University of Northern Iowa

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STEM Education, Ethics & Communication

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STEM Education, Ethics & Communication

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STEM Education, Ethics &Communication

- Science Communication is Important. Example:

- Growing perceptions about a gap in STEM students and graduates to fulfill STEM careers in the United States

- Investments at all levels, Federal, State, local, private to support science education

- Summer 2015 - Iowa adopts new science standards patterned after the Next Generation Science Standards (NGSS)
  - Education standards for science education in K-12 include expectations for development in communication skills and ethical reasoning and understanding

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Value of Communication in STEM Education

- Sharing information, making arguments, debating and communicating science information part of the process of developing scientific literacy

- Many contemporary failures of science to successfully explain and defend their work leading to problems for public decision-making
    - Issues such as climate change, vaccinations, GMO's, genetic testing, evolution

- The communication skills focus is currently on language arts, literacy, and technical writing. Missing are public communication, advocacy, persuasion, argumentation, mass media communication

Value of Ethics in STEM Education

- Communication ethics: persuasion, advocacy, honesty, accuracy, omission, representations

- Multitude of research ethics related topics: data handling, laboratory safety, subject confidentiality, intellectual property, authorship

- ALLEA (2013) published a statement on the need for ethics education in science. In it they state that: "[e]thics education in science should cover both internal and external research ethics, both canons of good research practice and ethical aspects of the relations between science and society (p.3)."

Current Research Arc

- Critical assessment of communication and ethical reasoning needed as part of STEM education

- **Survey of educators concerning ethics and communication content in STEM related education**

- Identification of critical communication and ethics content needed, and identify weaknesses in current training

- Recommendations for communication and ethics education in STEM and science education
  - Activities and lessons
  - Teacher education and training
  - Pathway to more successful STEM education initiatives

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Results of Existing Survey and Recommendations for Future

- Support for both communication and ethics education curriculum

- Concerns with content and effectiveness of training

- Belief in the relationship between communication, ethics, and STEM

Methodology

- Online Survey consisting of 16 questions

- Posted on the listserve of National Science Teachers Association (NSTA) from August 24th to September 15, 2015

- Over 100 individuals accessed the survey

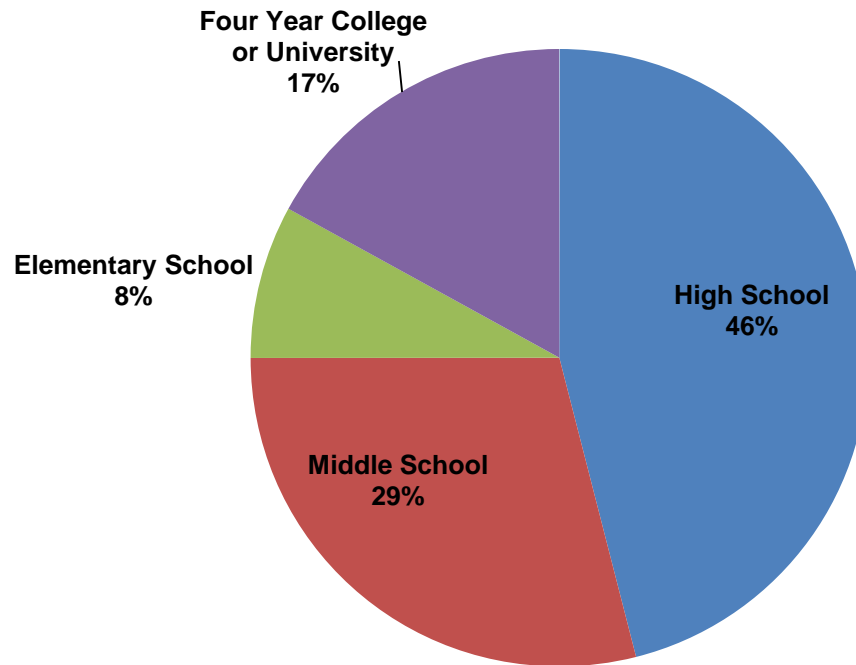- 51 completed the survey.

