



# Adaptive Learning Environments Based on IRT: Possibilities and Challenges

Kelly Wauters, Piet Desmet and Wim Van den Noortgate

# Outline

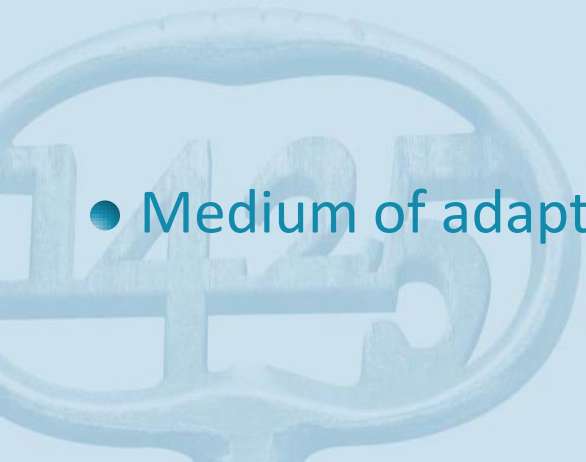
- Adaptive e-learning environments
- IRT in learning environments
  - Motive
  - Item difficulty
  - Learner's ability
  - Item selection algorithm
- Conclusion

# Adaptive e-learning environments



# Adaptive e-learning environments

- Form of adaptivity:
- Source of adaptivity:
- Medium of adaptivity:



# Adaptive e-learning environments

- Form of adaptivity:

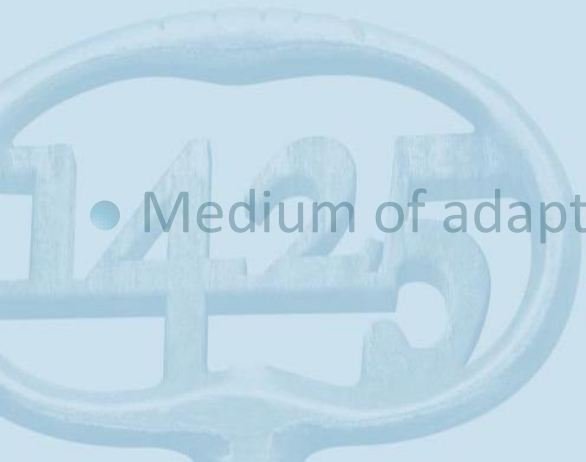
  - Adaptive form representation (pictures, videos, hyperlinks,...)

  - Adaptive content representation (intelligent help, discover misconceptions,...)

  - Adaptive curriculum sequencing (dynamic selection of optimal item for each learner)

- Source of adaptivity:

- Medium of adaptivity:



# Adaptive e-learning environments

- Form of adaptivity:

  - Adaptive form representation

  - Adaptive content representation

  - Adaptive curriculum sequencing

- Source of adaptivity:

  - Course/item features (difficulty level, topic, ...)

  - Person features (ability level, cognitive load, interests,...)

  - Context features (device, time, location,...)

- Medium of adaptivity:

# Adaptive e-learning environments

- Form of adaptivity:

  - Adaptive form representation

  - Adaptive content representation

  - Adaptive curriculum sequencing

- Source of adaptivity:

  - Course/item features

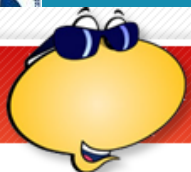
  - Person features

  - Context features

- Medium of adaptivity:

  - Task-based (e.g. ASSISTment [1])

  - Item-based (e.g. Franel [2])



Un été à la campagne - B2

Préparation à l'écoute

PE1

PE2

PE3

Compréhension globale

Compréhension détaillée

Thème lexical: Création d'un logeme

Thème grammatical: L'accord du pa

Orthographe- Prononciation

Actes de langage: Faire une réserv

Activités complémentaires

Un été à la campagne - B2 > Préparation à l'écoute > PE1

**Cochez la bonne réponse.**

Voici le logo de 'Gîtes de France'. Cette organisation:



- regroupe tous les hébergements de vacances à la campagne en France.
- accueille des jeunes en difficulté.
- construit des maisons modestes pour des familles nombreuses françaises.
- regroupe toutes sortes de logements qui accueillent des touristes en France.
- regroupe toutes les agences immobilières en France.



