, their application, the process in which they are created, and the manner in which they are presented, reviewed, and revised. The author excellently explains how this process benefited the students and the administrators. The explanation of administrator benefit was exceptional in that student benefit was a predictable topic, but the extension to how administrators benefited was a surprising, thoughtful, and progressive analysis. The necessary revisions are noted, line by line, within the text, and are categorically accounted for in the following bulleted list.

Revision Guidelines:

- Insert commas where indicated.
- Consider revision of word choice where recommended.
- Elevate diction in sentences that employ casual word choice.
- Use more specific language in places that could be perceived as vague like “relatively” and “rather”.
- Combine separated words like “straight forward” and “them selves”.
- Locate the noted run-on and lengthy sentences and divide into more concise sentences.
- If sentence division is undesirable, omit unnecessary text to improve conciseness.
- Improve narrative flow through the use of segues
- Add references where needed.

Review : **Incorporating Concept Sketching into Teaching Undergraduate Geomorphology**

By: Reusser, Corbett, and Bierman

This is a very interesting approach to teaching in the sciences and the procedure and results are well explained in this document. With some revisions it will successfully present the points you are trying to make. Beginning broadly, the organization of the document is logical and it flows well; incorporating background, specific procedural information, results, and weaknesses into the text.

That being said, there are a few areas where rewording of the text would help it to be clearer. Also, at times the background seems to bog down somewhat. Several specific instances are noted in the text comments. For example the paragraph on page 3, line 15-20, could likely be eliminated with the pertinent information included elsewhere. Also, I find that by the time I get to the applications section I still do not have a good mental picture of what these concept sketches might look like. Can you show us one earlier on as an example?

Other suggestions in terms of presenting this paper are to include examples of performance in the 2008 geomorphology class as compared to past years. If this technique is superior to alternate approaches, does it show up in the grades or is it more of a qualitative achievement? Even if that is not possible, it would make the paper stronger if some sort of quantification could be put forth with the text around page 9. There may be privacy issues associated with that which I am not familiar with. Additionally, in the future it would be interesting to tie in other assessment tools and compare results with those of concept sketches.

While the concept sketches seem to be very successful- especially as a teaching tool for synthesis of information- I am somewhat concerned with the idea of running an entire class using concept sketches as the only means of (exam based) assessment. While I think that they are a powerful tool in that they are able to bring spatial relations as well as connections in knowledge “bites” together, it seems that there is a risk of falling into the trap of assessing students on their ability to be artistic and/or think graphically. While both of these, particularly thinking graphically, are extremely important tools in the field of geology, it is really not an entirely fair assessment. For example, just because said student does not “think graphically” (or present artistically) does not mean they do not have an acceptable understanding of the topics pertinent to Geomorphology and their intricacies. While these skills are important, it seems that this technique places too much weight (in terms of grading) on them for a titled Geomorphology class. In an effort to avoid such problems I would suggest not relying solely on concept sketching to asses student performance, but to use traditional essay exams in tandem (as is suggested at the end of the text).

The figures are quite effective in demonstrating the different applications of the concept sketches. I particularly like the global one (the color version). The one section that could benefit from some re-wording is page 6, line 7-22. This explanation of concept sketches used in the terrace lab is somewhat unclear and could be streamlined. With these changes made, I think this will be a smooth and well presented explanation of how concept sketches can (and have) strengthen geology/science classes.

Mark Isselhardt

Critical Writing (Geology 371)

1/21/09

Reusser, L. J., Corbett, L. B., and Bierman, P. R. 2009, **Incorporating Concept Sketching into Teaching Undergraduate Geomorphology,** for submission to The Journal of Geoscience Education.

Successful instruction of undergraduate Geomorphology should result in students who can draw connections between the visible landscape (ongoing physical processes and current conditions) and a location's past history (including human influences). Students who can make these linkages will also be well equipped to make predictions as to reasonable future conditions of selected landscapes. The author's paper suggests using concept sketching as a tool for students and instructors alike. Concept sketches or annotated diagrams are reported to be useful during early semester ice breaking activities, later as a spatially explicit way to record and analyze lab data and perhaps most importantly for instructors as an end of semester assessment of student learning. These three methods of integrating concept sketching are clearly outlined and discussed as Applications #1-3 in this article. By the end of the semester instructors saw significant improvement in students' ability to identify, integrate and suggest expected conditions across a given landscape. Students' ability to create concise captions, limited to the essential points being illustrated was also much improved.

