

Software Education in Mining Engineering

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Outline

- Introduction
- Problems/concerns to be addressed
- Results of survey
- Conclusions
- Responders' comments

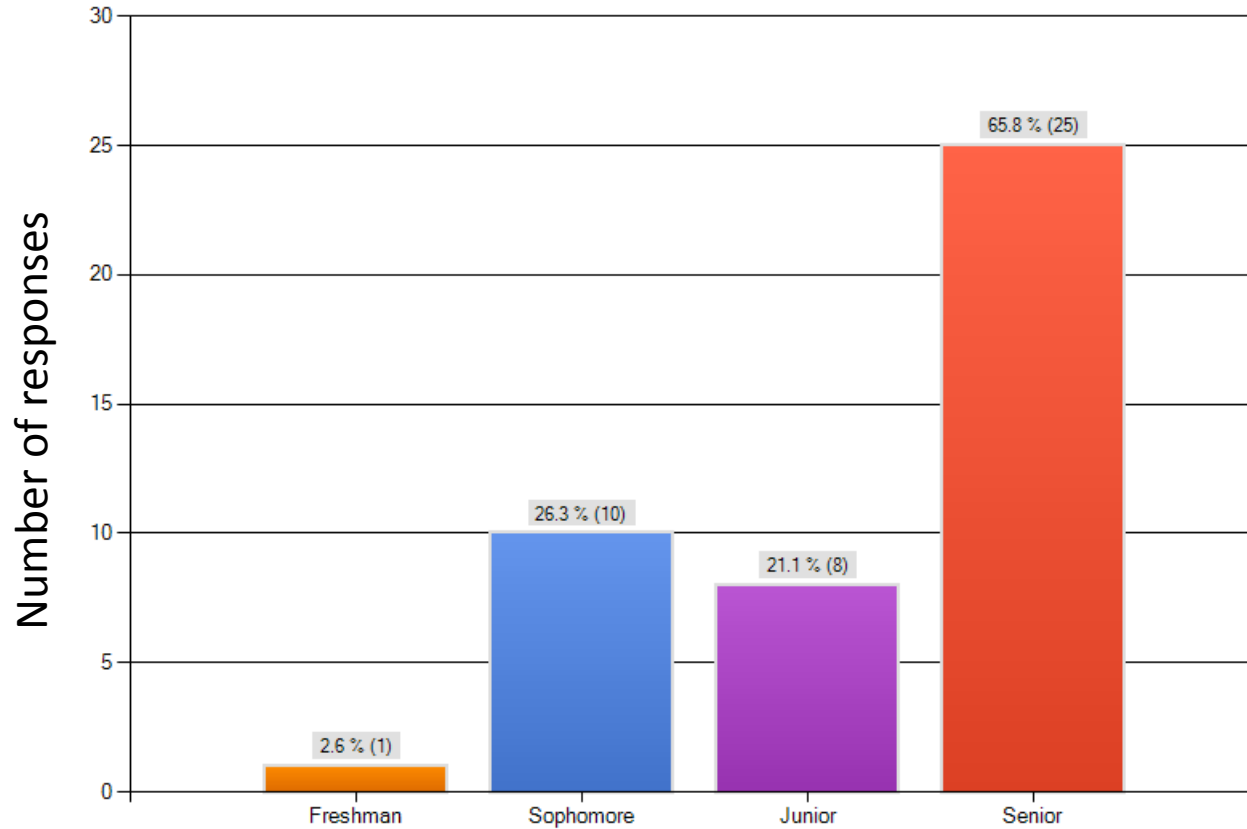
Introduction

- The purpose of this study is to determine how software education is delivered to students as part of mining engineering curriculum.
- Total of about 38 responses were collected from different countries
- Approximately 19 hours, total spent time on software teaching per course.