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Survey Demographics

- 51 Respondents

- 79% Women

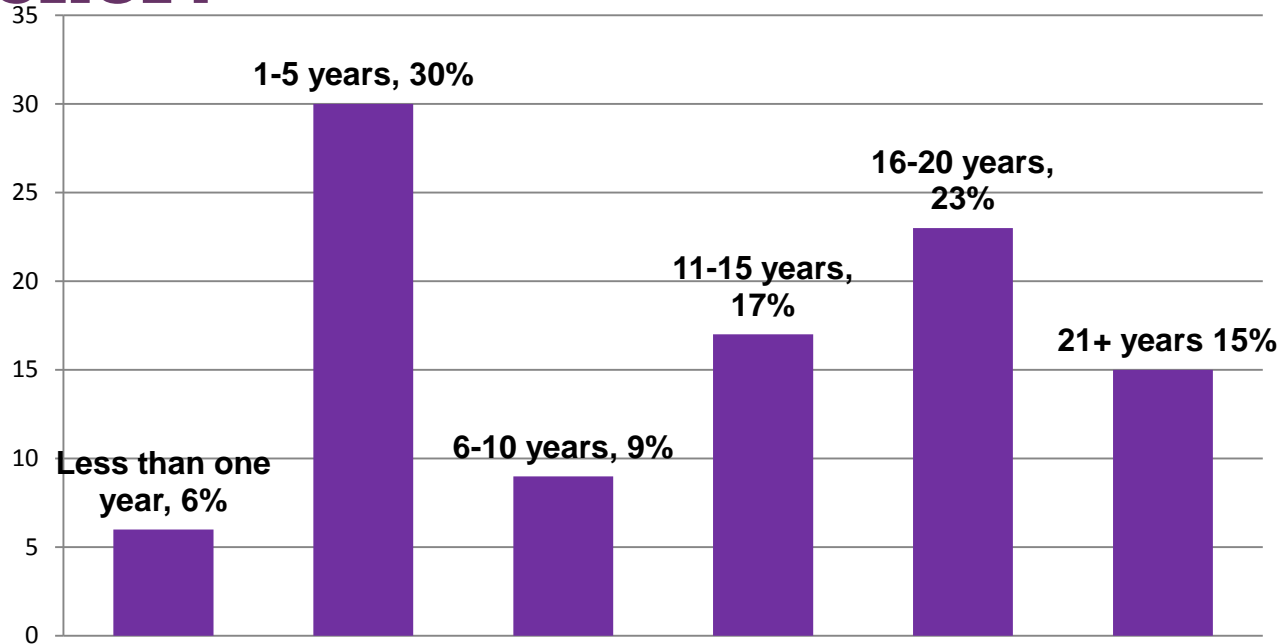- 52% taught in multiple areas

Educational Background
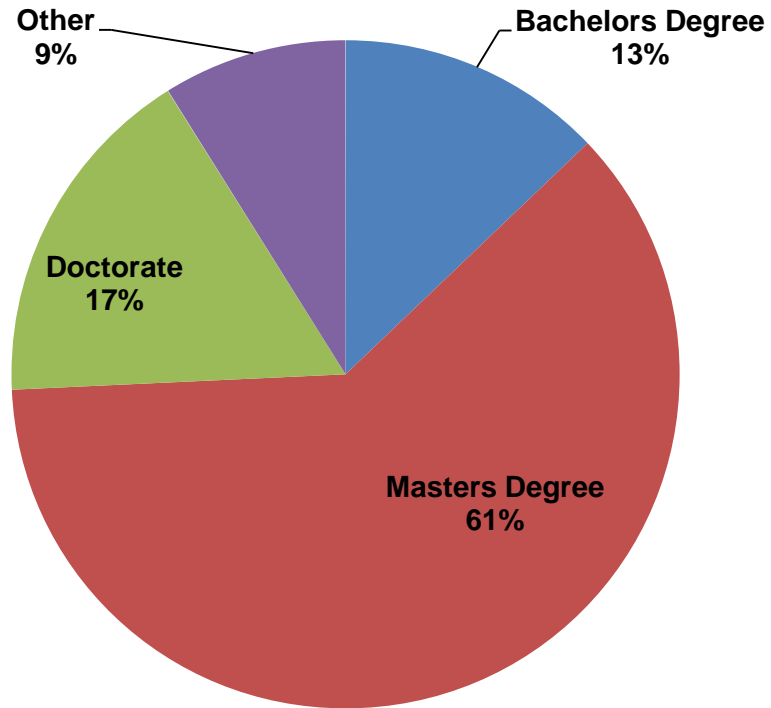
Participants' Institution