This paper is clearly written and does a good job explaining how concept sketching could be incorporated into geomorphology curriculum. Allowing students to explore visual medium to work through spatially explicit concepts seems well suited. This paper deserves to be published in JGE with only minor changes. There are only a few minor spelling mistakes that would be caught well before final submission. The reader can follow a student's development of concept sketches from modest brainstorming activities to the more sophisticated synthesis of field data and see the potential in each step. Areas that could be strengthened generally relate to how an instructor would incorporate concept sketching into their course. The concept sketch examples cover a very broad spatial scale (from local to global). Are there limits to the scope that these sketches can be used? If not limits are there scales that seem ideal (micro-meso)? Are there accepted or defined symbols that are being put forward or are students free to create on their own? Are there any general rules that apply when attempting to layout a concept sketch? The figures (1-4) give a good sense of how various concept sketches appear when completed. It was however difficult to tell what is initially provided to the student. Table 1 seems a bit sparse. Perhaps another illustration could be included that includes two concept sketches; one that clearly meets the definition of an effective sketch and one with areas in need of improvement. When applying the grading rubric how did the authors arrive at the weighting scheme? If a student successfully made a sketch of a particular cross section but incorrectly identified the geomorphic feature, how would the grading proceed? Highlighted throughout this paper are the four key levels of thinking that are essential to an effective sketch caption (identification, explanation, prediction and linkages). It would be helpful to work through one caption from start to finish (perhaps from Table 2) so that a potential instructor could see the progression.

The paper deviates from the format laid out in the Content Guidelines for Manuscripts by incorporating the results section into the "Applications" section. This is an effective way to present the results and the guidelines do state that authors are to decide the best way to present their work.

1. Are you assuming a certain level of competency on the part of the students? Perhaps a simple table of the most common Do's and Don'ts would fit in here?
2. A more detailed description of what a prompt provided to the student would look like might be helpful here. How much content is supplied by the instructor and how much is student generated?
3. It's excellent to establish this tone at the beginning.
4. Thinking critically and independently is very important of Application #2. However, one concern might be that with the second part of Application #2 students take remotely sensed data completely on face value. The pairing of field data would likely help to avoid some confusion.
5. Figure 3's text is cropped and prevents accurate understanding. It is hard to tell the student work from the instructor prompt.
6. Figure 4 includes some elements not identified or sketched. Is this an author edited version of student work? It's a bit confusing. For clarity, remove B-B' and E sites. Add "abbreviated" or some other language to explain that sketch is a summary of student work.
7. On line 14, change to say "a detailed list of **questions** that needed…" This will make more sense when the reader gets to line 18.
8. Is it up to the judgment of the instructor to decide what constitutes a clearly organized sketch?
9. Were students' needs for instructors during mid-term and final poster preparation largely to help with layout or to clear-up questions about content (or both)? If this was added to the mid-term would you not be available during the final poster prep?

January 19, 2009
Critical writing review for Luke/Lee/Paul
Incorporating Concept Sketching into Teaching Undergraduate Geomorphology

Concept sketches are valuable tools for integrating ideas from multiple disciplines. Concept sketches were used by three teachers at UVM for teaching an undergraduate geomorphology class. The sketches proved to be very helpful in both: 1) aiding students in conceptualizing and processing the complex interactions that drive geomorphology; and 2) measuring students understanding of these same processes.

I found this paper to be very interesting and provide valuable insight into both the merit and application of concept sketches for teaching complex ideas. Pedagogy is continuously evolving, and this paper is a valuable contribution to the progression of this field, and the journal chosen for submission appears to be very appropriate. However, like all papers, there are several areas that might be improved to help strengthen the valuable argument that the authors are making.

The introduction is well written, and does an excellent job of setting up the importance as well as applicability of concept sketches. This is highlighted with the great quote on page 2 line 13-14, where the authors link the need for communicating science with the rest of the world. The introduction sets up the main issue of proving the usefulness of concept sketches in the classroom. This is an excellent point, and is a great foundation on which to build the paper. However, as will be discussed below, the authors should be careful not to dilute this fundamental argument with very in-depth discussions on the layout of the class, and instead try to use examples from the class to support the utility of concept sketches. One helpful point in the introduction would be to include the level of the undergraduate class that the sketches were used in, as this is important for the reader in understanding the background that the students are coming into the class with.

