

# Evaluating Teachers' Perceptions of Students' Questions Organization

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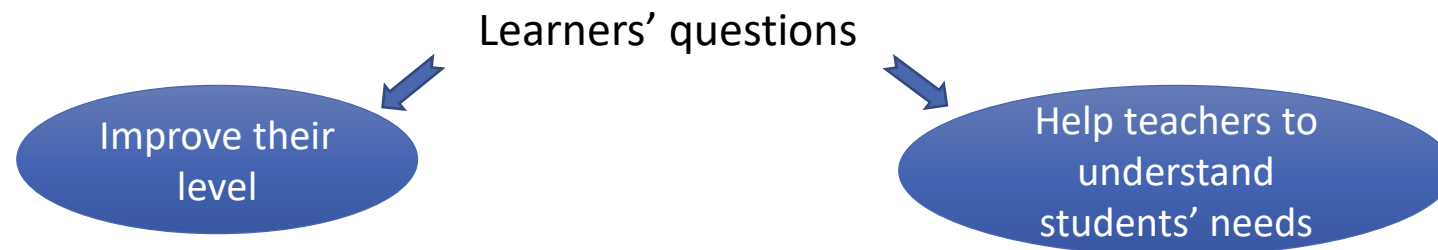
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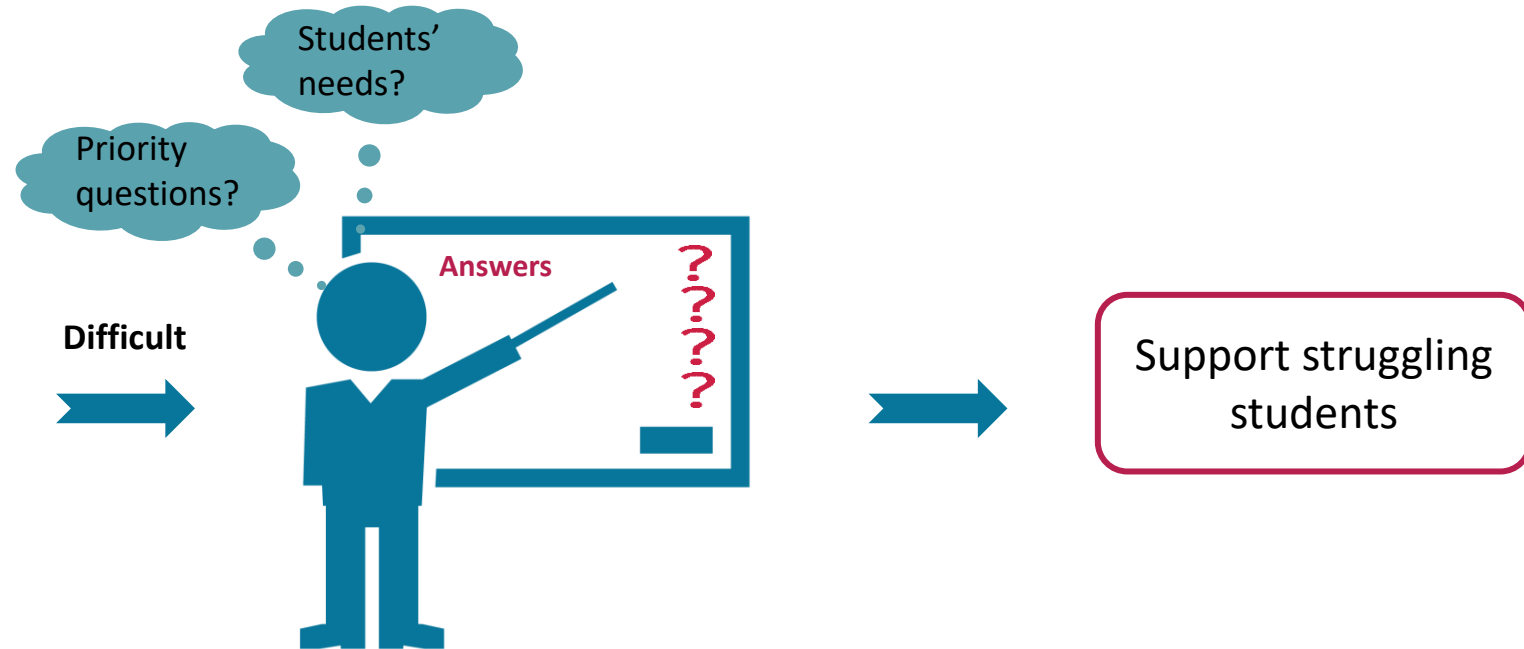
# Introduction: learners' questions are crucial



