An Active Learning Approach to STEM Writing Intensive Courses

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Writing in STEM classes

Learning to Write
- High emphasis on genre norms
- Does not deliver content
- Emphasis on formal communications in genre
- Less reflective

Writing to Learn
- Writing as a vehicle for content delivery
- More frequent writing with reflective components
- Writing not as a formal method of communication
- Less emphasis on genre norms
shared literary conventions, similarities in topic, theme, style, tropes, and an overall predictable form
Importance of Genre Writing

• Genre is embedded in the discourse of a community

• Genre serves as a social marker / indicator of cultural capital
  • Becoming a member of a scientific discourse community in a critical event in a scientists career (Florence 2001)
  • Initiation into the epistemic conventions of a discipline (Kelly, Chen and Prothero, 2000)

• Interactive > presentational writing instruction (Hillocks 1986)
STEM Faculty don’t use interactive writing instruction

Instructional Elements

- Lecturing
- Example Papers
- Books/Writing guides
- Provide Rubric
- Revision
- Structured Activities
Elements of Interactive Writing Instruction

• Telling students the rules of the genre and expecting application is insufficient
  • Each new comer to a field must situate themselves within the community’s discourse (Bazermann 1992)

• Students must construct the genre themselves (Yore, Hand and Florence 2004)
  • Develop awareness of text qualities in different circumstances
  • Trial and error must be guided
  • Students play different roles
REALs Framework (Grabinger and Dunlop 1995)

• Promote study and investigation within authentic contexts
• Encourage the growth of student responsibility, initiative, decision making and intentional learning
• Cultivate collaboration among students and teachers
• Utilize dynamic, interdisciplinary, generative learning activities that promote higher order thinking
• Assess students progress using realistic tasks and performances
Design of the course

• 4 Credit lecture / lab course
• Lecture meets 3 times per week
  • Lecture days 1 & 2 – Content Delivery
  • Lecture day 3 – Writing Workshop
• Lab meets once per week
  • First half of semester is skills learning
  • Second half is an independent research project
• Student Generated Rubrics
  • Students given 3 exemplars for homework and asked to rank which was best and why.
  • Students discuss their finding with their groups
  • Groups generate their own rubrics to assign objective grades to papers.
    • Groups must assign weight to different elements within the writing and write clear criteria by which a reader could assign a grade to the paper
  • Each group shares their rubric
  • Rubrics are collectively joined into 1 class rubric
  • Instructor uses the rubric generated to grade the students work
Writing Workshop

• Authentic Experience
  • Students study grant writing in workshop
  • Student work in groups to generate a grant proposal for their lab project (many revisions in consultation with instructor)
  • Students conduct the research in lab, collect and analyze data
  • Students apply what they have learned about writing a research paper to write a manuscript of the research (individually)
Common Writing mistakes
(according to STEM faculty)

• **Introduction**
  • Anecdotal information
  • Unnecessary background
  • Oversimplification
  • Superficiality
  • Weak connection between background and hypothesis

• **Methods**
  • Including material that is inappropriate for the readership/excessive detail
  • Oversimplification
  • Lacking in detail
  • Errors in past tense

• **Results**
  • Oversimplification
  • Raw data
  • Same data in a different way
  • Trends not stated
  • Superficial writing/Only figures and tables/no writing

• **Discussion**
  • Subjectivity
  • Oversimplification
  • Superficiality
  • Over stating significance
  • Weak connection to literature
  • Doesn’t understand error

• **Technical errors**
  • Not Concise (run on sentences, redundant information etc)
  • Logical connections/flow
  • Quotes/citation errors
  • Poor language choices
  • Passive voice
  • Grammar
Data from student Manuscript

• Introduction
Data from student Manuscript

• Methods

![Bar chart showing frequency of common errors in student Manuscript, comparing traditional and active methods. The x-axis represents different errors: Including material..., Oversimplification, Lacking in detail, Errors in past tense. The y-axis represents frequency.]
Data from student Manuscript

• Results
Data from student Manuscript

- Discussion

![Bar chart showing frequency of common errors in traditional vs active learning. The x-axis represents different common errors such as subjectivity, oversimplification, superficiality, over stating significance, weak connection to literature, and doesn’t understand error. The y-axis represents frequency ranging from 0 to 1. Red bars represent traditional learning, and black bars represent active learning. The chart shows varying frequencies for each error type.]
Data from student Manuscript

• Technical

![Chart showing frequency of common errors in technical manuscripts. The x-axis represents different common errors: Not Concise (run on), Logical connections/flow, Quotes / citation errors, Poor language choices, Passive voice, and Grammar. The y-axis represents frequency, ranging from 0 to 1.2. The chart compares Traditional vs. Active styles.](chart.png)
Conclusions

• Gains in genre specific norms of writing
  • Introduction, methods and results show largest reduction in common errors
  • Modest reductions in discussion
  • Students still need more work in how to construct arguments with evidence

• Very minor reductions in technical aspects of writing
  • Most noticeable reductions were in technical aspects most closely associated with the genre
References