The methodology and background section is concise and well written and provides the reader with a solid background to be able to critically evaluate the success of concept sketches. The "Application on concept sketching in Geomorphology" section would be a great area to focus on for revising the paper, and would help to strengthen the paper. In this section, the authors use a step by step description of the class lay-out in order to provide a transparent description of the class, which allows the reader to evaluate the success of the concept sketches without interpretation from the authors. However, at times the description of the class, though well written and interesting, may begin to detract from the over-arching idea of the utility of concept sketches. Perhaps portions of this section could be truncated by providing a link in the paper to a class syllabus or website. Also, it may be helpful to combine classroom/lab/mid-term sections into one, as this would reduce description of the class layout, while also eliminating potential redundancy within sections.

The conclusion section provides an excellent overview of the application of concept sketches throughout the course, while also providing useful feedback from both teachers and students. The description of anecdotal evidence from discussions with students is useful, but I wonder if this could be further strengthened with qualitative evidence. If course evaluations were used, is it possible to incorporate a very brief analysis of these evaluations? What scores did the class receive? How did students perceive this class relative to others they have taken? These questions are addressed through anecdotal evidence in the paper, but qualitative assessment through course evaluations or even a post-course survey would be very helpful in strengthening the argument of the utility of concept sketches. In particular, any comments that focused directly on the application of the concept sketches would be most useful.

Overall, this paper is well written and would be valuable contribution to the field of teaching. One thought, could this paper, or ideas from this paper reach beyond the field of Geomorphology? Could a more specific focus on the applicability and utility of concept sketches for teaching complicated, multi-disciplinary topics be useful for a broader field of scientists and teachers?

Incorporating Concept Sketching into Teaching Undergraduate Geomorphology – Reusser, Corbet and Bierman

Review by Andrea Pearce
1/21/09

Reusser et al. present a case study of using concept sketching as a teaching and assessment tool for geomorphology students at the University of Vermont. They assert that concept mapping will be a good tool for teaching a course such as geomorphology because of the extensive linkages between different topics in geology, science in general and effects human land use. Concept mapping is used in several facets in this course, as an in class tool, as a way of organizing and conceptualizing field notes and data, and as an assessment tool. Anecdotally, students learned from the process of creating concept sketches, particularly as they were given feedback from instructors and opportunity to revise and improve upon their work. Likewise, the opportunity for feedback provided the instructors an indication of student comprehension, allowing for more emphasis where needed. Suggestions for improvements in the future include requiring more essay-type writing assignments to practice concise writing and encouraging better organization of the posters.

In general, Reusser et al. make a good case for using concept sketching as a teaching tool and geomorphology is a good example of the type of subject that can benefit from it. The methods are described in adequate detail that readers could attempt to use concept sketching in their courses. However, the manuscript may benefit from a greater review of past uses of concept sketching in science education (If there isn't much out there about concept sketching, I'm also thinking that you could look in to some of the concept mapping literature, though it's a little different, I think there is has been a lot of education al research done with them). While the authors present anecdotal evidence that the students find concept mapping to be helpful or more helpful than other teaching methods, there is little if any data or actual feedback to support this claim. Including a few direct quotations from students could make the presentation of this method more convincing. Overall the writing is clear and the style appropriate to the subject. The included figures help convey the use and composition of the different styles of concept sketches used in the course. It is my opinion that using actual examples from students could be more powerful than reconstructions, even if pieces were used for space considerations.

This manuscript is well suited to the goals of the Journal of Geoscience Education and is worthy of publication at this journal. I recommend it be accepted with minor revisions. Minor editorial notes are included in the attached copy of the manuscript and more significant comments follow:

- Page 1, Line 40 – *"students self-reporting that the sketches helped them to synthesize large amounts of seemingly disparate information"* Are there any specific examples of this self-reporting or data that could be used to support this claim later in the text?

- Page 2, Lines 17-26: It may be helpful to the reader if you could provide background about concept sketching. There are probably examples of assessment data already out there to support that concept mapping is an effective tool for teaching complex concepts. Whether in geology or another field, I think it would make the introduction stronger (If there isn't much of concept sketching, I'm pretty sure concept mapping, which is different, but similar, has been used fairly extensively and even some of that research would help make your case. Also, Donna used concept mapping in one of the integrated courses she has been involved with.).