Problems/concerns to be addressed

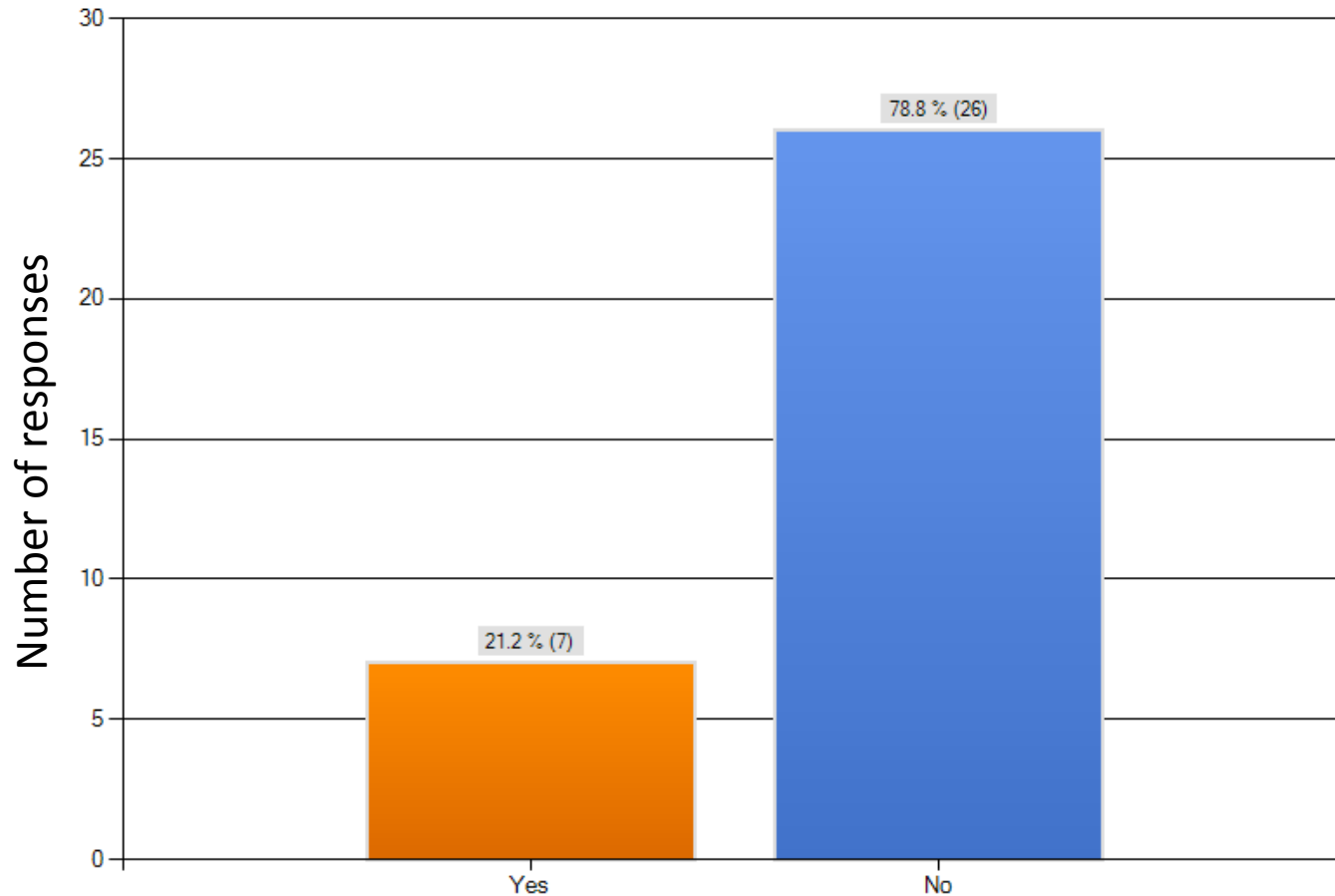
1. The growing amount of software which is used in mines.
2. The time spent teaching software to students is time not spent teaching the fundamentals of mine design etc.
3. The need for students to understand the theory behind the software and its limitations.
4. The learning time needed by students to be able to use the software effectively in class projects.

When is software taught?