# Prioritizing questions: a tricky task when online

## Questions

- 1 Pouvez-vous expliquer ce qui distingue l'atome de l'élément chimique ?
- 1 Pouvez-vous préciser à quoi correspondent les  $Q_A$  et la courbe d'isodensité ? Le ray
- 1 Pouvez-vous donner la représentation de Lewis du scandium 21Sc ?
- 1 Pourrait-on revenir sur la notion d'effet d'écran  $sp$ . Dans la formule  $Z^2 - \sigma$  sigma connaît-t
- 1 Pour une représentation de Lewis : y a-t'il des conventions concernant la place des élec
- 1 Je n'ai pas compris la définition de l'affinité électronique. Pourriez vous expliquer en quoi
- 1 Pour le bloc P, quelques éléments sont des métaux et d'autres non. Lors d'une question
- 1 On a vu que le rayon atomique par exemple augmentait de la droite vers la gauche, et
- 1 Je ne comprend pas à quoi sert le nombre d'oxydation, pourriez vous l'expliquer ?
- 1 Pourrait on ré-expliquer la deuxième méthode pour former la représentation de Lewis ?
- 1 Pourrait-on ré-expliquer comment trouver le moment dipolaire d'une molécule ?
- 1 Est-il possible de prévoir d'après la classification périodique quels composés sont déficit
- 1 Peut-on revenir sur l'influence sur les températures de changement d'état pour les intera
- 1 Pouvez-vous expliquer en quoi interviennent les liaisons Hydrogènes pour la mise en s
- 1 Dans la diapo 29 vous dites que  $K_0 = Ka1 / Ka2 = 10$  puissance (  $pKa2 - pKa1$  ) Dans la
- 1 Question 3 : pourquoi les mélanges de x mol de AH avec x/2 mol de HO- (ou x mol de
- 1 Je n'ai pas compris le concept de l'électrode théorique, pourriez vous le ré-expliquer ?
- 1 Dans la formule de Nernst, pourquoi lorsque l'on remplace RT/F par 0,06, on remplace l
- 1 Pouvez vous réexpliquez la première méthode de l'obtention des demi-équations redox, n
- 2 Pouvez-vous ré-expliquer cette diapositive, avec les théorie de Planck et d'Einstein, ains
- 2 pourriez-vous bien détailler les différences entre couches et sous-couches, et l'organisa
- 2 Pour l'atome d'H, dans le modèle de Schrödinger, nous avons fait un diagramme énergét
- 2 On a une formule pour quantifier l'énergie de H. Quant aux atomes polyélectroniques, E
- 2 Pourquoi ne met-on pas de lacune électronique sur la représentation du  $Na^+$  ?
- 2 à quelle famille appartient les éléments des colonnes 13,14,15,16 du bloc P? (non n
- 2 Qu'est-ce qu'un corps simple? une molécule diatomique=2corps simples réunis?
- 2 est-ce que tous les métaux de transition sont réducteurs? (ceux le plus à droite ont plu
- 2 comment connaît-on les charges partielles des atomes dans les molécules? de plus, ch
- 2 le rayon ionique va-t-il dans le même sens que la rayon atomique? (de droite à G et de l
- 2 (6) pourriez vous détailler le calcul des charges formelles pour  $NO_3^-$ ? Comment procède
- 2 De manière générale, comment savoir si un élément est un métal ?
- 2 Moment dipolaire: y a t il un sens à respecter pour les moments dipolaires de chaque li
- 2 pourriez-vous expliquer plus en détail la différence entre charge partielle et charge form
- 2 Peut-on trouver si une molécule est polaire ou non autrement qu'avec la géométrie de la