# Adaptive learning environments

- Form of adaptivity:

  - Adaptive form representation

  - Adaptive content representation

  - Adaptive curriculum sequencing

- Source of adaptivity:

  - Course/item features

  - Person features

  - Context features

- Medium of adaptivity:

  - Task-based

  - Item-based

Adaptive curriculum sequencing in item-based learning environments by matching the item difficulty level to the learner's ability level

# Adaptive learning environments

- Form of adaptivity:

  - Adaptive form representation

  - Adaptive content representation

  - Adaptive curriculum sequencing

- Source of adaptivity:

  - Course/item features

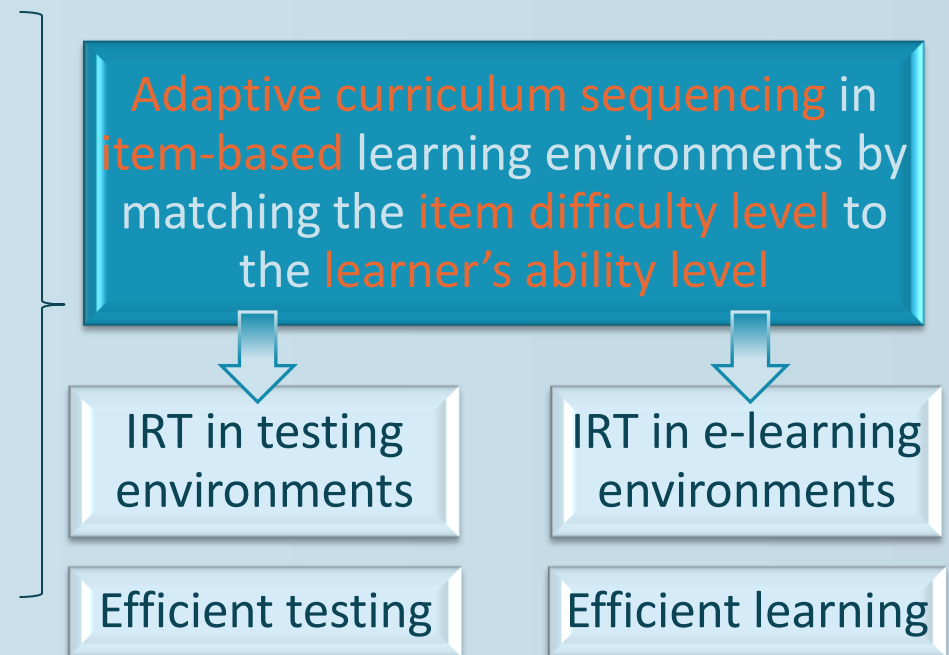
  - Person features

  - Context features

- Medium of adaptivity:

