Evaluating Teachers’ Perceptions of Students’ Questions Organization

Fatima Harrak\textsuperscript{1}, François Bouchet\textsuperscript{1}, Vanda Luengo\textsuperscript{1} and Pierre Gillois\textsuperscript{2}

\textsuperscript{1}Sorbonne Université, LIP6, Paris, France
\textsuperscript{2}Université Grenoble Alpes, Grenoble, France

@fbouchet @VandaLuengo
fatima.harrak@lip6.fr

LAK 2020 - Frankfurt

https://huit.re/harrak-LAK2020
Introduction: learners’ questions are crucial

Learners’ questions

Improve their level

Help teachers to understand students’ needs

Evaluating Teachers’ Perceptions of Students’ Questions Organization
Prioritizing questions: a tricky task when online

Questions

- How do you explain the change between the different elements?
- How do we explain the relationship between the electrons and protons in an atom?
- How can we represent the periodic table of elements?
- How do you explain the difference between the noble gases and the alkali metals?

Priority questions?

Students’ needs?

Support struggling students
Our goal is to provide teachers with additional information (types of questions and learners’ profiles) to help them choose questions (Harrak et al., 2019, 2020). Which type of question organization best fits the needs of teachers to prepare their Q&A session in a blended learning context?
Overview

- Introduction

- Related work
  - Pedagogical Context
  - Alternative organizations
  - Survey Analysis & results
  - Conclusion and perspectives
Role of students’ questions has been proved in many studies to improve understanding of students’ needs [Chin et al. 2008]

Contexts studying students’ questions [McNamara et al. 2017]:
- Provide answers to students (e.g. AutoTutor [Graesser, 2017], iSTART [McNamara, 2014])
- Examine how questions relates to a reference text (e.g. ReaderBench [Dascalu et al. 2014])

Students’ profiles vs. questions nature (students’ needs)
- Students’ profiles can help in better time allocation [Essa & Ayad, 2012; Lonn & Teasley, 2014]
- Better understanding students’ needs can increase their performance [Kiemer et al. 2015; Sierens et al. 2009]

Increasing the visibility of students’ pedagogical needs and students’ profiles
Overview

- Introduction
- Related work
  - Pedagogical Context
    - Alternative organizations
    - Survey Analysis & results
    - Conclusion and perspectives
Pedagogical context

Specific hybrid training system from Grenoble University

- 1600 students in the 1st year
- 200 students in the 2nd year
Pedagogical context

Specific hybrid training system from Grenoble University

1\textsuperscript{st} week

2\textsuperscript{nd} week

3\textsuperscript{rd} week

4\textsuperscript{th} week
Overview

- Introduction
- Related work
- Pedagogical Context

Alternative organizations

- Survey Analysis & results
- Conclusion and perspectives
Categorization of questions

Example (translated from French):

“Could you detail the differences between the atomic radius of the anion and the cation of two atoms?”

represented by the vector [Dee,0,Pin,0]

Questions’ coding scheme have been defined to analyze students’ questions in terms of intentions

Questions’ coding scheme have been defined to analyze students’ questions in terms of intentions

<table>
<thead>
<tr>
<th>Dim1</th>
<th>Question type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ree</td>
<td>Re-explain/ redefine</td>
</tr>
<tr>
<td>Dee</td>
<td>Deepen a concept</td>
</tr>
<tr>
<td>Ver</td>
<td>Validation/ verification</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dim2</th>
<th>Explanation modality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exa</td>
<td>Example</td>
</tr>
<tr>
<td>Sch</td>
<td>Schema</td>
</tr>
<tr>
<td>Cor</td>
<td>Correction</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dim3</th>
<th>Explanation type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Def</td>
<td>Define</td>
</tr>
<tr>
<td>Man</td>
<td>Manner (how?)</td>
</tr>
<tr>
<td>Rea</td>
<td>Reason (why?)</td>
</tr>
<tr>
<td>Rol</td>
<td>Roles (utility?)</td>
</tr>
<tr>
<td>Lin</td>
<td>Link between concepts</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dim4</th>
<th>Verification type (optional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mis</td>
<td>Mistake/ contradiction</td>
</tr>
<tr>
<td>Kno</td>
<td>Knowledge in course</td>
</tr>
<tr>
<td>Exp</td>
<td>Expected knowledge in exam</td>
</tr>
</tbody>
</table>

[ Harrak et al., LAK 2018]
Towards prediction of students’ profiles (based on their questions)

1. Constant clusters across several years
2. Similar students’ profiles on year N+1 with students who asked similar questions on year N

[Harrak et al., JLA 19]
Questions’ organization

Goal: Help teachers to choose students’ questions in Q&A session (with additional information than vote) and feed their reflection

3 organizations proposed to the teacher:

- Organization based on students’ pedagogical needs
- Organization based on the predicted students’ profiles
- Mixed organization (combining the two)
Questions’ organization: students’ needs

Re-explanation questions
- Ask for an explanation already done in the course material
  Questions:
  1. Could you re-explain how to find the dipole moment of a molecule?
  2. Could you revise the notion of buffer solutions, particularly on how to create a buffer solution?

Deepen questions
- Broaden a knowledge, clarify an ambiguity or request for a better understanding
  Questions:
  3. How can we compare two atoms that are neither in the same row nor in the same column?
  4. Could you explain what distinguishes the atom from the chemical element?

Verification questions
- Verify or validate a formulated hypothesis

Mistake/ contradiction
Questions:
  5. It seems there is a mistake in the speech on slide 5: you say that “the Na+ and NaCl (Cl-?) Ions
  6. Hello, in the example on electrophoresis you say that the a are negatively charged with ph=1, whereas
their ph < phi it should not be positive as presented on the example of mixture separation?