# Introduction: goal and research question

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

# Related work

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 [Kierner et al. 2015; Sierens et al. 2009]

Increasing the visibility of students' pedagogical needs and students' profiles

# Overview

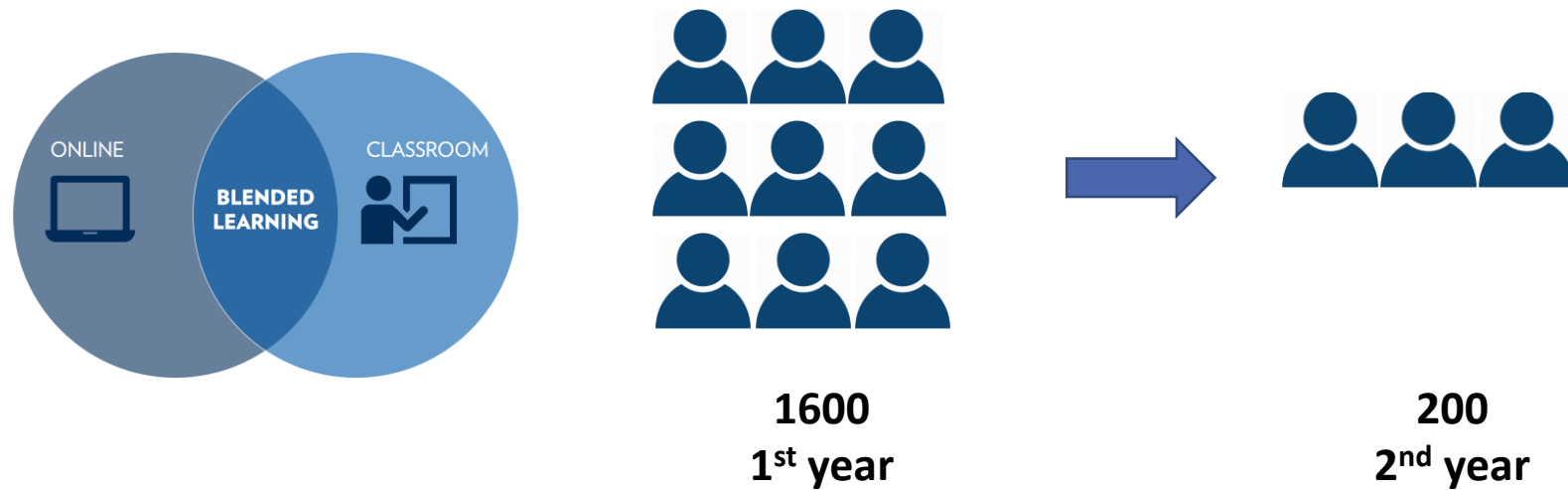
- Introduction
- Related work

## □ **Pedagogical Context**

- Alternative organizations
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# Pedagogical context