What is the total length of time you have spent as a full time STEM teacher?
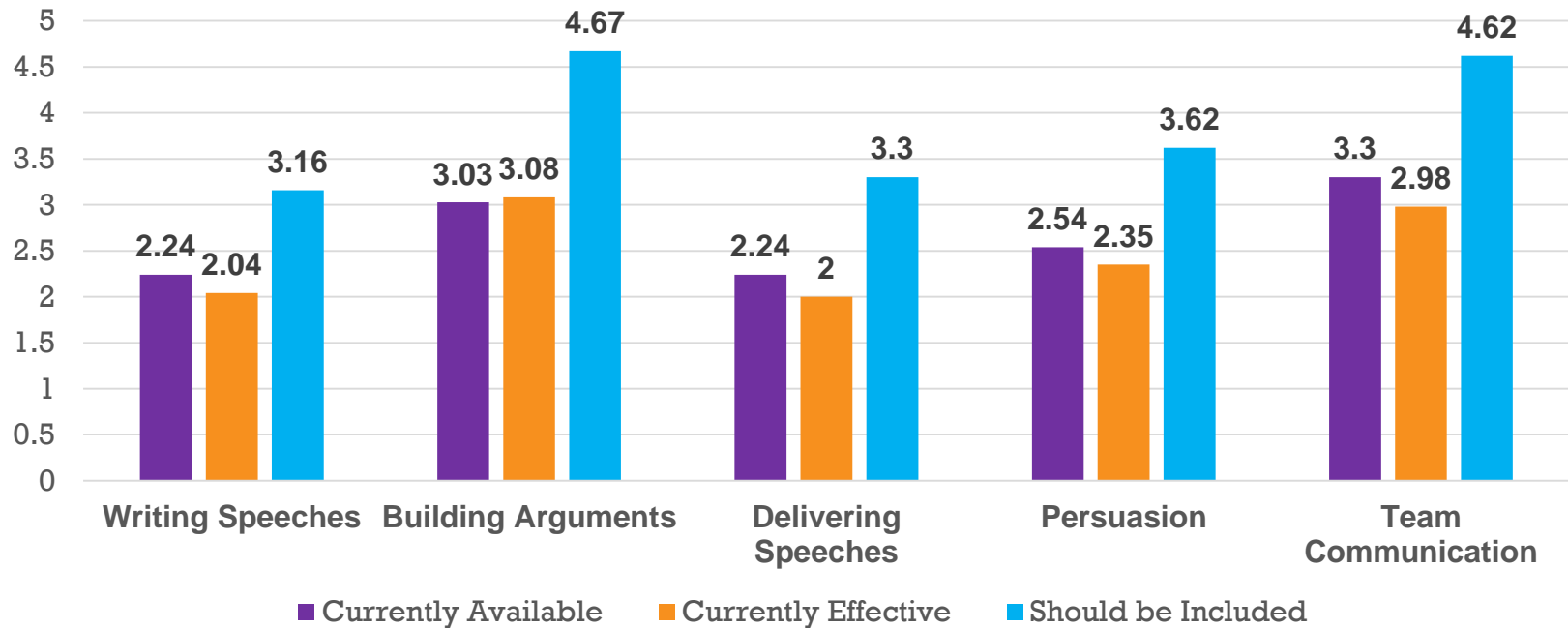
Disciplines Represented

- Biology = 12

- Science = 12

- Chemistry = 6

- Physics = 4

- Others represented included Environmental Science (3), Technology (3), Math (3), Physical Sciences (3), Earth Science (3), and Robotics (2)