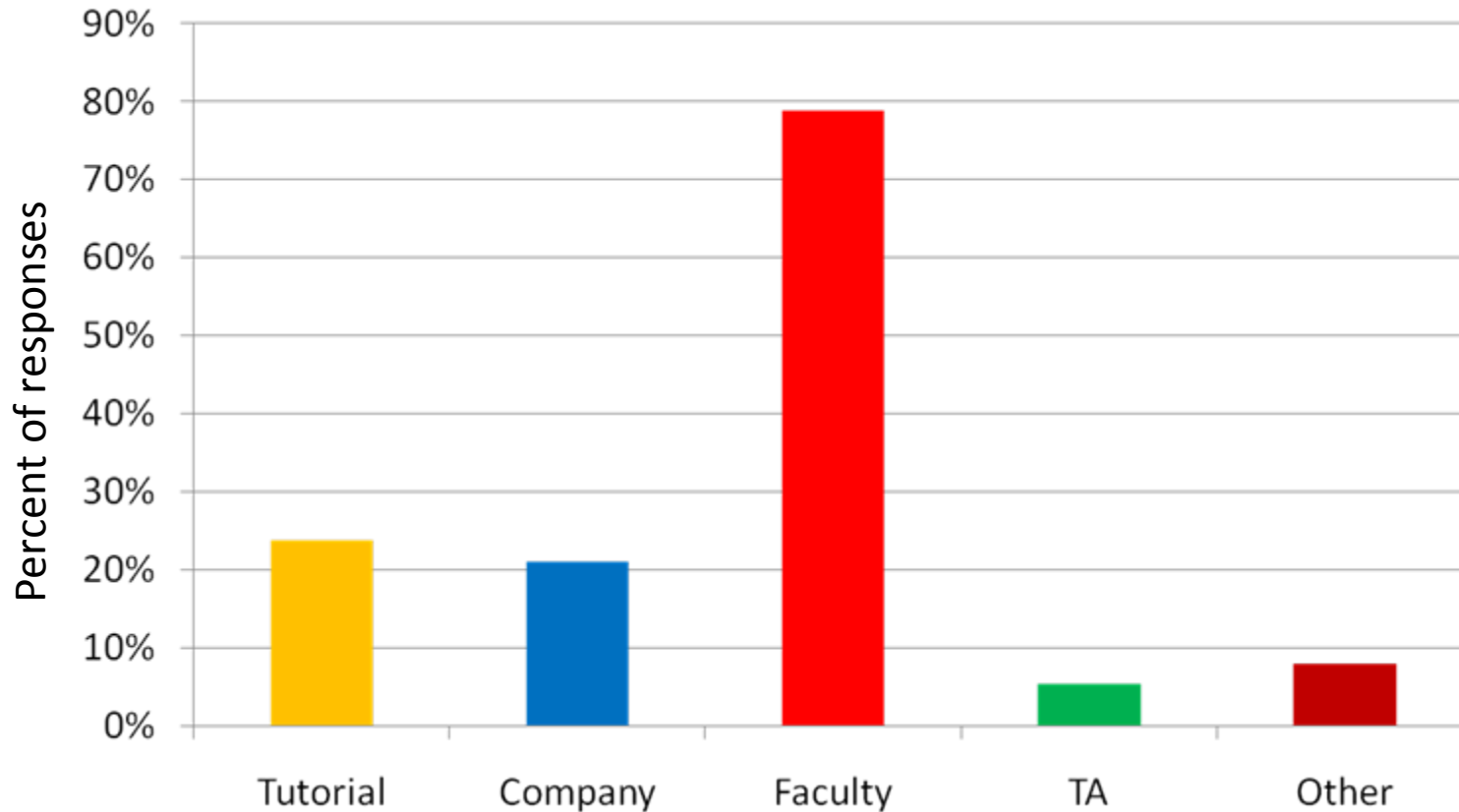
Majority of the software education is offered during the last year of undergrad program.

Is the course just for teaching the software?



