Title:
Characterizing Employer’s Expectations of the Communication Abilities of New Engineering Graduates

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Abstract:
One of the perennial challenges of writing in the disciplines is how to prepare students to be effective communicators in the professions they will be entering. Communication teachers working in the disciplines are often not aware of what is expected of recent graduates by their employers. To better understand the gap between recent graduates’ communication abilities and employers’ expectations, the authors surveyed software engineering professionals. They asked which of 67 communication abilities are unimportant for software engineers, which ones are learned on the job, which ones recent graduates are expected to have but lack, and which ones recent graduates possess.

Results showed that employers expect graduates to communicate clearly and professionally, while specific audiences or forms of communication may be learned on the job. Recent graduates meet many of employers’ expectations but lack others. For example, most are reported to use English fluently and to use terminology correctly but to lack concision and cohesion. Employers disagree about whether graduates’ communication is sufficiently professional.

These results raise interesting questions about the boundaries of communication pedagogy. For example, employers seem to attribute value to politeness in communication; should communication educators attempt to teach students to be nice? Employers also attribute particular value to oral communication; should we decrease emphasis on written communication? We believe these results can inform, but should not dictate, communication pedagogy.
Characterizing Employer’s Expectations of the Communication Abilities of New Engineering Graduates

Susan Ruff, MIT, and Michael Carter, NCSU
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Special Focus Issue: *Integrating Communication Instruction Throughout STEM Curricula*

2008 Chautauqua
Teaching Communication Skills in the Software Engineering Curriculum
Paul Anderson, et al.

Interviews and focus groups provided a rich picture of engineering communication, but this isn’t sufficient to inform teaching since we may not need to teach abilities learned on the job or elsewhere.

38 abilities important for software engineers, e.g., the ability to discern when to ask a question rather than assert an opinion and when to remain silent rather than to speak.
Research Questions

Which communication abilities do employers expect recent graduates to have?

Do recent graduates meet expectations?

Which abilities do employers not expect?

Why not?
Is the ability unimportant or learned on the job?
Do you expect recent graduates to be able to...

...give clear high-level overviews?

☐ Yes, but they usually lack this ability.

☐ Yes, and they usually possess this ability.

☐ No, this ability is unimportant for software engineers.

☐ No, this ability will be learned on the job.
The online survey was advertised in at least 7 states

To

- Participants in our prior research on software-engineering communication
- Participants in the 2008 Chautauqua in Teaching Communication Skills in the Software Engineering Curriculum
- Frontiers in Education conference (attendees and exhibitors)
- Employers at 2 career fairs at MIT
- BRAWN, a Boston-area technical communication mailing list

Help educators produce software engineers with **excellent communication skills**.

20 minute survey: [web.mit.edu/ruff/SEcomm](http://web.mit.edu/ruff/SEcomm)

$150 drawing for taking the survey
$150 drawing for forwarding the link

Forwarding and participation were encouraged by two $150 drawings
The sample is not random, so demographics matter.

Results may best represent information industries along the coasts.
Results

Do you expect recent graduates to be able to...
...give clear high-level overviews?

Yes, and they usually possess this ability. (Region C)

Yes, but they usually lack this ability. (Region A)

No. [These results are elaborated later.]

Dashed lines delineate regions of statistically significant results.
Results: Yes but they usually lack this ability

1. Connect new information to information that is familiar to the audience.
2. Order information in a way that makes explanations easy to follow.
3. Recognize one’s own communication weaknesses and improve.
4. Be concise.
5. Communicate via code comments.

Employers expect the abilities in Region A, but graduates are not meeting expectations. We might consider increasing emphasis within curriculum.

Abilities 1 & 2 are meant to capture notions of cohesion and coherence.

Code comments are a genre specific to software engineering.
Results: Yes, and they usually **possess** this ability

Employers expect the abilities in Region C, and graduates are meeting expectations. Perhaps keep curriculum as is.

