

Chocolate Bar Machine Scheduling: Dunking into Inquiry-Based Learning and the World of Work

Florian Stampfer

University of Innsbruck

Noordwijkerhout, February 4, 2017



The mascil Framework

Valued outcomes

- Inquiring minds
- Applying science in real life
- Preparing for active citizenship and lifelong learning
- Understanding the nature of science
- Understanding how mathematics and science are used in the World of Work

What students do

- Inquire, pose questions
- Explore problems, engage in solving them, use their knowledge to find solutions
- Explain situations and phenomena
- Reflect on the results and processes
- Make sense for themselves
- Explore the World of Work



Teacher guidance

- Values and builds upon pupils' reasoning and reflections
- Connects to pupils' experience
- Motivates students by connecting school and work

Classroom culture

- Shared sense of purpose/justification
- Value mistakes, contributions (open-minded)
- Dialogic
- Shared ownership
- Collaborative

IBL tasks

- The context is **meaningful**
- The situation evokes **multiple solution strategies**
- The students **plan inquiry**
- The task supports **collaboration and communication**

World of Work

- The **context** of the task relates to the WoW
- Students have to take a professional **role**
- Students' **activities** reflect workplace practices
- The task asks for a **product**

Dunking into IBT and WoW

Chocolate Bar Machine Scheduling

- special task to provide a fast and effective tool involving pre-service and in-service mathematics teachers in a mascul learning environment

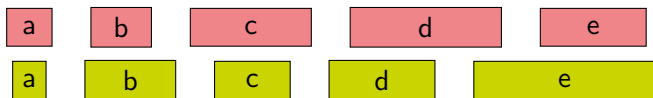
Chocolate Bar Machine Scheduling

Introduction

Chocolate Bar Machine Scheduling

A chocolate factory produces different sorts of chocolate bars (hazelnuts, nougat, milk ...). For each sort, the melted chocolate is deposited into bars on a machine M_1 and then the bars are packed on a machine M_2 . The processing times of five sorts a, b, c, d, e on each machine are given.

	a	b	c	d	e
M_1	3	4	8	10	7
M_2	2	6	5	7	12



For which order of the sorts is the total processing time – the interval between the time the first sort starts on machine M_1 and the time the last sort leaves machine M_2 – the shortest? Describe your ideas and strategies!

Planning in een chocoladefabriek

Een chocoladefabriek produceert verschillende soorten chocoladerepen (melk, puur, hazelnoot, ...). Van iedere soort wordt de gesmolten chocola met machine M_1 in reepvormen gegoten en daarna wordt met machine M_2 de reep ingepakt. De tijd die de machines nodig hebben voor vijf verschillende soorten chocola a, b, c, d, e en f zijn hieronder gegeven.

	a	b	c	d	e
M_1	3	4	8	10	7
M_2	2	6	5	7	12



Voor welke volgorde van de vijf soorten is de totale verwerkingstijd – de tijd tussen het moment waarop de eerste soort start op machine M_1 en het moment waarop de laatste soort ingepakt is in machine M_2 – het kortste? Beschrijf je ideeën en de manier waarop je het probleem hebt aangepakt.

Chocolate Bar Machine Scheduling

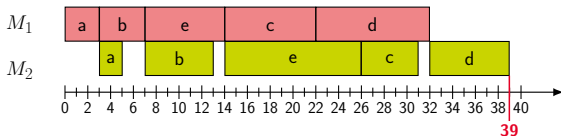
Discussion

Intuitive Approach

Hypothesis: “the shortest first”

1. Sort all jobs in ascending order with respect to their processing time at machine M_1 .
2. Schedule the jobs in this order.