- Page 4, Lines 2-7: This paragraph has two main points, 1- some work done in groups, some individually, and 2- revisions based assignment assessment. Maybe you could create a topic sentence (based on sentence 2) that introduces the evaluation process and then go into detail about how they did the assignments, revised, etc.

- Page 5, Lines 12-19: The second sentence conveys the most important message in the paragraph. You could lead with it as a topic sentence and explain the rest of the details after. The last sentence may be more suited to the previous paragraph in the discussion of collaboration and open discussion.

- Page 6, Lines 13-16: Do you need this sentence? It is geologically accurate and informative, but does it add to the story of how you are teaching geomorphology? The following sentence seems (to me) to describe what the exercise helped the students do. (But, I'm not a geologist and maybe that level of detail is needed? you would know better than I).

- Page 8, Lines 9-23: Do you have any specific comments from the students that you could include here to support this? They could make this paragraph more powerful.

- Page 10, Lines 1-14: Include suggestions of other subjects in geology, or beyond, where this type of teaching tool could be useful. A suggestion of courses, situation, or types of students for whom this may not be a good teaching/learning tool would benefit instructors at different types of institutions.

- Figure 3 could benefit from some reorganization to better fit on the page.

- Figures 4 and 5 – It appears to me that there is a discontinuity between the presentation quality and format between the reconstruction in Figure 4 and the photograph of the actual student work in Figure 5. I'm not exactly sure which would be more helpful to someone interested in using concept sketches, the raw student work or the reconstruction. The previous figures are already compiled to represent an idealized student submission, which could guide other educators as to what they might wish their students to achieve. Would it be more useful for other

educators to see examples (pieces of a sketch or the whole thing) of what their students might create?

This manuscript appears to abide by the formatting instructions set forth for authors, though looking at the journal website and electronically published articles, it does not appear that figures are reproduced in color either in print or online. The shading used in Figure 4 may not reproduce well.

Martin Lee

Review of 'Incorporating Concept Sketching into Teaching Undergraduate Geomorphology'

This paper is a good case study of how the University of Vermont's 2008 geomorphology class incorporated concept sketches as the main assessment of student learning. The paper demonstrates how concept sketches help students learn important aspects of geomorphology while clearly presenting data and concepts. I like how geomorphology is described as incorporating many different disciplines, because this justifies the use of concept sketches as a useful pedagogical tool for the subject matter. Concept sketches were incorporated in the class on the first day, to get students thinking about different scales of geomorphology. Laboratory settings incorporated concept sketches so that students could extrapolate classroom knowledge into clear and logical annotated descriptions of different concept prompts. The midterm project was a large concept sketch on rivers and soils, and feedback to the students provided insight into how they could improve their sketches. The final project was an addition to the midterm concept sketch; so that students could correct misconceptions from the midterm project as well as incorporate the newly studied hillslope processes. Anecdotal feedback from students and the teachers of the class prove that this method of teaching geomorphology is positive.

The purpose of the paper (review criterion#1), to present how concept sketches worked in the classroom, field, and lab, was clearly listed in lines 23 to 26 of page 2. The purpose sentence summarized the introduction well, as the content of the paper shifted to methods and background. The settings and methodology of using concept sketches in the classroom was clearly laid out in the methods and background setting (review criteria #3 and #4). The setting for each of the concept sketches assigned for the course was briefly outlined, and the expectations from the concept sketches were generally discussed as well as specified in detail with a rubric (tables 1 and 2). The Applications section (starting on page 4) is the body of the text where the methodology and outcome of the concept sketches are in detail, along with discussion. The conclusion and future refinement section of the paper discusses the benefits of concept sketches for the student and teacher, as well as some ideas for improving the use of concept sketches. Overall the paper was well written.

I thought that the information about the use of concept sketches was logically presented, and after some of the sections are strengthened the paper should be accepted (Accepted with minor revisions).

- The context (review criterion #2) of the manuscript is well defined in terms of geomorphology, but I think the paper could use some examples from previous studies where concept sketches are used in the classroom.
- The intro moves smoothly from geomorphology and into how concept sketches are an ideal way for students to convey their knowledge of geomorphic processes, while producing a product that can be systematically assessed by teachers. As a reader I was left without knowing whether any other case studies have used concept sketches, or whether the use of concept sketches in the classroom is novel with pretty much no previous studies published. The reference for the definition of a concept sketch is useful; did that reference use concept sketches in the classroom?