Knowledge in course
Questions:
  7. Are all transition metals reductive?

Exam
Questions:
  8. Should we learn the metals of block P by heart?

Other questions
Questions’ organization: students’ profiles

<table>
<thead>
<tr>
<th>Cluster A</th>
<th>Cluster D</th>
<th>Cluster B</th>
</tr>
</thead>
<tbody>
<tr>
<td>#students</td>
<td>18-29%</td>
<td>14-25%</td>
</tr>
<tr>
<td>Grades</td>
<td>lower</td>
<td>higher</td>
</tr>
<tr>
<td>Attendance</td>
<td>low</td>
<td>high</td>
</tr>
<tr>
<td>#questions asked</td>
<td>low</td>
<td>high</td>
</tr>
<tr>
<td>#votes</td>
<td>popular</td>
<td>unpopular</td>
</tr>
<tr>
<td>% Retaking students</td>
<td>low</td>
<td>high (42%)</td>
</tr>
</tbody>
</table>

**Struggling students: grades < to the average**

**Questions:**
1. Could you rewrite the notion of buffer solutions, particularly how to create a buffer solution?
2. Are all transition metals reductive?

**Average students**

**Questions:**
1. Could you re-explain how to find the dipole moment of a molecule?
2. How can we compare two atoms that are neither in the same row nor in the same column?
3. It seems there is an mistake in the speech on slide S: you say that ”the Na+ and NaCl (Cl-) ions
4. Should we learn the metals of block P by heart?
5. Struggling students: grades > to the average

**Questions:**
4. Could you explain what distinguishes the atom from the chemical element?
5. Hello, in the example ... it should not be positive as presented on the example of mixture separation?
Questions’ organization: mixed

<table>
<thead>
<tr>
<th>N</th>
<th>Re-explain questions</th>
<th>Struggling</th>
<th>Average</th>
<th>Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Could you re-explain how to find the dipole moment of a molecule?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Could you revise the notion of buffer solutions, particularly on how ...?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>Deepen questions</td>
<td>Struggling</td>
<td>Average</td>
<td>Good</td>
</tr>
<tr>
<td>3.</td>
<td>How can we compare two atoms that are neither in the same row ...?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Could you explain what distinguishes the atom from the chemical element?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>Verification questions</td>
<td>Struggling</td>
<td>Average</td>
<td>Good</td>
</tr>
<tr>
<td>5.</td>
<td><strong>Mistake/ contradiction</strong></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>It seems there is an mistake in the speech on slide 5: you say that ...</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Hello, in the example on electrophoresis you say that the aa ... ?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td><strong>Knowledge in course</strong></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>are all transition metals reductive?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Exam</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Should we learn the metals of block P by heart?</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Overview

- Introduction
- Related work
- Pedagogical Context
- Alternative organizations

- Survey Analysis & results

- Conclusion and perspectives
Survey analysis

Survey made of 28 questions, answered by N=36 teachers involved (different ages and experience), to evaluate:

Teachers’ experience in Q&A

Flipped classroom appreciation
Analysis of organizations’ choices

Perception of proposed organizations

<table>
<thead>
<tr>
<th>Students’ needs organization</th>
<th>Students’ profiles organization</th>
<th>Mixed organization</th>
<th>Current organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>3</td>
<td>11</td>
<td>11</td>
</tr>
</tbody>
</table>

"... this system will only work if used correctly by students"

"I am not for favoring the good over the struggling ones (this is a risk), our goal is to help them all"

"a bad method added to a good one"
Analysis of organizations’ choices

Perception of proposed organizations

<table>
<thead>
<tr>
<th>Students’ needs organization</th>
<th>Students’ profiles organization</th>
<th>Mixed organization</th>
<th>Current organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>3</td>
<td>11</td>
<td>11</td>
</tr>
</tbody>
</table>

No consensus over a particular organization

Are the differences in teachers’ organizations choices related to their different Q&A session experience or their perception of the flipped classroom?
Preferred organization according to the teachers' background

Clustering (K-Means) teachers, the features:
- Experience in Q&A session
- Flipped classroom (saving time, facility, organization)

<table>
<thead>
<tr>
<th></th>
<th>Cluster 1</th>
<th>Cluster 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>#teachers</td>
<td>22</td>
<td>14</td>
</tr>
<tr>
<td>Seniority</td>
<td>less</td>
<td>more</td>
</tr>
<tr>
<td>Received questions</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>Addressed questions</td>
<td>average</td>
<td>high</td>
</tr>
<tr>
<td>Flipped classroom</td>
<td>less</td>
<td>More</td>
</tr>
<tr>
<td></td>
<td>appreciated</td>
<td>appreciated</td>
</tr>
</tbody>
</table>

Characterization of clusters

Variables related to the organizations’ choices for each teacher:
- Facility
- Utility
- Appreciation according to the current organization

Results did not reveal any clear differences in the choices made by the teachers of the two clusters
Overview

- Introduction
- Related work
- Pedagogical Context
- Alternative organizations
- Survey Analysis & results

☑ Conclusion and perspectives
Conclusion

3 questions’ organizations proposed to teachers:
- Pedagogical needs (nature of questions), students’ profiles (students’ level) and mixed
- No preferred organization choices

Some limits:
- Misinterpretation some of the questions asked and the principle of the proposed organizations
- Difficulty for choosing a relevant questions’ organization (other factors beyond the Q&A experience)
Conclusion

3 questions’ organizations proposed to teachers:
  • Pedagogical needs (nature of questions), students’ profiles (students’ level) and mixed
  • No preferred organization choices

Perspectives:
  • Towards personalized dashboards instead of “one size fits all”
  • Source of inspiration about how to deal with students’ questions

@fbouchet @VandaLuengo fatima.harrak@lip6.fr