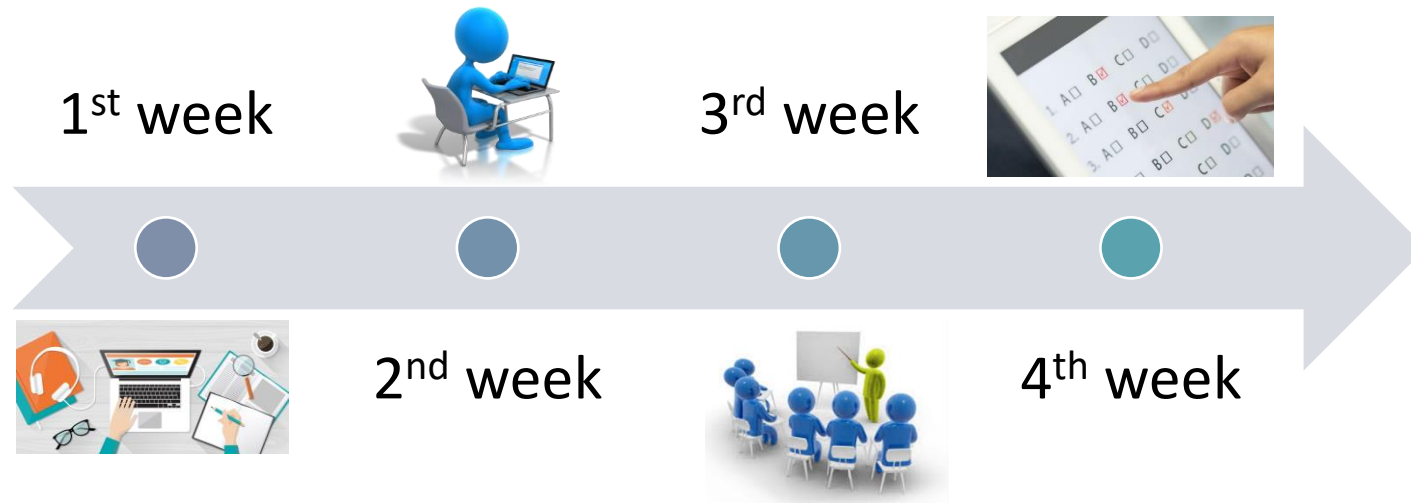
Specific hybrid training system from Grenoble University





# Pedagogical context

Specific hybrid training system from Grenoble University



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# 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?”

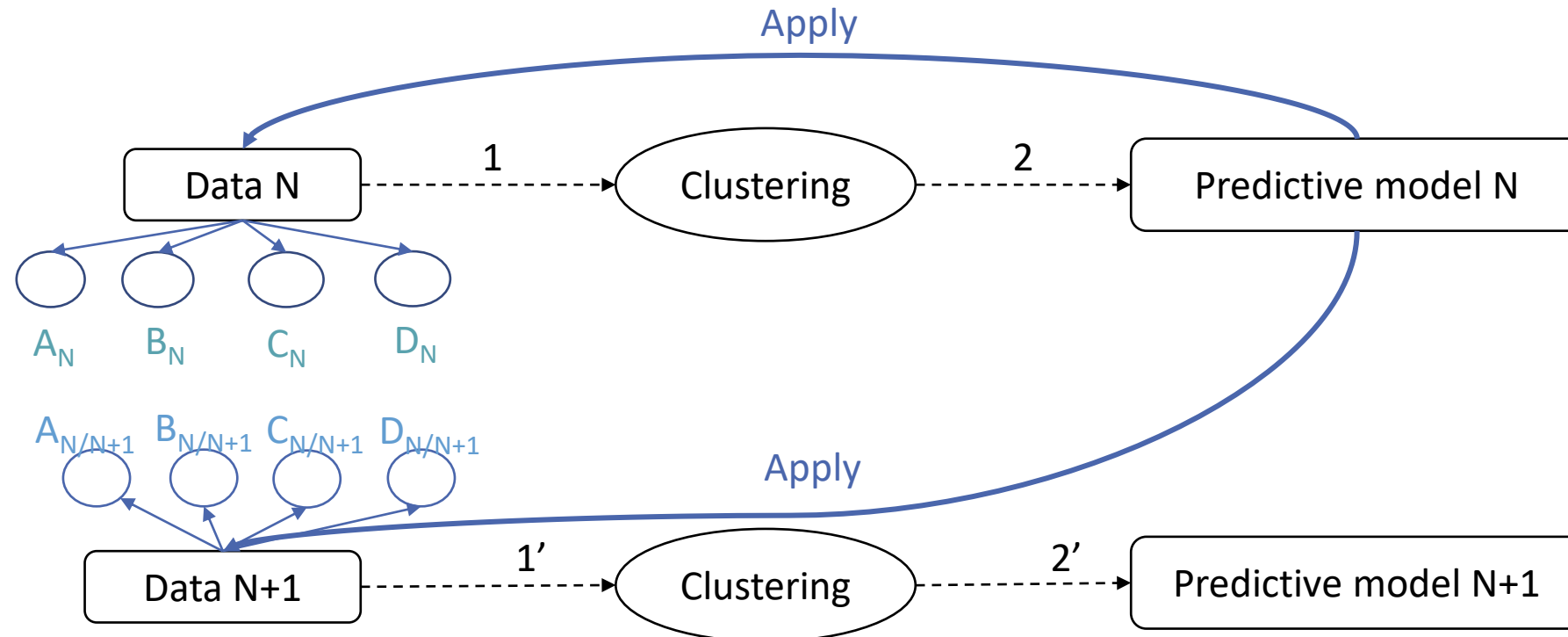
represented by the vector [**Dee**,0,**Lin**,0]