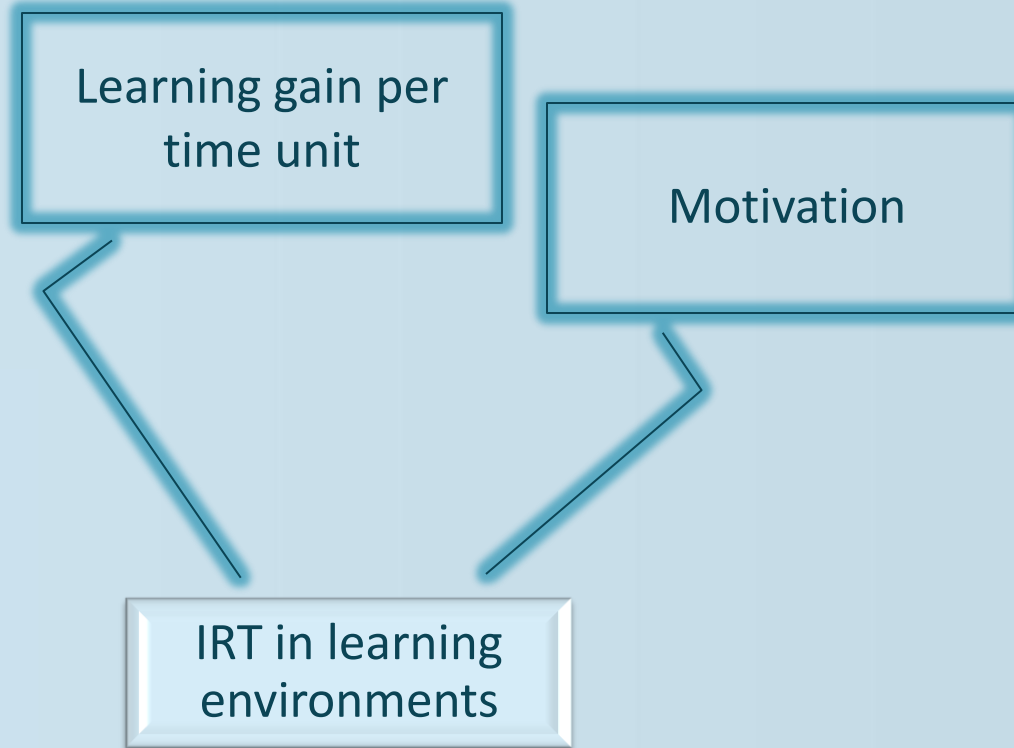
  - Task-based

  - Item-based



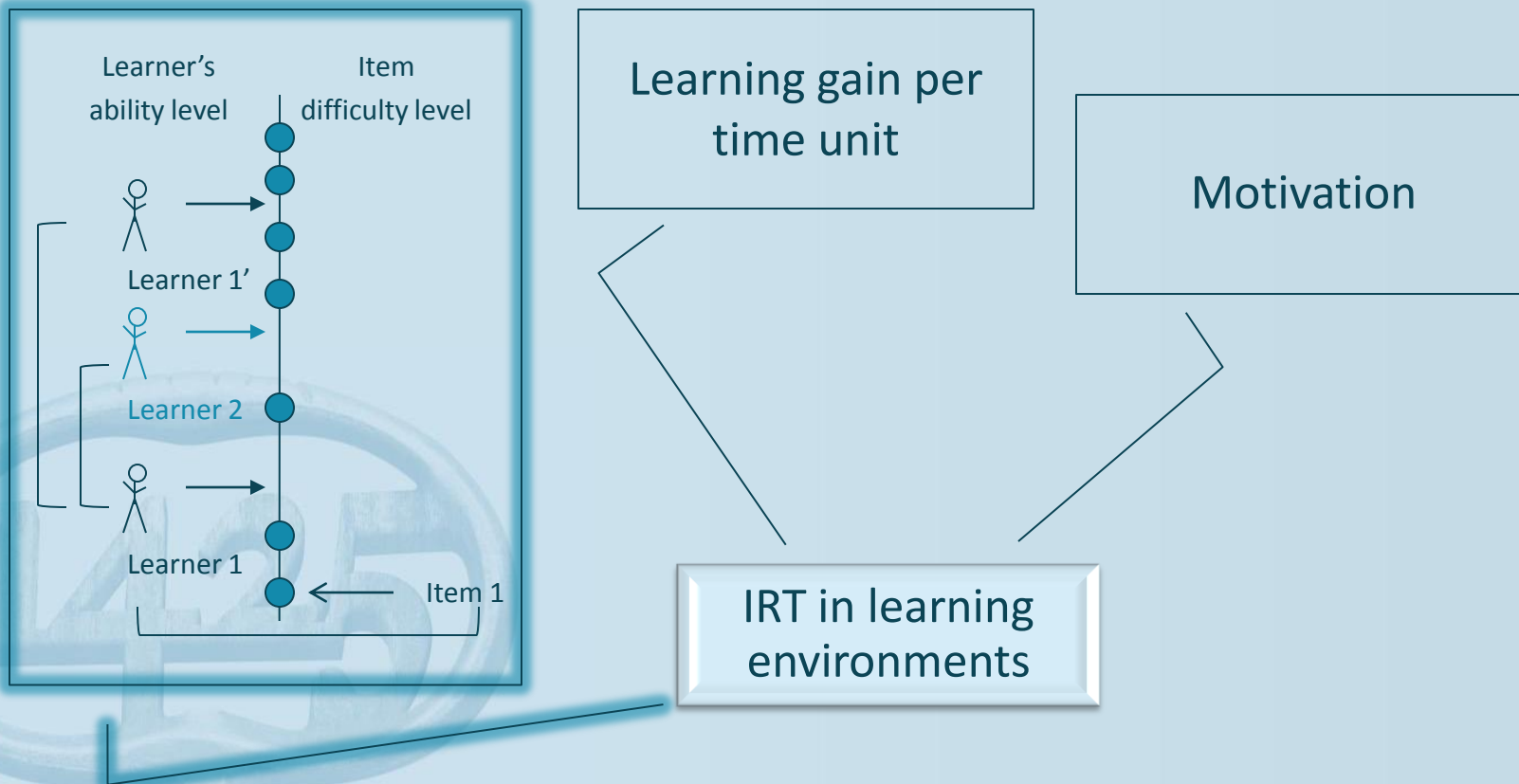
# IRT in learning environments

Extrapolation of the ideas of IRT and CAT to learning environments



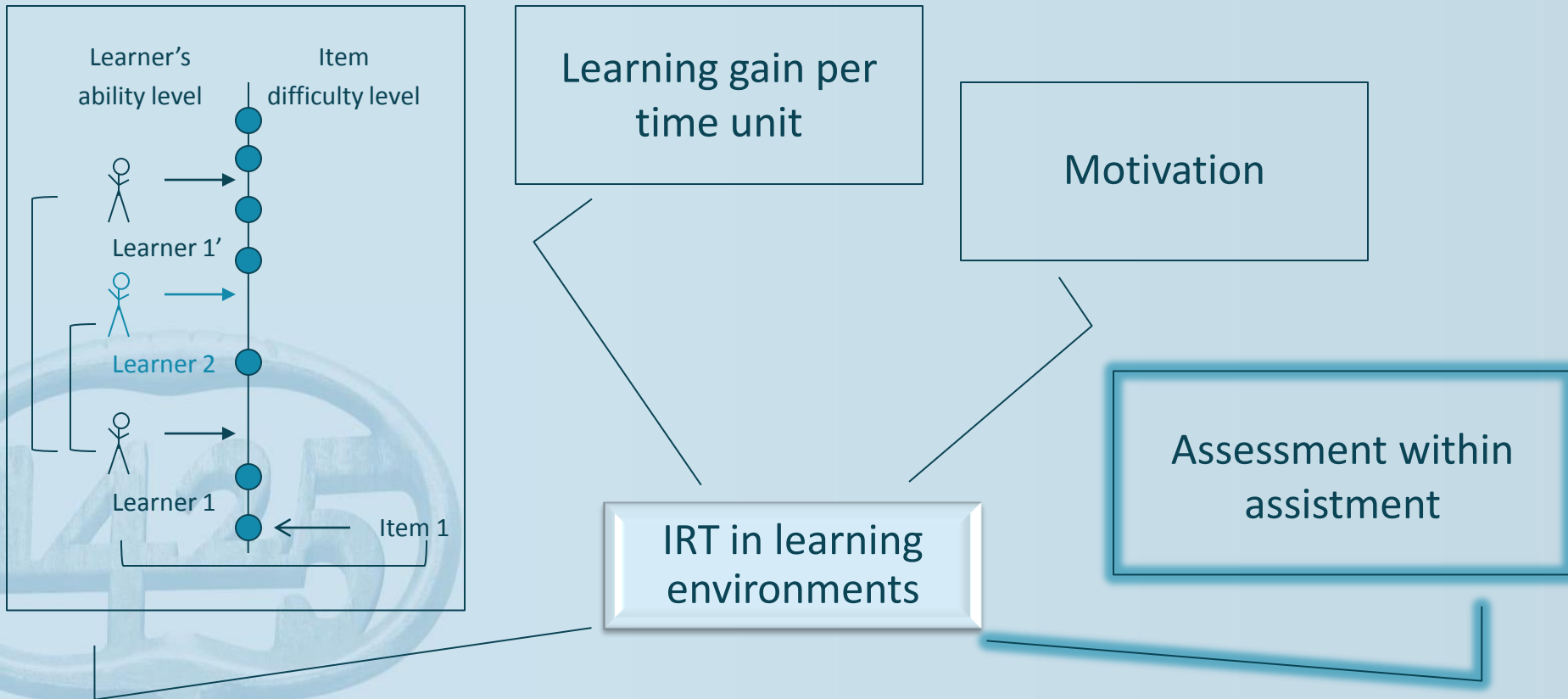
# IRT in learning environments

Extrapolation of the ideas of IRT and CAT to learning environments



# IRT in learning environments

Extrapolation of the ideas of IRT and CAT to learning environments



# IRT in learning environments

Feasible?



# Item difficulty estimation

- Existing learning environments:

  - Proportion correct

  - Learner's feedback ("How difficult did you find this item?")