- Single listings include Agricultural Science, Geology, Engineering, Science Camps, Science Education & Science Researcher
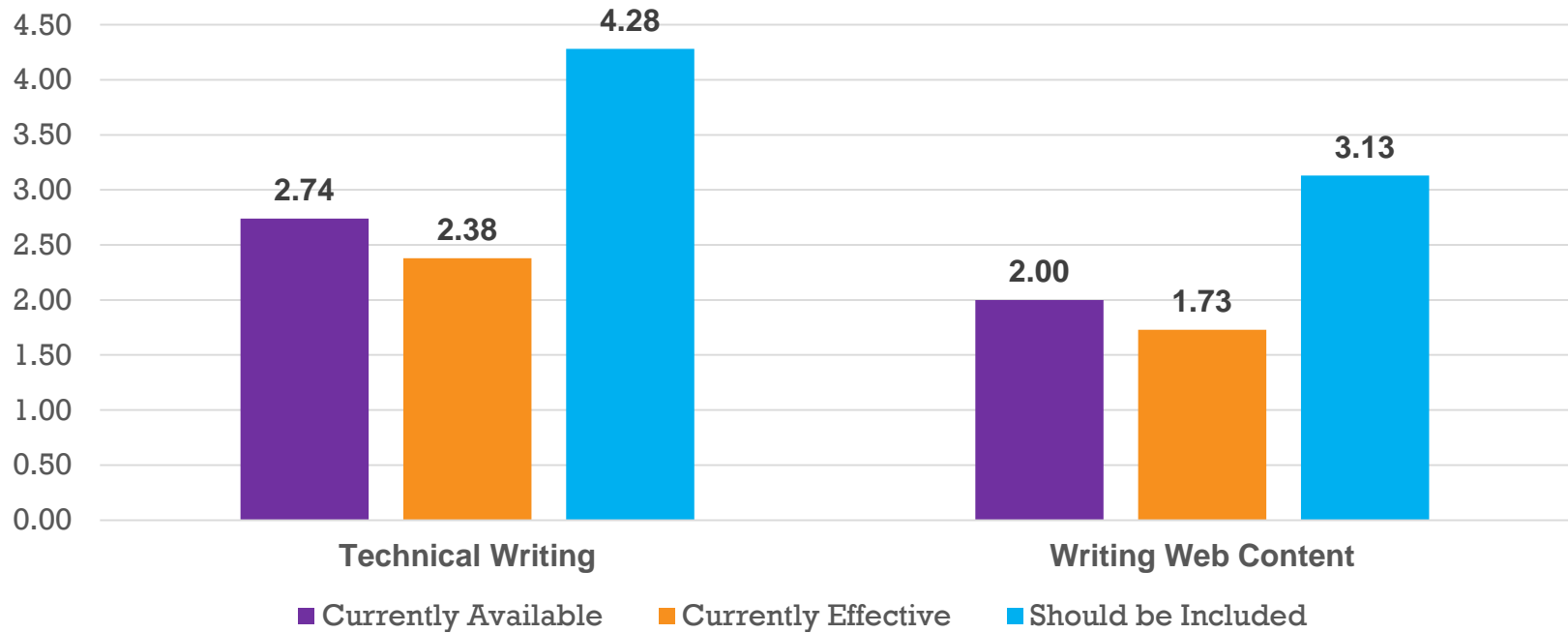
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Means for Communication Skills Items

Chart showing means for communication skills items across five categories with three measures each: Currently Available, Currently Effective, and Should be Included.

Category	Currently Available	Currently Effective	Should be Included
Writing Speeches	2.24	2.04	3.16
Building Arguments	3.03	3.08	4.67
Delivering Speeches	2.24	2	3.3
Persuasion	2.54	2.35	3.62
Team Communication	3.3	2.98	4.62

Means for Written Communication Skills

Bar chart titled with categories "Technical Writing" and "Writing Web Content".

Technical Writing:
- Currently Available: 2.74
- Currently Effective: 2.38
- Should be Included: 4.28

Writing Web Content:
- Currently Available: 2.00
- Currently Effective: 1.73
- Should be Included: 3.13

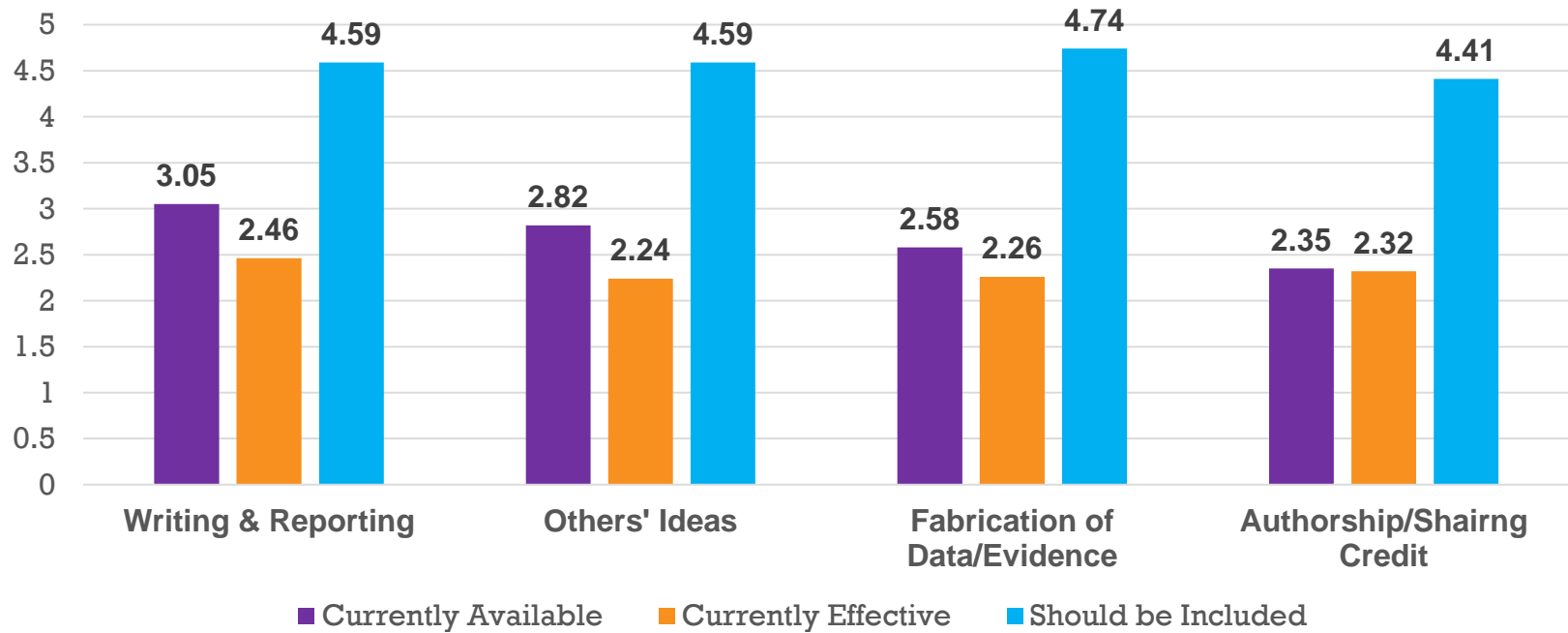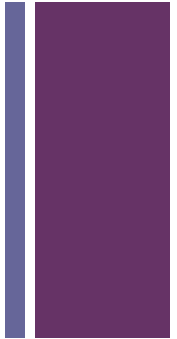Legend: ■ Currently Available ■ Currently Effective ■ Should be Included