Martin Lee

The applications section (starting on page 4) was a detailed overview of what happened during each case of using concept sketches for the geomorphology undergraduate class. This section is the body of the paper and contains information pertinent to almost all review criteria. The subtitles 'Applications 1-3' go into more detail about how the different concept sketch settings were implemented. This reiteration of the methods is probably useful for this kind of curriculum and instruction paper. The 3 applications subtitles are each mini methods and results sections. I think it would be difficult to separate the methods, results, and discussion here; it flows well as it is. So, each application subtitle includes the results and observations that show how the concept sketches worked in the class room (review criterion #5). Examples of concept sketches were included as figures.

- I think that discussing possible pitfalls (integral to review criterion #6), and/or more on how this kind of learning compares to more typical styles of learning and assessment should be included.
- On page 6 lines 19-23 insight into improving part of the course is mentioned, but I think pitfalls in concept sketches themselves should be discussed (did this student misunderstanding have anything to do with concept sketches?)
- On page 8 line 17, regarding the trap of most final exams I think there could be something good about coming to class prepared for a test. Was there any feedback from the students worth mentioning to improve the assignment design (lines 21 to 23, page 8).

I hope my comments were helpful, good luck with the paper.

Martin

The authors succeeded in putting forth a developing technique which raises student involvement in college-level Geomorphology courses. The new course steers students away from textbook vocabulary lists and encourages interaction not only with other students but, hands-on, with the material they are studying through use of concept-sketches, aerial photography, and field excursions. Changes in how laboratory assignments and exams were executed aimed to make a sometimes disjointed subject more accessible and personal to college students with no previous background.

The methods used for this new style of teaching are clearly described both in writing as well as through example. Concept sketching can be used in many formats; three are used in this course (sketching in the class, for lab, in lieu of exams) and well described. Each use of concept sketching was explained in further detail specifically (e.g. making observations on aerial photos, transferring a canoeing experience onto a blank prompt). Provided in the methods is basically a "How-to" guide which allows those interested in using it enough leeway to make it applicable to their own locality. Figures were extremely helpful in understanding the authors' intent and they illustrate the usefulness in concept-sketching done well, though some edges of images were cut off.

Concept-sketching was very strongly supported method in most cases by not only the authors but the authors' feedback from the students, as well. The synthesis of outdoor observations being transferred to paper in the classroom was obviously useful for the students at the University of Vermont; however, the methods provided may not work in all regions and did not cover the wide range of material under the umbrella of Geomorphology. Vermont works well

for river and slope processes in that so many picture-perfect examples are well within the financial and plausible reach for those studying it. Not all learning centers are near rivers so accessible as the Winooski, some are not near rivers at all, and some may be within reach of other processes not expounded in this method of teaching. The authors' intents and the benefits of concept sketching are clear in the paper; however there is an attitude, subtly present, that puts textbook learning in a bad light, when in some places, textbook learning may be the only option.

The students in the Geomorphology class seemed to welcome the idea and usage of concept-sketching, though with such a small class size the overall feedback may be biased toward students with similar learning interests, habits, and abilities. The authors say in the second paragraph of page six that sometimes, they, as instructors, needed to "reconsider what types of guidance students need to successfully assemble the information for themselves" but never elaborate on how this will be done for the betterment of future classes.

Aside from some grammatical/spelling errors, this review of Geomorphology class centered on the use of concept-sketches is informative, useful, and an interesting revamp on a typical classroom. With a few minor edits, I would approve this paper for publication:

- Grammatical and spelling errors (see paper)
- Some figures are too large compared to the journal's specifications *or* they are too small and do not take advantage of the space provided
- Tables do not have suggested captions

January 20 Review for the Journal of Geoscience Education

Title: Incorporating Concept Sketching into Teaching Undergraduate Geomorphology

Decision: Accept with Revisions

This paper presented a case study that supports the use of a teaching tool called concept diagrams in undergraduate geology courses, particularly those like geomorphology which rely on the synthesis of material across disciplines. Examples of the different types of concept sketches assigned to students during a 2008 semester were detailed and samples were shown which I found very helpful for understanding the utility behind such a learning exercise. The departure from standard university level teaching methods (particularly in large introductory courses) was clear in that the sketches go beyond recitation of memorized facts and provide students and instructors the chance to make deeper correlations between seemingly isolated subjects and perhaps aid in the applicability of the information in the future.