  - Expert rating ("What is the percentage of learners who will answer this item correct?")

  - Paired comparison



# Item difficulty estimation

- Why not based on IRT calibration?

Item-based learning environments: Franel/BLCC/De post





# Item difficulty estimation

- Why not based on IRT calibration?

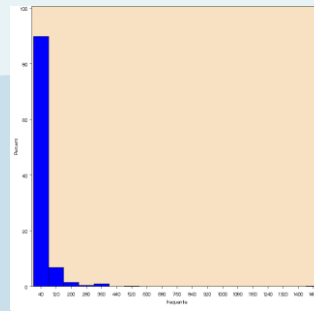
Item-based learning environments: Franel/BLCC/De post

Missing values

Administration frequency

30000 items

Learner's freedom

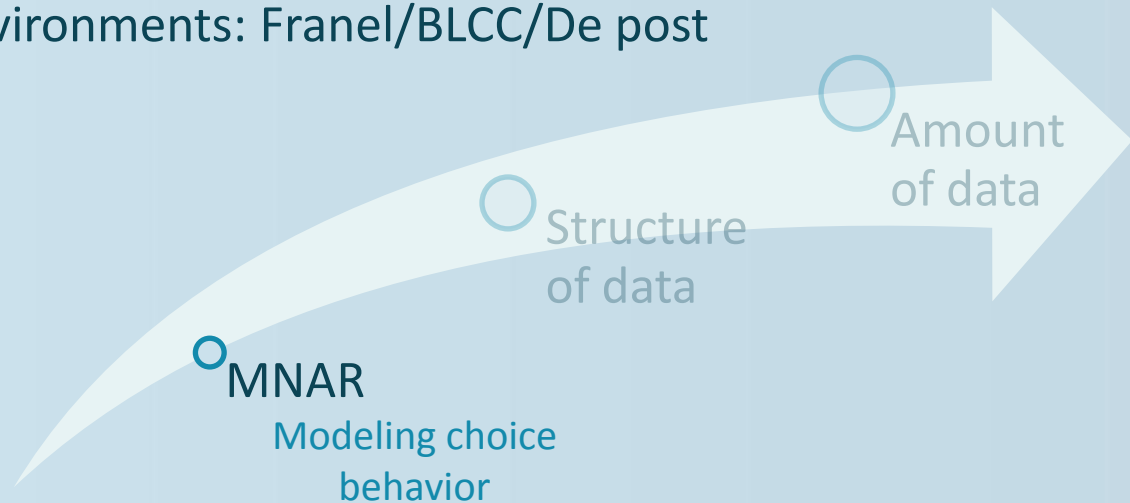


# Item difficulty estimation

- Why not based on IRT calibration?