Means for Visual Communication Items
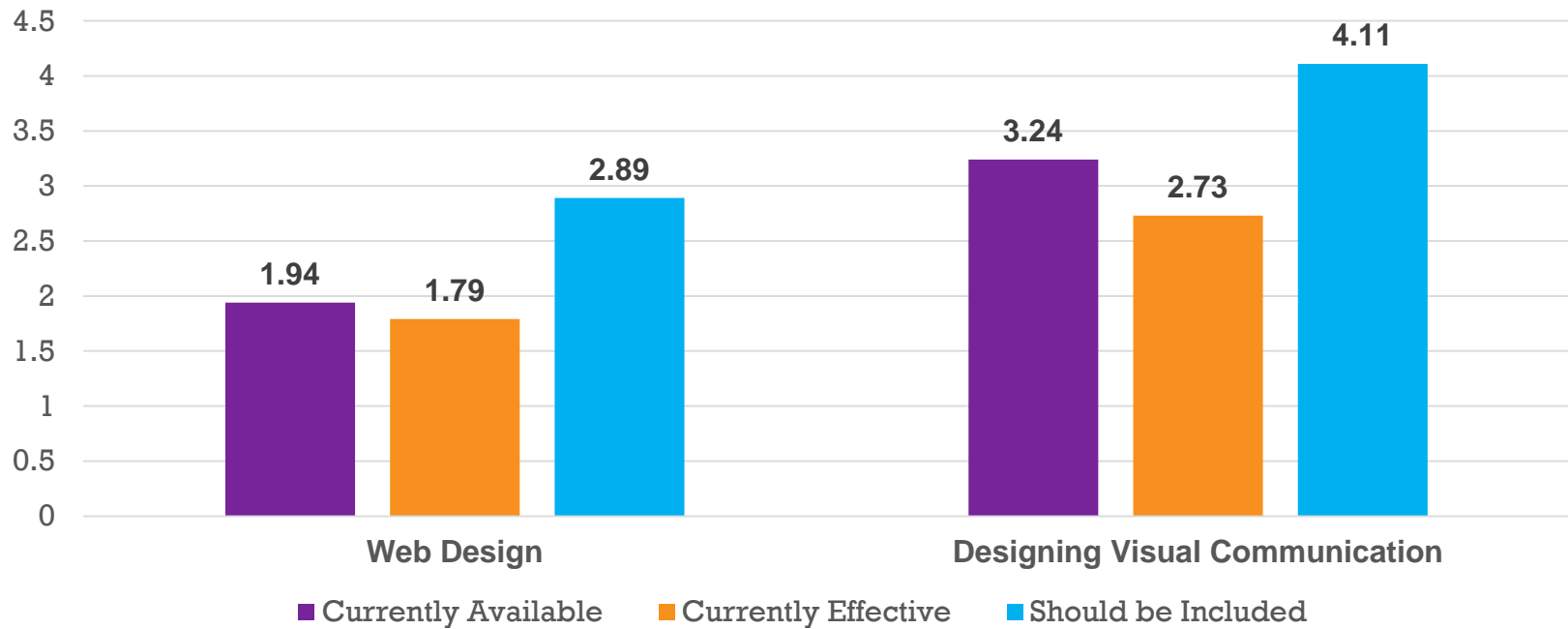
Means for Research Ethics: Plagiarism Items

|	Writing & Reporting	Others' Ideas	Fabrication of Data/Evidence	Authorship/Shairng Credit
Currently Available	3.05	2.82	2.58	2.35
Currently Effective	2.46	2.24	2.26	2.32
Should be Included	4.59	4.59	4.74	4.41