Overall I thought the paper explained how and why concept sketches were used in this particular course although there are areas where I wish the authors would have expanded their scope a bit. For instance, in the abstract it is mentioned that many of the skills honed in the creation of a concept sketch would be used in "future endeavors", however, I didn't feel like the case for this was made successfully. A convenient spot for this to go may be after the sentence in the intro after talking about the societal relevance of geomorphology. I think it's a good point and it deserves a more complete explanation. Another area I think is worth mentioning in conjunction with the use of these diagrams in geomorphology is a brief list of ideas, perhaps at the end of the introduction, of other uses for these diagrams or examples of how they are used in other disciplines. The rest of the introduction was a good support of why concept sketches should be used at all although the grammar and spelling in this section needs to be reviewed.

Admittedly I am not familiar with educational literature or the depth to which papers such as this would go into class structure, but I found the Methods and Background section strong and concise in some topics and perhaps a little too detailed in others. I thought the strongest paragraph here to be the final one discussing the different levels of thinking and how you were able to get the level of understanding you wanted from the students. I did think that the first two paragraphs were a bit too detailed, particularly when the due dates and class times were being discussed on the top of page 3. I thought here an overall structure of the course including lecture and lab length but without needing to include what days of the week each took place. One piece of information I would have found helpful though is a background on the type of student taking this class beyond their major. Are they seniors? Freshmen? Do they have geology experience or are they required to have taken any prerequisites?

I thought the that next section in which you discuss each application of concept sketches within the structure of the class was strong and for the most part, provided enough detail for me to clearly understand both the goals of the exercise and the form of the resulting sketch. One question I had was in reference to Figure 1 of the first application. From the introduction I expected this to look different. I thought there would be connections between captions or some kind of linking that was more than spatial. I

know that this was the first of the concept sketch exercises but I was wondering if this was the intention, whether that's all that should be expected of the first try or if this is just a quick example of what someone might come up with? The other place in which I felt like I needed some more detail was in the paragraph talking about the long profile of the river. At the end of the paragraph (page 6, line 21-ish) you mention that not all the students were able to get the main concepts and that other preparations should have been made but I want to know what those might be. What could you do better specifically to make it easier for students to grasp?

Although overall I think the case made for using concept sketches was a good one, and I'd be interested in now trying similar things with my classes, I think for the paper to really be applicable to more people, the scope should be expanded as I talked about above. However, another assessment tool you used deserves a little more attention then I think you're giving it in this paper and that is the face-to-face meetings to give feedback. It allows the students the chance to see how much you really paid attention and cared about their work, as well as give them an opportunity to ask questions of the teacher on why something was wrong or how it could be improved. This is something that could easily by used in many other settings and subjects and something I've never experienced in my academic career without the student initiative of attending office hours. Too often I've seen teachers actively avoid discussing grades with students which only hurts the student/teacher relationship by distancing the teacher from learning.

My last comments are in regards to the figures and tables. I realize that some of them may not be complete, but just to check, the "detailed rubric" (Table 2) is going to be more than 1 line right? The last thing is that I don't necessarily think that figure 5 in necessary to the point of your paper. You did a good job of explaining the poster presentation and the usefulness of students sharing their work and asking questions of others and I don't really think the picture significantly enhances the text in that regard.

Overall, good job, I think there are a lot of things in this article that teachers and students could benefit from.

Carrie Pucko

The idea of using concept sketches into teaching Undergraduate Geomorphology is very interesting and the methods used in the particular course proved to be a high level tool in each of the assessments. Particularly, I found this idea very helpful to the future geologists who attended this course, to improve their logical-mathematical and spatial intelligence by constructing concept sketches. The paper is well-written and clear and addresses an important issue. It offers a clear overview and solution of the problem. It has both major strengths and on the other hand minor weaknesses. Even though this is not the final format of the future submitted paper, I think this paper should be published with minor revisions.