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

Dim1	Question type
Ree	Re-explain/ redefine
<b>Dee</b>	Deepen a concept
Ver	Validation/ verification
Dim2	Explanation modality
Exa	Example
Sch	Schema
Cor	Correction
Dim3	Explanation type
Def	Define
Man	Manner (how?)
Rea	Reason (why?)
Rol	Roles (utility?)
<b>Lin</b>	Link between concepts
Dim4	Verification type (optional)
Mis	Mistake/ contradiction
Kno	Knowledge in course
Exp	Expected knowledge in exam

[Harrak et al., LAK 2018]

# Towards prediction of students' profiles (based on their questions)



[Harrak et al., JLA 19]

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

# 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

Dim1	Question type
<b>Ree</b>	Re-explain/ redefine
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## 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 an **mistake** in the speech on slide 5: you say that "the Na<sup>+</sup> and NaCl (Cl<sup>-</sup>) ions
6. Hello, in the example on electrophoresis you say that the aa 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

Struggling passive	Nitpicking active	Actively understanding
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	Cluster A	Cluster D	Cluster B
#students	18-29%	14-25%	36-40%
Grades	lower	higher	higher
Attendance	low	high	high
#questions asked	low	high	high
#votes	popular	unpopular	popular
% Retaking students	low	high (42%)	average (31%)
Questions type	Re-explanation & definition	Verification: mistake or contradiction	Verification of knowledge & link between concepts
Majority of questions asked	1 <sup>st</sup> half	2 <sup>nd</sup> half	1 <sup>st</sup> half
#students	18-29%	14-25%	36-40%

## Struggling students: grades < to the average

### Questions:

2. Could you **revise** the notion of buffer solutions, particularly how to create a buffer solution?
7. are all transition metals reductive?

## Average students

### Questions:

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

## Good students: grades > to the average

### Questions:

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

# Questions' organization: mixed

<b>N</b>	<b>Re-explain questions</b>	<b>Struggling</b>	<b>Average</b>	<b>Good</b>
1.	Could you <b>re-explain</b> how to find the dipole moment of a molecule?	X		
2.	Could you <b>revise</b> the notion of buffer solutions, particularly on how ...?	X		
<b>N</b>	<b>Deepen questions</b>	<b>Struggling</b>	<b>Average</b>	<b>Good</b>
3.	<b>How</b> can we compare two atoms that are neither in the same row ...?		X	
4.	Could you <b>explain</b> what distinguishes the atom from the chemical element?		X	
<b>N</b>	<b>Verification questions</b>	<b>Struggling</b>	<b>Average</b>	<b>Good</b>
	<ul style="list-style-type: none"> <li><b>Mistake/ contradiction</b></li> </ul>			
5.	It seems there is an <b>mistake</b> in the speech on slide 5: you say that ...		X	
6.	Hello, in the example on electrophoresis you say that the aa ... ?			X
	<ul style="list-style-type: none"> <li><b>Knowledge in course</b></li> </ul>			
7.	are all transition metals reductive?			X
	<ul style="list-style-type: none"> <li><b>Exam</b></li> </ul>			
8.	Should we learn the metals of block P by heart?		X	