Means for Research Ethics & Skills Items
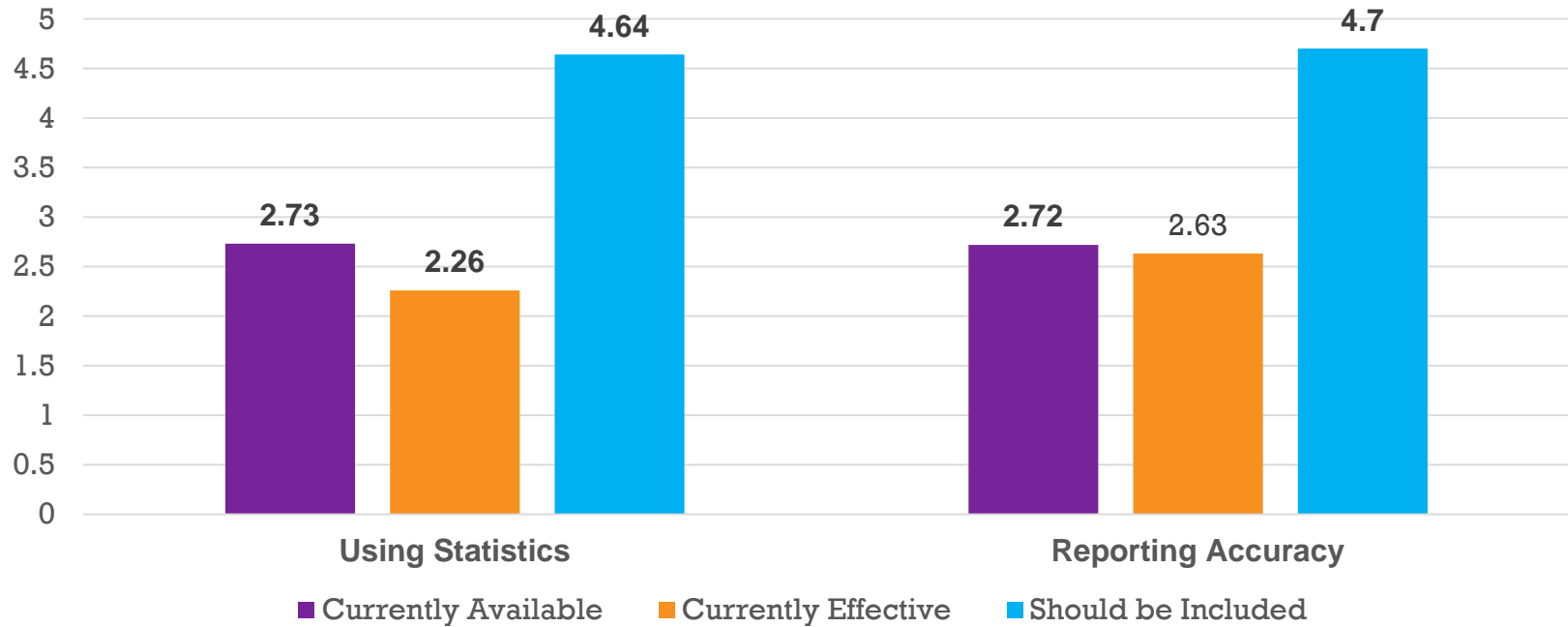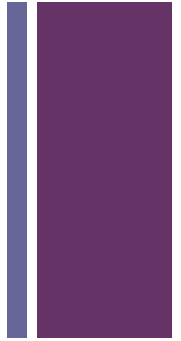
+ STEM Education Should Include Training in Effective Communication