According to the instruction for contributors to JGE in the first page should be a phone and fax number. The introduction is very well organized but I think it would be better if you could write more details in some parts (introduction, application). One can identify the paper's purpose and goal from the first paragraph. But despite the very good paper's format, the text is not aligned to both the right and left margins which should have a three-centimeter margin all around. Also it would be helpful to correct some minor mistakes in sentence structure and in spelling caused mainly from quick typing errors (e.g. page 2, line 8). I do not know which style of documentation you will eventually use to cite print and electronic sources to your paper but it would be a good suggestion to cite the sources you used at the end of each sentence and not in the middle (e.g. page 2, line 14). Some of the figures are not easy to read because they have a lot of information on them (e.g. figure 2, 3). Maybe more figures showing the construction of the sketches would help the paper. Due to the fact that I am not familiar with the subject I could not make any comments about the references or propose any reference.

Other major issues that could strengthen the paper could be to add other examples from classes that used this technique and present how did that change affect the grades and the learning process of the course. I found especially interesting the part where you mention the problems that you as an instructor encountered. Additionally, it would be better if every student could summarize his/her opinion of this new teaching approach in one or two sentences and present them as further evaluation. My only major concern after reading this paper is that the results and the conclusions come up after only one year of using the technique of concept sketches and there were only 19 students. A bigger sample of students could provide you with more results and with a bigger variety. Another very good solution of this problem it could be a paragraph where you compare the grades between a class that did not use concept sketches and the class that did use. Unfortunately, only if this technique was incorporated in the learning process for many years we could have more than the grades to compare (lab reports, sketches etc.). At this point, I would like to point out that the authors do motivate their research but I do not know if the research is strongly related to other work reported or will be reported to the references. As for the conclusions, my opinion is that are very meaningful and reasonable.

In conclusion, the paper is a good inspiration of future improvement in all courses with similar subjects and should be used to improve the learning process at all levels. Taking into consideration all the above discussed issues, this paper should be submitted with appropriate revisions and no significant changes.

Nikos Fytilis
Review of "Incorporating Concept Sketching into Teaching Undergraduate Geomorphology"

Assignment #1 Due date: 01/21/09

Review of paper "Incorporating Concept Sketching into Teaching Undergraduate Geomorphology".

The manuscript presented a new approach on the teaching process of Geomorphology which is based on incorporating concept sketches performed by students, as well as the benefits of this process to the students and their instructors.

This manuscript is quite clear in its content and easy to read and the various figures are very helpful. However, there are a few points that if revisited could help making this paper even better.

First of all, there are some spelling errors located at the abstract, the introduction, the methods and background and the figures.

Also, although it is repeatedly stated that the process was beneficial to the students and that they also commented on that, I believe that some statistics on the students' final grades could strengthen that argument. For example, what percentage of the students got an A at the final exam?

In addition, as a reader I would like to see if this technique has been used again in the past for the specific class in another university or even for other classes.

However, a point that really strengthens the value of this paper is that the method presented proved to be beneficial not only for the students but for the instructors themselves as the level of each student could be easily identified. Another good aspect is that in this paper, not only the merits of the process are stated but also the various problems encountered and the solutions that could help in the future.

Furthermore, as for the figures presented in the end, although figure 3 is not very clear and the edges seem cut, generally they are well presented and the final figure (figure 5) gives a very friendly tone showing the writers' good intention towards the students.

In conclusion, taking into consideration all matters discussed above, I believe that this paper should be published and by this way help in readdressing traditional teaching techniques in academic institutions.

Christina Syrrakou

Charles Trodick's Review of

Incorporating Concept Sketching into Teaching Undergraduate Geomorphology

Accept with Major Revisions and Re-review

The ideas presented in this paper are very important and need to be presented to the geoscience teaching community. The paper needs to be revised so that it can clearly get its point across. I do understand that the paper has been rushed, which is what has contributed to the problems with the paper. The main reasons I believe there needs to be a re-review is that the figures and references need to be finalized. The body of the paper itself is very good it just needs basic revision.

I think you could add a section titled "What is a Concept Sketch" or a good reference that goes into the full details of what a concept sketch is. Someone who is unfamiliar with them may have difficulty figuring out all the details from this paper. I understand this is a paper about putting the sketches to use in the classroom, so a good reference would probably be best. As a whole, this sounds like a good idea especially when teaching visual learners. People who are not visual learners could have difficulties with it but it does not make it any less important, because so much of Geomorphology is visual.

You should possibly have a section, which describes generic instructions for setting up a geomorphology class using concept sketching. This should be just something short so that the teacher does not need to reread the entire paper to remember what needs to be done to effectively teach the class. More feedback, both good and bad, from students in the class that have taken large amount geology or related courses could strengthen the paper I think. I think with the changes outlined above, revision of the

body of the paper, addition of references and finishing of the figures this will be a very important paper and will help Geomorphology teachers everywhere, especially new ones.