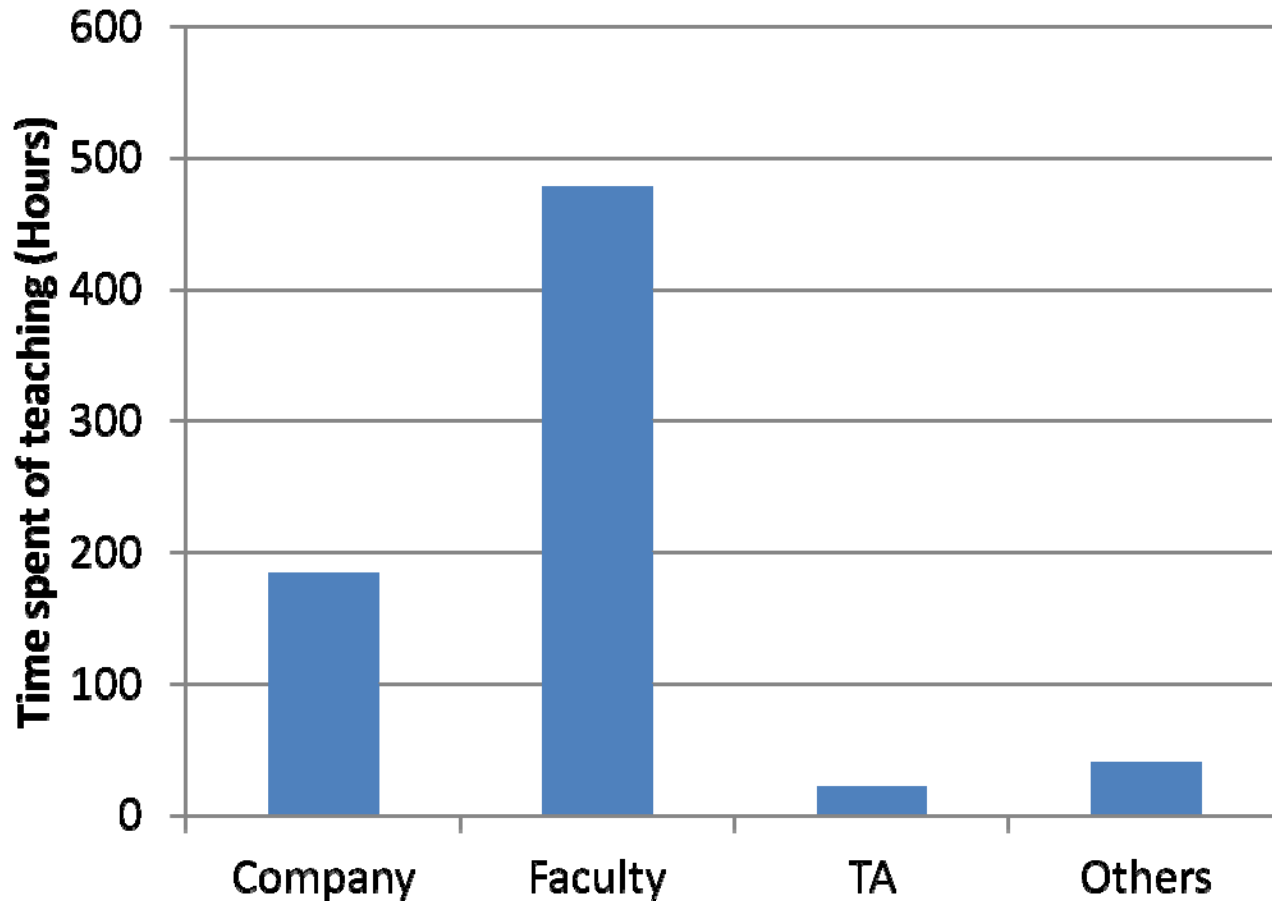
Majority of the software education is integrated as part of a course.

Who teaches the software



Majority of the software education is done by faculty.

Total surveyed spent time on teaching software per course



Majority of the software education time spent is by faculty, close to 500 hours per semester, followed by vender at about 200 hours .