5. STEM education should include training in effective communication.

Strongly disagree 4.2%
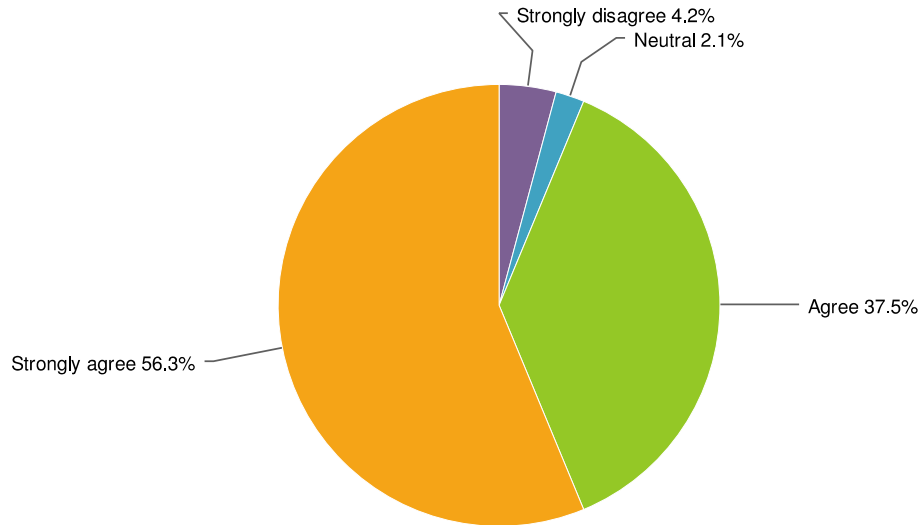
Agree 14.6%

Strongly agree 81.3%
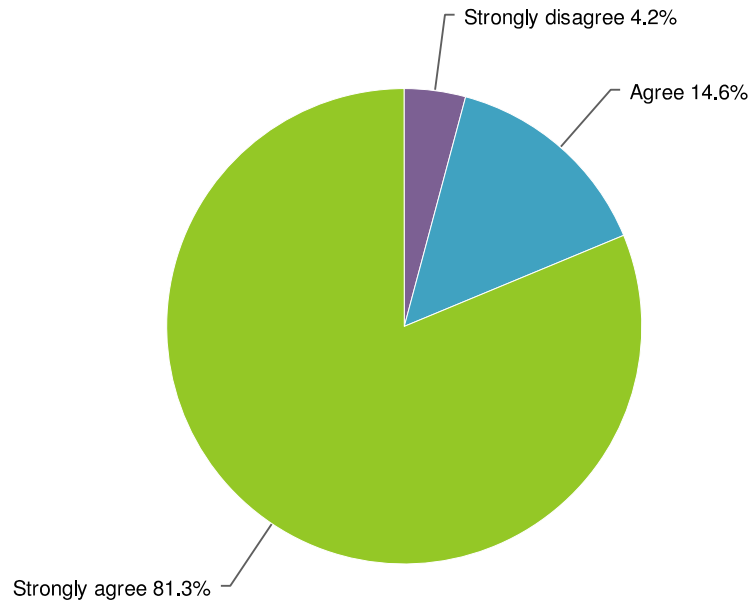
+ STEM Educators Should Include Communication Training In Their Curriculum

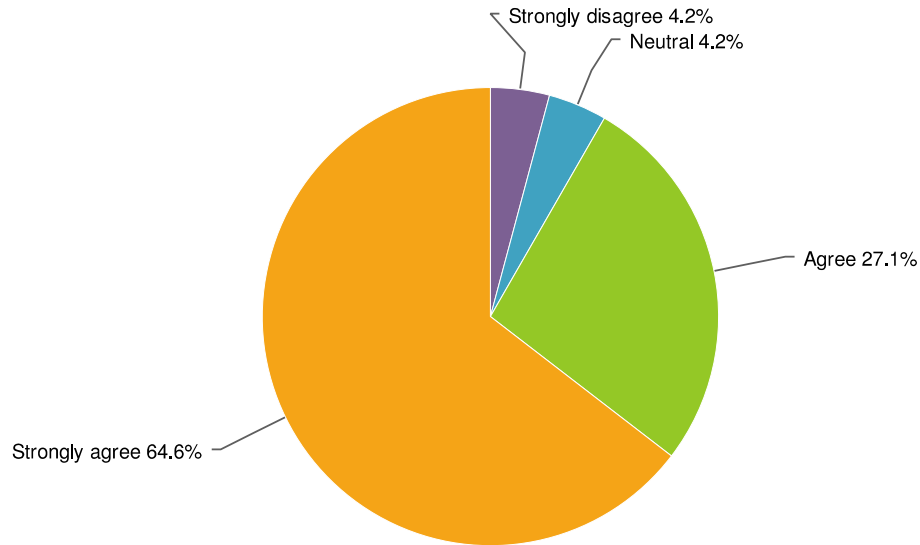7. STEM educators should add communication training to their current curriculum.