Charles Trodick

Review: Incorporating Concept Sketching into Teaching Undergraduate Geomorphology

Paper summary:

This paper provides information on a new curriculum developed for an undergraduate Geomorphology course at UVM. The curriculum introduced concept sketches as a tool for students to use for synthesis of course concepts. To aid the student's comprehension of course material, students were encouraged to participate in group discussions of personal observations, collaborate with classmates on assignments, and public speaking activities by presenting their work to the class. Informal feedback from the students at the end of the course suggested that concept sketches provided students with a better synthesis of course material and sketches helped students assimilate the small- and large-scale concepts. The instructors themselves were able to use the concept sketches throughout the semester to evaluate student progress and understanding of material by the detail and organization of the student's sketches. The authors concluded that concept sketches are an effective teaching tool and plan to use this method in future semesters.

Evaluation of paper:

The methods and background section of this paper provides a brief and clear description of the concept sketches as a learning tool and then justification for why this should be used as a tool (identify underlying connections with concepts and encourage higher-level thinking). It is well laid out in providing information and examples for how this tool was implemented in the structure of the course (classroom, laboratory, assessments) as described in the applications section. This section is an essential part of the paper as it provided examples of each type of exercise employed and was key for understanding the utility and way in which these sketches could be used for learning in the classroom as an alternative to more traditional methods. The lesson examples given provide enough detail that they would supply other educators with a model for integrating conceptual sketches into their curriculum. *Also important as it is a basic need of the Journal of Geoscience Education*.

The current evaluation method using informal feedback from the professors and students provides compelling statements of success but it would be more authoritative if an additional method of evaluation of the effectiveness of concept sketches were used (see suggestion second bullet below).

As a whole the current draft of the figures clearly illustrate the message of what the students were provided with and what they were to construct. However I found Figure 3 a bit confusing in terms of reading about the exercise in the text and then viewing the way the students were utilizing their concept sketch in the figure. In the finalized version of this illustration it would aid the reader by making first the connection between the text and relevant section of the graph clearer and second to give emphasis to the actual graph of the different terraces themselves, to make them easier to identify on a black and white image.

As concluding remarks, the refinements section did a great job of detailing the specific points such as the point that organization and concise summary of information was identified as something to be emphasizes more strongly earlier in the course. However this area could be expanded to identify other overarching pitfalls/limitations of

this learning style that were observed during this course that could be provided for other educators.

Status of paper & recommendations:

Overall this paper is well written and illustrates a great tool that should be shared with the educational community, I recommend that this paper be accepted for submission. Below I have detailed a few and recommendation regarding paper content and layout:

- In the background/methods section the paper briefly alludes to the prior ("traditional") teaching method used in this course as lecture, lab, exams, and a final paper/project. It would be valuable to include a 1-2 sentence description of differences in student expectation and how data was given to students from these teaching styles.
    - How has this method differed from the previous method of teaching course? For example:
        - In prior years were students given an all written lab in with step-by-step instructions to work through exercises?
        - What teaching tools were previously used to help students integrate distinct concepts?
        - Do both methods provide a written or graphical opportunity for students to present what they learned?
- The evaluation method presented in paper was purely observational (via students and professors). Have you thought about other ways in which this curriculum could be evaluated in its teaching effectiveness and knowledge retention versus "traditional" methods of classroom learning? The development of a survey for evaluation is out of the scope of the intended research but as it is stated this curriculum will be used for subsequent sections of this class, a formal evaluation could be an interesting consideration for the future.
- A minor suggestion regarding flow of the paper would be to breakup the Conclusions and Future Refinements section. The Journal of Geoscience Education describes the "results section" of submissions as providing information on descriptions of limitations and potential pitfalls, which are currently positioned in the refinements section at the end. It could improve the flow of the conclusions section to truly be wrapping up with summarizing statements rather than the refinement paragraph for the ending note.

Compliance with identified journal requirements:

In terms of being compliant with the Journal's requirements for submission, all the material in the final draft needs to be double spaced with a 3cm margin and the table captions should be below the table itself. Also see comments in the last bullet point above regarding suggestions for the Results and Conclusions for 'Curriculum and Instruction' submissions.