Conclusions

- Main conclusion is that the software is mainly taught by faculty
- A surprise conclusion is that the software is taught mostly during senior year but logically one would argue that software education should start from freshman year and continue through to the senior year.
- Most of the spent time on software education is primarily by faculty and then by the software vendor.
- The software education is delivered as part of a course

Comments

1. The following comments provided by responders were found to be also useful.
2. Not all components are taught. Reliant on student's ability to understand theoretical concepts BEFORE using software to develop solutions. Most students can manage to learn how to 'operate' the software no problem - but certainly lack objectivity in terms of analysis of the results (often erroneous) data produces.
3. Use of commercial mine design software is required by the Canadian Engineering Accreditation Board.
4. Our Sophomore-level course, Elements of Mine Design, is essentially a tool box course where the students learn statistics, reserve estimation, and design software. We intend to increase the number of labs dedicated to Vulcan in the coming years, from 2 to 5, or so, as I become more familiar with it. I have spent a large portion of this semester teaching (and re-learning) software, so this survey is timely. I am curious to see how other departments address the issue, and whether there is a better way.
5. The course is split into: - Mine Planning I - basics with a total of 120 hours per semester (60 contact hours and 60 project work and self learning = 12 credits) in year 3 - Software usage Excel 40% and Surpac 30%. Mine Planning II - advanced with a total of 120 hours per semester (60 contact hours and 60 project work and self learning = 12 credits) in year 4, Software usage Surpac 80%

Comments

6. In my course the use of software is strictly limited to support of design and planning functions for open pit mine study (may be conceptual study, business plan study, etc.). The software is NOT introduced in a junior-level open pit mining methods course. The limitations of software are explicitly discussed; this is why I teach the software rather than the vendor. This requires a professor with extensive knowledge of both the underlying principals as well as the functionality of the software, and someone who is willing to invest time is benchmarking the software. For the course I have condensed two vendor offered courses (two weeks total) into 24 hours of tutorial instruction; a TA is available to assist the students outside of this. The implementation of software is complex and requires dedicated faculty. Too many professors seem willing to allow vendor instruction or to simply follow the vendor-provided tutorial materials which stress the use of the tool rather than underlying principals. Based on my own industrial experience I believe the stress on 'button-clicking' in mine design over the past decade has greatly impaired a generation of mining engineers who have little understanding of fundamental concepts and are unable to CRITICALLY analyze software results. Although the software is freely available there are travel costs associated with ongoing refresher training. **I strongly believe mining faculty should resist the urge to incorporate more software training in undergraduate programs. We are here to educate engineers, not train technicians, and an entire semester could be spent covering materials that companies should be sending their new hires on training courses for.** software used for other courses includes mine 2-4D and geovariances (isatisis).

Comments

7. Good balance between Surpac specific skills and general understanding of the issues and models used in mine planning is difficult to achieve. The students want employable skills and assume that it means they can do things in Surpac. But that doesn't always translate to technical competence in interpreting results.
8. Graduate Diploma of Mining program Company Economics and Finance 1 day training in use of Xeras Mine economic evaluation software Surface Mining 1 day (2 half days) on Talpac truck/haulage evaluation and Dragsim dragline simulator
9. The taught component of the course takes 10 hours and involves tutorials on the use of the Rocscience suite of software. This is a course in the Graduate Diploma of Mining Within the Master of Mining Engineering course Advanced rock mechanics the software is also used 40% of the assignment work being based around the programs Slide, phases 2, phases 3 and unwedge
10. The taught component of the course takes 24 hours and involves tutorials on the use of Surpac. In addition to this the students undertake a design exercise where they have to use Surpac, which is 60% of the overall assessment for the course and consists of 2 design problems In addition Surpac is used in teaching the Computer Applications course in the Graduate Diploma of Mining, 5 day intensive course, 3 days on campus is used for training and assessment purposes Use of Surpac is also encourage in doing assignments in other mining engineering subjects from undergraduate to Graduate Diploma and Master of Mining Engineering