For our task:

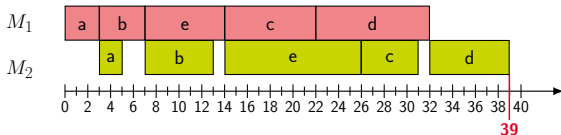


Intuitive Approach

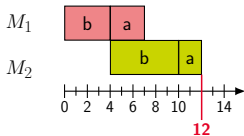
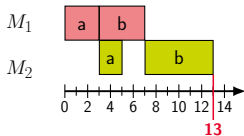
Hypothesis: “the shortest first”

1. Sort all jobs in ascending order with respect to their processing time at machine M_1 .
2. Schedule the jobs in this order.

For our task:



Counterexample to the hypothesis:

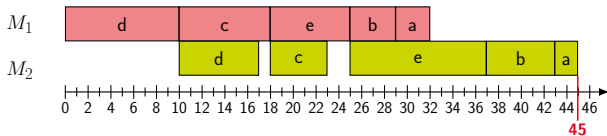


Inverse Intuitive Approach

Hypothesis: “the longest first”

1. Sort all jobs in descending order with respect to their processing time at machine M_1 .
2. Schedule the jobs in this order.

For our task:

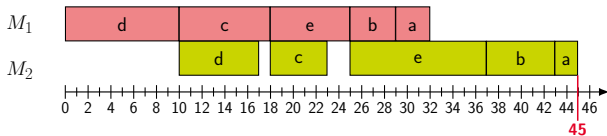


Inverse Intuitive Approach

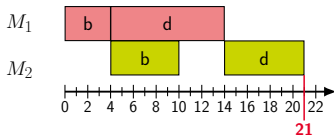
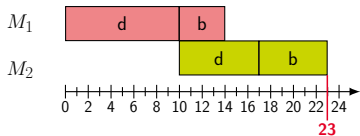
Hypothesis: “the longest first”

1. Sort all jobs in descending order with respect to their processing time at machine M_1 .
2. Schedule the jobs in this order.

For our task:



Counterexample to the hypothesis:



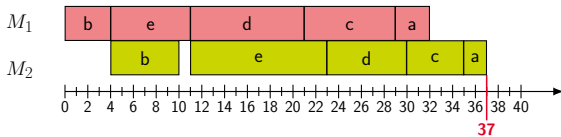
Johnson's rule

1. List the jobs and their processing times at each machine.
2. Select the job with the shortest processing time. If this processing time is at machine M_1 , then schedule the job first. If this processing time is at machine M_2 then schedule the job last. In the case of ties, select the first listed job. In the case of ties between the processing time at machine M_1 and machine M_2 schedule the job first.
3. Eliminate the shortest job from further consideration.
4. Repeat steps 2 and 3, working towards the center of the job schedule until all jobs have been scheduled.

Johnson's rule

	a	b	c	d	e
M_1	3	4	8	10	7
M_2	2	6	5	7	12

For our task:



Implementation of the task



Introduction of
the task

Implementation of the task



Introduction of
the task



Development
of the task

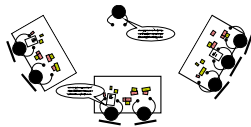
Implementation of the task



Introduction of
the task



Development
of the task



Discussion of
the task

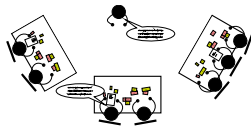
Implementation of the task



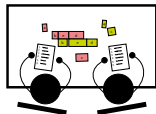
Introduction of
the task



Development
of the task



Discussion of
the task



Systematization
of the
mathematical
learning

Teacher's Questioning in IBMT

Menezes et al., 2013

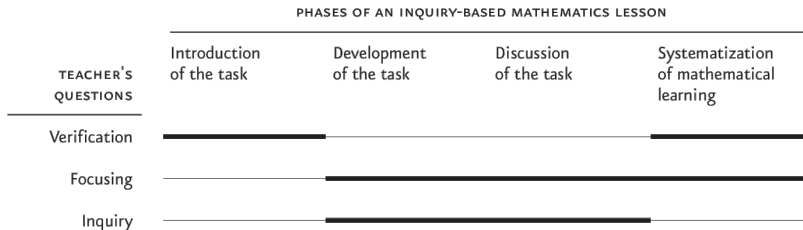


FIGURE I – THE TEACHER'S QUESTIONS IN AN INQUIRY-BASED MATHEMATICS LESSON

Quelle: Menezes et al., 2013: Essay on the role of teacher's questioning in inquiry-based mathematics teaching, p. 69

