

Lesson Plan: The past and future of the technical ceramics industry

Author: Jonathon Foreman M. Ed., MS Materials Science and Engineering

Overview

Each student uses the Bulletin Archive Online to research technical and business events for one specific portion of the ceramics industry over the past 100 years. These events are correlated to an important current event in the same era using the Archive or another source. Each student prepares a written report or visual timeline that connects the chosen events to present a narrative of how the ceramics industry has adopted and adjusted to the events over time. Finally, students make predictions for 5-10 years into the future using evidence from timeline and events occurring presently.

Skills

- Finding facts/information via database and internet searches
- Documenting evidence/bibliography
- Making connections using data from different sources and over time
- Drawing conclusions and making predictions using evidence

Target education range

- Undergraduate students in chemistry, physics, materials science or technology, or business
- Advanced high school students (ACT, College Plus, or IB programs)
- This lesson can be performed by individual students (suggested) or in small groups (up to 3).

Abstract

Few industries are monolithic. Most have areas of specialization by products or customers served. As one considers a future career, it is important to understand the wide range of options available within a field and to envision where each has potential to grow over time.

Examining an industry sector over time provides some insight into flexibility and responsiveness, two indicators of potential future performance. Industries that can adapt and reinvent are more likely to exist in the future. For example, many oil companies are investing in alternate energies.

The goal of this lesson is to predict future performance of a sector of the ceramics industry by examining significant technical and business changes/events over time and correlating them to contemporary events in the global society.

Materials/equipment required

- Internet access
- Access to the ACerS Bulletin Archive Online
- Optional: art supplies for visual timeline and/or computer projector for presentations

Expected time required: 4-5 hours outside of class room for research. 20 minutes class time to explain the project and, optionally, 1-2 class periods for presentations.

The Big Questions

1. In what ways has a specific segment of the ceramics industry adopted to societal needs over time?
2. What do you envision as the future for that segment?

Instructions

Explain goals, reasons and abstract to class. Provide interim and final due dates along with formats for deliverables (notes/bibliographies, formal paper, poster/timeline, presentation, etc.)

Provide specific action instructions to students – written on board and/or as electronic/paper handout

Instructions to students

1) Each student/group picks a major industrial customer/client of the ceramics industry. Alternately student/group can choose a specific class of ceramics, which may be easier to work with.

Examples of industries using ceramics

- Bricks, concrete, and other ceramic structural materials
- Glass for windows and walls
- Coatings or tiles for protection or decoration
- Lighting and optics
- Production of chemicals or metals (e.g. steel, petrochemicals, fertilizers, ethanol)
- Parts for machinery, heavy equipment, and transportation
- Supplying other large ceramics customers (e.g. powders to make parts)
- Appliances
- Electronics
- Sanitary ware (sinks, tubs and toilets)
- Dinnerware (plates, cups, glasses, utensils)
- Electricity generation and transmission
- Reducing pollution
- Medical or other precision tools and implements
- Dentistry, bone and tissue repair, and prosthetic devices

Examples of specific materials

- Alumina (aluminum oxide)
- Zirconia (zirconium oxide)
- Ferrites
- Titanates
- Spinels
- Carbides, borides and/or nitrides
- Chalcogenides
- Mullite
- Minerals and raw materials
- Porcelain
- Enamels

2) Provide background on the chosen industry or material. For industries describe specific uses for ceramics and/or types of ceramics used. For materials, list typical uses of the material.

3) Student/group finds and documents evidence from articles, advertising, surveys, editorials, etc. within the ACerS Bulletin Archive online of technology and business events over time. The suggested guidelines for this lesson:

- Choose between 5 and 10 technology-related issues affecting the ceramic/industry chosen preferably over the past 50-100 years. Use words/terms from step 2 to help with this search.
 - Examples: raw materials supply, new processes, new material found, new functionality of ceramic material or product
 - Must be an implemented technology and not a breakthrough that was never turned into a manufacturing process or product
- Choose 5-10 items of business information or market changes around the same times as the technology issues
 - Examples: market surveys, New CEOs who made significant changes to industry leading company, sector growth, industries closing or consolidating
 - Also new customer industries (e.g. jet age, personal computers), but identify specific needs in the new industry that ceramics addressed.
- Archive search hint: use the + sign to make sure the term is present in the search result
 - Example: +alumina +technology means alumina and technology must be on the page

4) Student/group finds and documents significant events in society within the same eras, using the Archive or other sources and also for significant present-day events/trends.

- Examples include war, treaties, economic booms and busts, etc.
- There can be some overlap with the business info of the previous section, but the events should be society focused.
 - Example: rise of passenger air travel overlapping jet age and need for high temperature components.

5) Student/group creates a narrative that connects the events within the eras and the along the timeline of the eras. Narrative should include analysis of the sequence of events to judge adaptability (flexibility, responsiveness) within the chosen industry/segments. Finally, the narrative should include a prediction of the state of the industry/segment in the next 5-10 years based upon the evidence, analysis and present-day events (i.e. how might the industry/segment respond?).

Evaluation

Suggested questions for evaluation

1. Does the quantity and quality of the evidence meet, exceed or fall short of defined expectations?
2. How well documented is each piece of evidence?
3. How focused is the evidence? Is there a plausible narrative linking the level of focus and the outcome?
4. How well does the analysis and predictions follow the evidence? Are items left out? Are assumptions made? Are the assumptions explicitly stated? Are they reasonable?
5. Is the project deliverable in an acceptable, exceptional or deficient format or manner?

Additional comments

During testing of the lesson I found it a bit challenging to get started. There is so much information that choosing a singular direction was difficult. Even after choosing a topic, I found that interesting data took me on another tangent.

From this experience I suggest the professor/teacher provide additional guidance. The following are ideas to consider. While they are not mutually exclusive, they should be considered as separate pathways for guiding the students on this assignment.

- 1) Perform an example study in class. Demonstrate how to
 - a. search for the information,
 - b. choose appropriate information, and
 - c. document where that information was found.
- 2) Narrow the parameters of the assignment. Such as
 - a. Provide fewer options for the students to choose from.
 - b. Narrow the time window or choose specific eras (possibly a specific era for each topic).
 - c. Focus on fewer parameters - technology or market data or even specific aspects of technology (e.g. measurement techniques or processing techniques or new applications)
- 3) Encourage students to follow the information that interests them. If they find an interesting tangent, let them pursue that tangent and help them redefine the topic of their report to match their research.
 - a. This option will likely increase the time required for the assignment
 - b. Professors may want to consider asking students to prepare a metacognition narrative on the processes they used to complete this assignment