Item-based learning environments: Franel/BLCC/De post

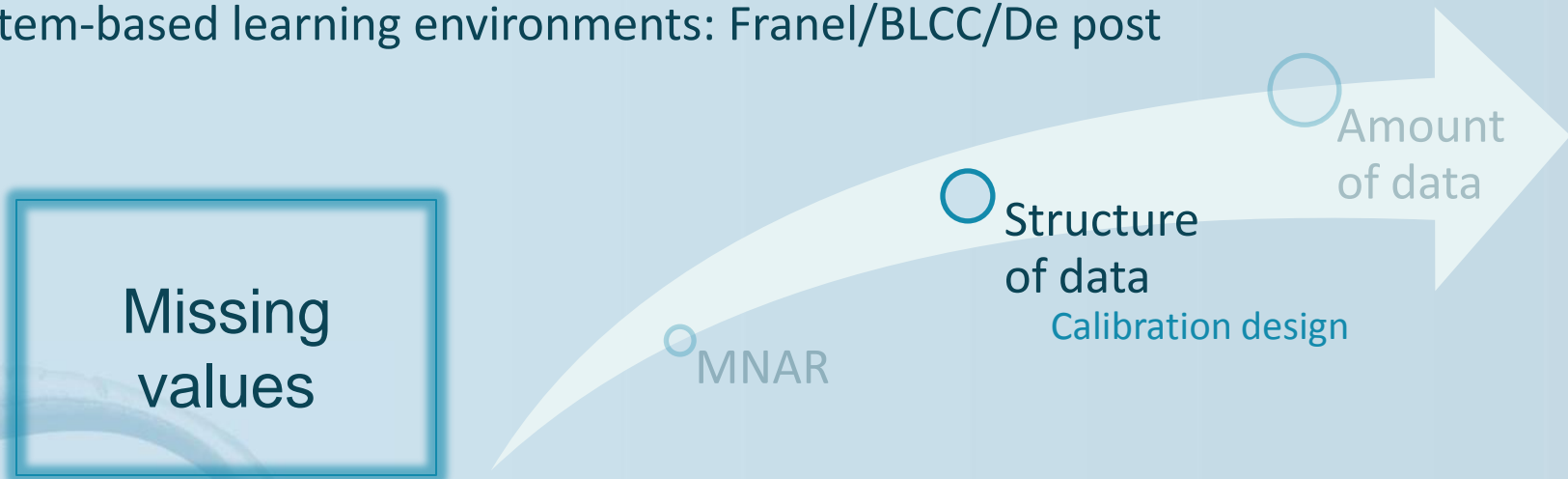
Missing values



# Item difficulty estimation

- Why not based on IRT calibration?

Item-based learning environments: Franel/BLCC/De post

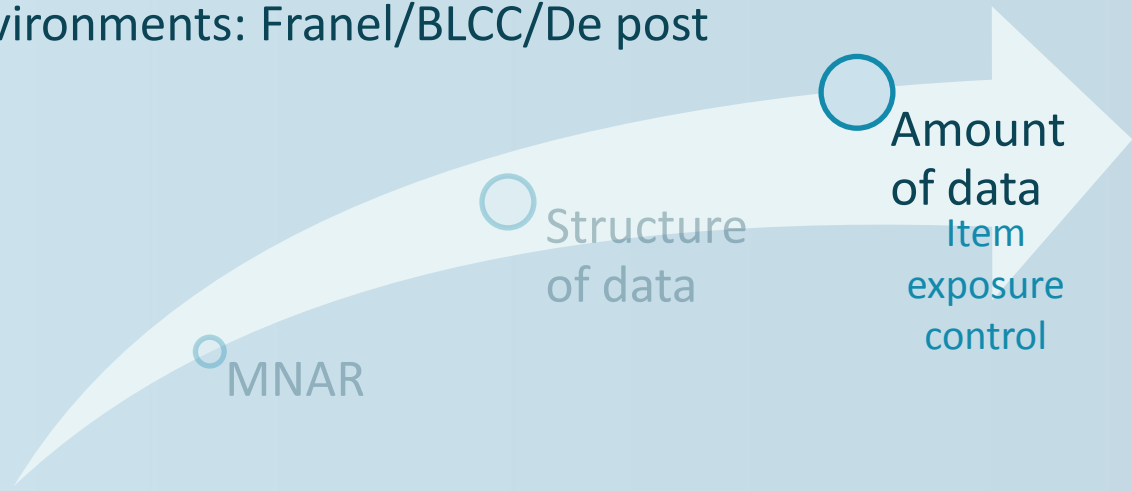


# Item difficulty estimation

- Why not based on IRT calibration?

Item-based learning environments: Franel/BLCC/De post

Missing values



# Learner's ability estimation

- Cold start problem  
Group adaptation

- Change in ability level  
Knowledge gain/loss



# Item selection algorithm

- Objective

  - Optimize learning efficiency

- Means

  - Item difficulty level (difficult, moderate, easy)

  - Learner's control (shared control)



# Conclusion

- IRT in learning environments?

Yes, but...

adaptation of the existing algorithms

combination of existing methods

Further research in progress



Thank you!  
Questions and suggestions

## Contact

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[www.kuleuven-kortrijk.be/itec](http://www.kuleuven-kortrijk.be/itec)



# References

- [1] Razzaq, L., Feng, M., Nuzzo-Jones, G., Heffernan, N.T., Koedinger, K.R., Junker, B. et al. (2005). The Assistment Project: Blending Assessment and Assisting. In C.K. Looi, G. McCalla, B. Bredeweg & J. Breuker (Eds.), *Proceedings of the 12th International Conference on Artificial Intelligence in Education* (pp. 555-562). Amsterdam: ISO Press.
- [2] Desmet, P. (2006). L'apprentissage/enseignement des langues à l'ère du numérique: tendances récentes et défis. *Revue française de linguistique appliquée*, 11, 119-138.