Teacher's Questioning in IBMT

Menezes et al., 2013

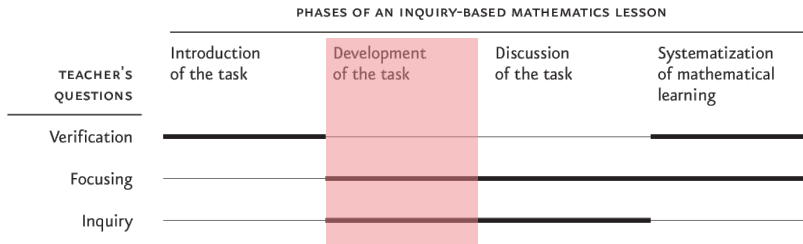


FIGURE I – THE TEACHER'S QUESTIONS IN AN INQUIRY-BASED MATHEMATICS LESSON

Quelle: Menezes et al., 2013: Essay on the role of teacher's questioning in inquiry-based mathematics teaching, p. 69

Teacher's Questioning in IBMT

Menezes et al., 2013

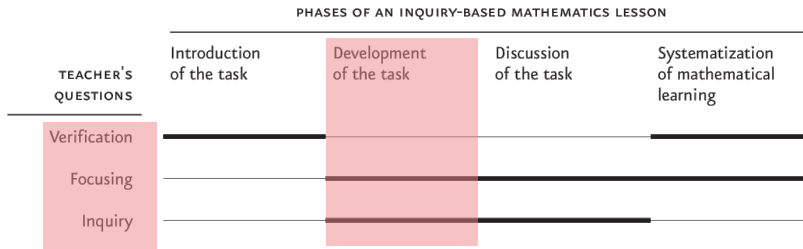


FIGURE I – THE TEACHER'S QUESTIONS IN AN INQUIRY-BASED MATHEMATICS LESSON

Quelle: Menezes et al., 2013: Essay on the role of teacher's questioning in inquiry-based mathematics teaching, p. 69

Experiences in Austria

Teacher's Questions

- Verification
- Focusing
- Inquiry

Experiences in Austria

Teacher's Questions

- **Verification**
- Focusing
- Inquiry

“Do you always start with job A?”

Teacher's Questions

- Verification
- **Focusing**
- Inquiry

“Do you have an example in which it [the hypothesis that one should start with the shortest job] is wrong?”

Teacher's Questions

- Verification
- Focusing
- **Inquiry**

“It is difficult [to start] with [a job in] the middle if you have many [jobs]. But why do you believe that this [job] is in the front and that [job] at the end?”

Experiences in Austria

Teacher's Questions

■ Verification	14% (9)
■ Focusing	32% (21)
■ Inquiry	54% (35)

Summing Up

- mascil framework

Summing Up

- mascil framework
- worked on a mascil task

Summing Up

- mascil framework
- worked on a mascil task
- different approaches

Summing Up

- mascil framework
- worked on a mascil task
- different approaches
- implementation (different phases)

Summing Up

- mascil framework
- worked on a mascil task
- different approaches
- implementation (different phases)
- teacher's questioning

Summing Up

- mascil framework
- worked on a mascil task
- different approaches
- implementation (different phases)
- teacher's questioning

... comments?

Further Information

Websites

- international: `http://www.mascil-project.eu/`
- subwebsite NL: `http://www.projects.science.uu.nl/Mascil/`

Contact

- E-Mail: `florian.stampfer@uibk.ac.at`

Thank you for your attention.