# Overview

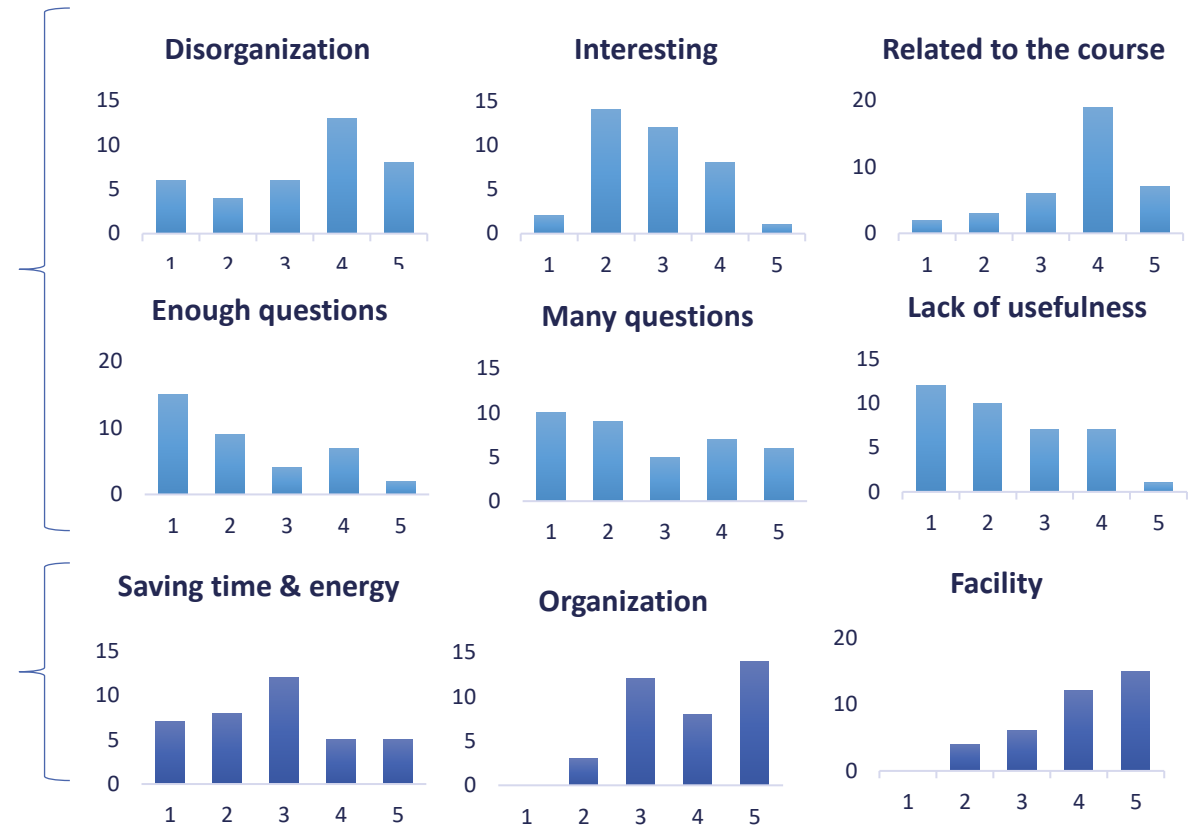
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# Survey analysis

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

Students' needs organization	Students' profiles organization	Mixed organization	Current organization
11	3	11	11

"... 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

Students' needs organization	Students' profiles organization	Mixed organization	Current organization
11	3	11	11



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)

	Cluster1	Cluster 2
#teachers	22	14
Seniority	less	more
Received questions	high	low
Addressed questions	average	high
Flipped classroom	less appreciated	More appreciated

## 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

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# 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

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