Comments

- 11.** The taught component of the course takes 12 hours and involves tutorials on the use of datamine. In addition to this the students undertake a design exercise where they have to use Ventsim, which is 40% of the overall assessment for the course. In addition Ventsim is used in teaching the Computer Applications course in the Graduate Diploma of Mining, 5 day intensive course, 2 days on campus is used for training and assessment purposes. Use of datamine is also encouraged in doing assignments in other mining engineering subjects from undergraduate to Graduate Diploma and Master of Mining Engineering.
- 12.** The taught component of the course takes 12 hours and involves tutorials on the use of ventsim. In addition to this the students undertake a design exercise where they have to use Ventsim, which is 20% of the overall assessment for the course. In addition Ventsim is used in teaching the Mine ventilation course in the Graduate Diploma of Mining, 5 day intensive course, half a day on campus is used for training purposes, students then download a student version of the program to undertake a design problem worth 30% of the overall marks when off campus. Ventsim is also used in Master of Mining Engineering program in the Advanced mine ventilation course for a 40% assignment involving multiple pollutants, emergency evacuation route selection for a block cave mine ventilation system.

Suggested software needs for Students:

- Open pit, Strip mining, and Underground mine design
- Open Pit optimization
- Surface and Underground mine development and production scheduling
- Hauling and Loading design
- Conveyor design
- Underground mine ventilation and climate design
- Mine Simulation
- Rock mechanics design – Surface and Underground
- Mineral Resource Estimation / Geostatistics
- Mineral processing
- Capital and Operating cost estimation
- Financial analysis

- **However it is important for the students to:**
- Understand the theory behind the software
- Know how to validate the software
- Know the limitations of the software
- Know what questions to ask of the software developers in order to understand the assumptions built into the models
- Be sufficiently adept at using the software to solve class assignments, case studies, and design projects without excessive time being spent trying to get the software to do what they want
- Know when and who to ask for help
- Learn to always ask the question of the results from a program application, “Does this make sense”. In other words know the order of magnitude of the expected answer
- Always question the results from the black box

- To achieve this the following are needed:
- Sufficient but not excessive class time teaching students the software. How much time is sufficient. How many credits
- Adequate assistance through available voluntary tutorial time to help students, particularly those with less aptitude and ability
- Adequate class time being spent teaching the theory, drawbacks, limitations, and application of the software
- Opportunity for students to apply particular software to realistic assignments
- Opportunity for students to enter mine design competitions

- PROBLEMS:
- Who should teach the software, -- Faculty, Graduate students, Software company personnel or Consultants either free or paid, Volunteer mining company personnel
- If Graduate students how do you maintain continuity
- If faculty, how much time should they spend learning the software and keeping up to date on new versions of the software
- Is this time spent by faculty the best use of their time rather than spending it on developing research proposals
- Does this time spent help or hinder faculty in the tenure process
- What software will the students actually use when employed at a mine. An advantage is the underlying similarity between particular application software
- What is the best compromise
- What can SOMP contribute to this aspect of teaching

Examples:

- Mining Games – Canada, Australia (computer application), and USA
- Mine Design Competitions – Carlson Software, SME/PCMIA, SME Aggregate/Quarry - extensive computer software use in all the projects submitted either individual or team
- Sharing of particular software tutorials developed by faculty on the SOMP web page
- Sharing of real data sets and projects obtained or developed by faculty on the SOMP web page
- www.edumine.com
- Retiring faculty – Availability of accumulated research and teaching material, notes, pubs., books etc., on SOMP web page
- Availability of Retired faculty interested in doing some substitute teaching on SOMP web page

Mine ventilation:

- Mine ventilation listserver. About 250 members worldwide, opportunity to share information, ask questions, respond to questions etc. No advertising
- To join: Contact Pierre Mousset-Jones mousset@mines.unr.edu
- Once accepted send comments etc. To mineventilation@unr.edu

Paper available:

- The Effective Use of Professional Software in an Undergraduate Mining Engineering Curriculum
- by V. Kecojevic, C. Bise, and J. Haight
- Interactive Learning Environments Vol 13 No.1-2 April-August 2005, pp 1-13