Strongly disagree 4.2%
Neutral 2.1%

Agree 37.5%

Strongly agree 56.3%

Teach Communication Education for STEM Across the Curriculum

6. It would be a good idea if communication education for STEM was taught across the curriculum.

- Strongly disagree 4.2%
- Neutral 4.2%
- Agree 27.1%
- Strongly agree 64.6%

+ STEM Education Should Include Ethics

4. STEM education should include training on ethics.

Strongly disagree 6.3%

Agree 18.8%

Strongly agree 75%
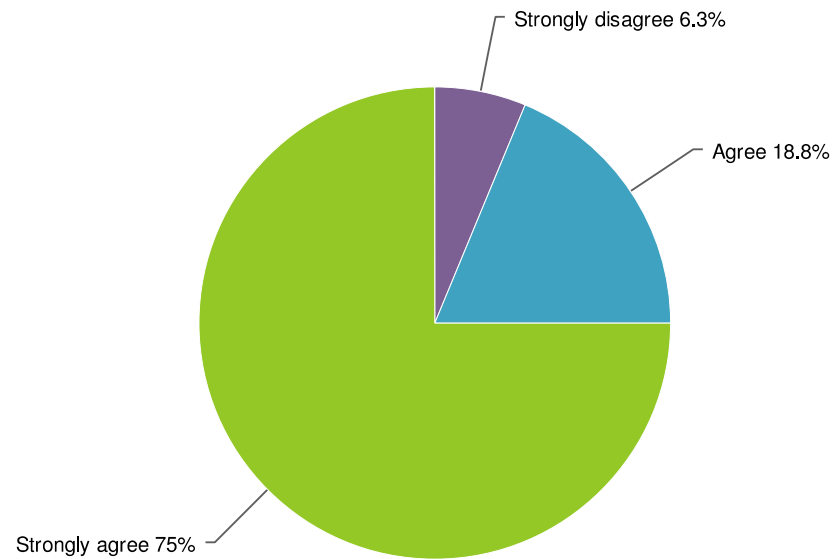
+ STEM Educators Should Add Ethics Training To Their Curriculum

8. STEM educators should add ethics training to their curriculum.

Strongly disagree 6.3%

Agree 35.4%

Strongly agree 58.3%
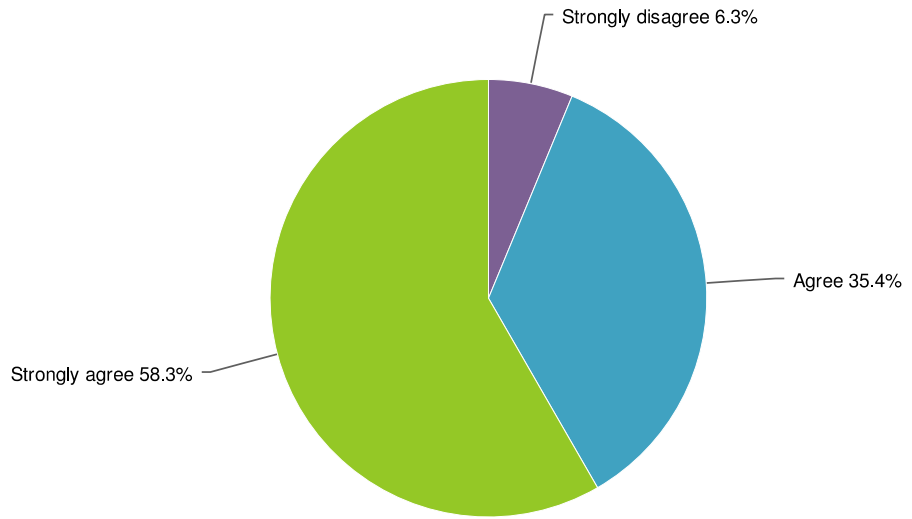
+ Supporting Comments from Survey:

- I have attended various STEM trainings that focus on the content but never on ethics and very little time spent on communicating STEM

- I believe that STEM is how scientists, engineers, and mathematicians work in the real world. Why not start teaching our students how to work in the real world now? Communication and ethics are things everyone uses so let's teach our students how to use them properly.

- Focus the communications on causing a scientifically literate community. Please do not just focus on "how to write technical papers." We scientists need to become experts at communicating sophisticated technical details in a manner that is accurate, yet understandable by the masses. Only then does ethics come in the picture - it is hard to focus on the ethics of a technology when the technology is not well understood.

+ Concerns and Objections from the Survey

- It will be difficult to get the information out to teachers.

- It is difficult to add much to an already overloaded curriculum, especially as science is not taught regularly in K-6.

- In regard to the ethics questions: Whose ethics? Who will establish the ethics? Its one thing to attempt to have a common set of ethics across a discipline at the post-K12 level but there is still way too much local control (for good or bad) at the local level of K12 education to mandate a one-size-fits-all set of ethics.

+ A Long Standing Issue, Past and Future

- A Whitney Brown