26. Communicate ideas one-on-one
27. During discussion, treat others with respect
28. Communicate to an audience of other software engineers
29. Communicate via small talk / social conversation
30. Communicate via telephone
31. Be nice to others, though words and tone
32. Use correct and consistent terminology
33. Use English fluently
34. Communicate via instant messaging
35. Communicate via e-mail
Results: Yes, but they may lack or possess this ability

Employers expect the abilities in Region B, but disagree as to whether graduates meet expectations. Perhaps provide individualized teaching for those students who need it, if possible.

For example,

7. Adjust communication based on non-verbal reactions
8. Discern when to ask questions rather than to assert an opinion
9. Communicate with a balance of confidence and humility
12. Listen actively
13. Avoid taking debate, feedback, or others’ opinions personally
14. Discern when to keep silent rather than to speak
15. Avoid complaining
20. Respond professionally to one’s own mistakes

These are abilities for communicating professionally—of being nice. Should we be in the business of teaching students to be nice? If we decide yes, how can we do so?
Results: Abilities **not expected** of recent graduates

**Learned on the job:**
- Experience with document management systems
- Communicate via online meetings
- Experience with tools for project planning
- Flexibility to communicate in different roles within an organization
- Be aware of the knowledge and concerns of customers of the company
- Be aware of the knowledge and concerns of business &/or marketing

Employers do not expect recent graduates to have these abilities because they're learned on the job. That's not surprising, since many of these abilities are specific to the job or company. We might choose to teach some in order to graduate particularly competitive engineers, but if time is tight, these abilities could perhaps be deemphasized or omitted from the curriculum.
Results: Abilities **not expected** of recent graduates

**Learned on the job:**

- Experience with document management systems
- Communicate via online meetings
- Experience with tools for project planning
- Flexibility to communicate in different roles within an organization
- Be aware of the knowledge and concerns of customers of the company
- Be aware of the knowledge and concerns of business &/or marketing

**Unimportant:**

None!

This isn’t surprising because most of the abilities in the survey had been previously identified as important for software engineers.
Results: Abilities not expected of recent graduates

Learned on the job:
- Experience with document management systems
- Communicate via online meetings
- Experience with tools for project planning
- Flexibility to communicate in different roles within an organization
- Be aware of the knowledge and concerns of customers of the company
- Be aware of the knowledge and concerns of business &/or marketing

Unimportant:
None!

Relatively unimportant:
- Communicate via conference posters
- Communicate via journal articles
- Be aware of the knowledge and concerns of lawyers

Employers do not expect these abilities, but they disagree as to whether the abilities are unimportant or learned on the job.

Academic genres are relatively unimportant for engineers
Summary of Results
(Software engineering, especially in information industries along coasts)

Employers don’t expect
- academic genres, e.g.,
  - journal article, conference poster
- company-specific knowledge, e.g.,
  - document-management systems or project-planning tools
  - concerns of customers or business/marketing

Employers expect clarity and professionalism.
- Clarity expectations are met in some ways, e.g.,
  - using terminology correctly
    but not others, e.g.,
    - communicatingconcisely & cohesively
- Employers disagree whether grads communicate professionally.

Implications vary by institution and individual
Thank you!

The remaining slides are backup:
- The meaning of the colors of the data points [i.e., the second half of the data from the split survey]
- The statistical analyses
- The graph for the abilities employers don’t expect
- A cross sectional look at the data that reveals abilities to teach students who would like to be particularly competitive graduates.
- A resource for teaching professional communication
- Implications re: oral vs. written communication
- A few motivational quotations
How important is each ability for software engineers in your workplace?

<table>
<thead>
<tr>
<th>Ability</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Be nice to others, through words and tone (e.g., in daily interactions)</td>
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<td>During discussion, treat others with respect (e.g., when giving an</td>
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<td>opinion, debating potential solutions, reviewing code)</td>
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<tr>
<td>Avoid taking debate, feedback, or others' opinions personally</td>
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</table>
Evaluators & practitioners agree on what’s important

Strong correlation between evaluators and practitioners: $R^2 = 0.69$. Agreement among practitioners is weak: error bar $\sigma \approx 1.3$. (0.7-1.9)

Average importance of ability, per practitioners:
- Most important (average importance $> 3.9$)
- Somewhat important (between 2.8 and 3.9)
- Least important ($< 2.8$).
Statistical analyses
67 abilities

Evaluators: N=32; 4 categories + Don’t Know
0-5 “Don’t Know” responses for each ability (mean=0.5)
2-tailed exact binomial tests with p=0.05
First round N=27-32 (mean=31.5)
Second round N = 20-32 (mean=26.5)
Total expected Type I errors: 5.55

Practitioners: N=64; 6-item Likert scale
0=not important
1=somewhat important
5=extremely important
standard deviation typically about 1.3
least/most important ≥ 2 standard deviations from mean (of means)
The sample is not random, so demographics matter.

Results may best represent information industries along the coasts.
Results

Do you expect recent graduates to be able to...
...give clear high-level overviews?

No, the ability is unimportant for software engineers (E)

No, the ability is learned on the job (G)

Yes.
Results: No, the ability is **learned on the job**

62. Experience with document management systems
63. Communicate via online meetings
64. Experience with tools for project planning
65. Flexibility to communicate in different roles within an organization
66. Be aware of the knowledge and concerns of customers of the company
67. Be aware of the knowledge and concerns of business &/or marketing
Results: No, the ability may be either learned on the job or unimportant for software engineers.

59. Communicate via conference posters
60. Communicate via journal articles
61. Be aware of the knowledge and concerns of lawyers
Either learned on the job or expected but lacking

- Use metaphors to communicate a system's purpose
- In conflicts, collaborate to identify win-win solutions
- Communicate across organizational boundaries
- Communicate to an audience of managers
- Communicate to an audience of UI designers
- Communicate to an audience of software architects
- Communicate to an audience of end users of the software
- Communicate effectively via conference calls
- Communicate effectively via formal requirements / specifications
- Communicate effectively via formal documentation
- Communicate effectively via code check-in notes
- Communicate effectively via bug reports

We might teach these if we’d like to graduate particularly competitive software engineers.
Implications?

Should we teach students to be nice?

For example,

7. Adjust communication based on non-verbal reactions
8. Discern when to ask questions rather than to assert an opinion
9. Communicate with a balance of confidence and humility
12. Listen actively
13. Avoid taking debate, feedback, or others’ opinions personally
14. Discern when to keep silent rather than to speak
15. Avoid complaining
20. Respond professionally to one’s own mistakes
21. During discussion, treat others with respect
31. Be nice to others, through words and tone

Can we?

e.g., Team writing: a guide to working in groups
by Joanne Wolfe
Implications?

Should we shift focus toward oral communication?

**Oral**
formal & informal presentations to a group  expected
one-on-one & group meetings  expected
small talk & discussion  expected
nonverbal communication  expected

**Written**
e-mail, instant messaging, code comments  expected
correct spelling  expected
formal documentation, specifications, other job genres  disagree
disagree
structure & formatting for fast reading  disagree
journal articles  not expected

Implications vary by institution and individual
The program must enable students to attain, by the time of graduation, an ability to communicate effectively with a range of audiences.

–ABET 2015-2016

Once again employers report that soft skills represent a more critical shortcoming of job applicants than technical skills. Communication remains the most cited shortcoming.

–State of St. Louis Workforce 2013

There is a widely held belief that ‘soft skills’ are greatly in demand in Computing graduates. There is less consensus on whether students lack them, and whether (indeed, how) the curriculum should provide them.

–Computing Graduate Employability, 2016
Council of Professors & Heads of Computing/Higher Ed. Academy