

The devil in details:

Teaching as managing inter-discursive gaps

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University of Haifa

25 March 2022

**Michigan State University
Mathematics Education Colloquium**

A teacher's story

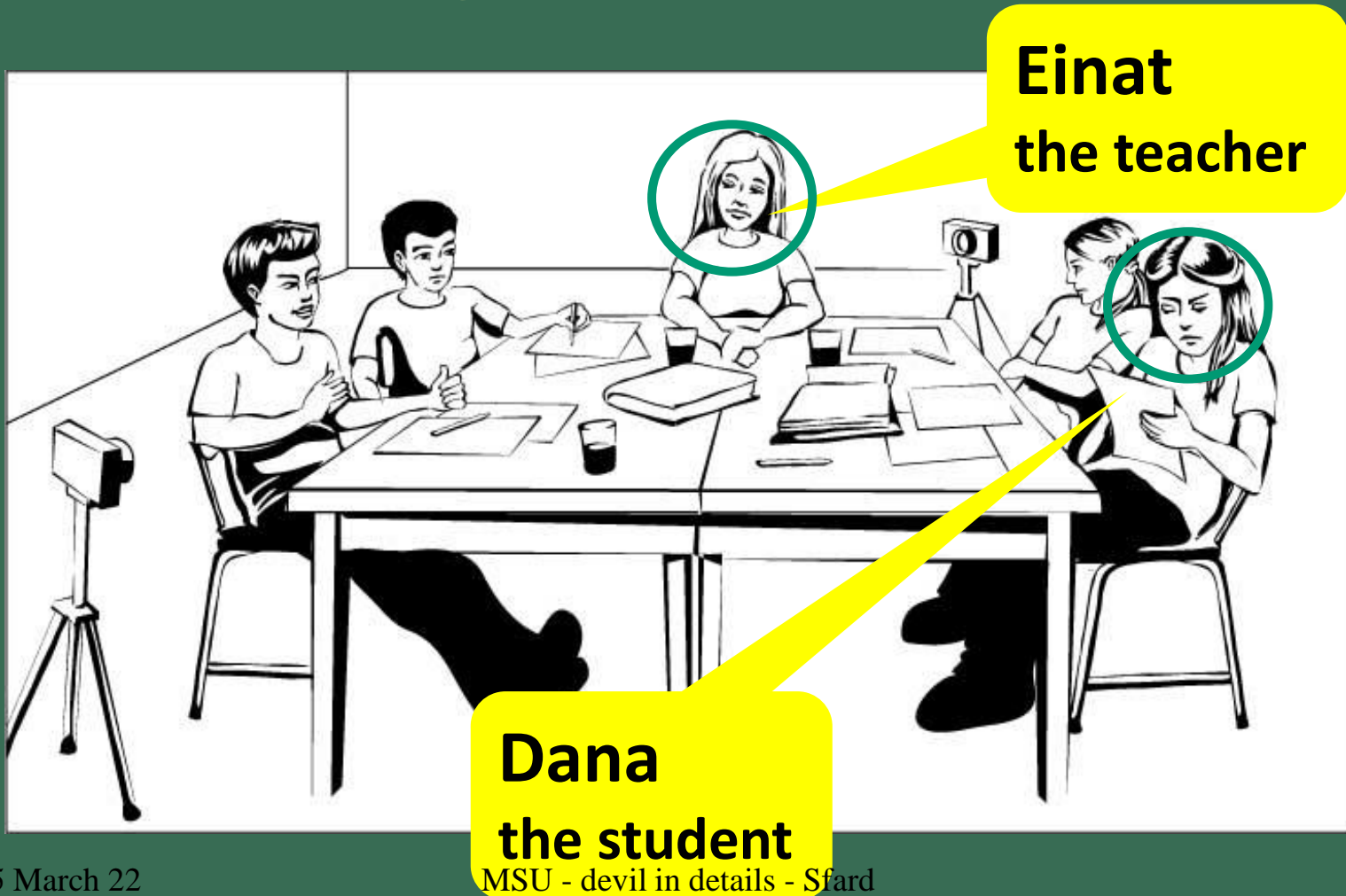


Einat Heyd-Metzuyanin

Vicious Cycles of Identifying and Mathematizing: A Case Study of the Development of Mathematical Failure.

Journal of the Learning Sciences, 24(4), 504-549. (2015).

Einat's after-school class of 13-year-old students





A teacher's story

Dana, Einat's students, had considerable difficulties solving mathematical problems.

After a brief period of work with Dana, the teacher decided she is '**clueless**', and also '**learning disabled**'

**But then,
something happened....**

A teacher's story



I started looking again [at all the] examples of Dana's 'cluelessness'.

And lo and behold, in none of them could I prove that Dana ... had no idea of what she was talking about.

But what was worse, I started seeing how I was missing.... significant teaching opportunities.

In dismissing Dana's suggestions ... as 'nonsense' or 'just guesses', I failed to notice that she actually had important ideas every now and then. ...

I thus committed one of the oldest teaching sins – I concentrated only on what Dana didn't know, and completely ignored what she did know.

A teacher's story



But the ... graver consequences were that Dana learned from me, yet again, that her own thinking was irrelevant and unimportant.

Was it then a wonder that she continued to act ritually, hardly ever 'thinking for herself'? No one ever asked her, genuinely, to justify her claims according to her own set of rules.

She was taught over and over again that the only rules that 'counted' in this 'mathematical game' were those established by others. It was then that I realized **I was part of Dana's problem, not part of her salvation.**



A teacher's story

"I was part of Dana's problem
not part of her salvation."

What the teacher was doing
mattered to Dana

but **not in the way the
teacher intended.**

She was responsible for, at least,

- students' learning
- their identities

she
contributed
undesirably

How do teachers matter?

In this talk:

I will ask: Why and how do teachers sometimes matter **in unintended ways**, against their better judgement?

I will claim: The devil is in our **unacknowledged teaching routines**

How do teachers matter?

In this talk:

I will ask: Why and how do teachers sometimes matter **in unintended ways**, against their better judgement?

uncontrollable

sometimes too brief to be noticed

What are they?

Where do they come from?

How do they become the devil's favorite?

I will claim: The devil is in our **unacknowledged teaching routines**

Plan

1. Teachers' routines

What they are & where they come from

2. Pitfalls of routines

How helpful routines lead to unhelpful results

3. Controlling routines

against the unintended mattering

Plan

1. Teachers' routines

What they are & where they come from

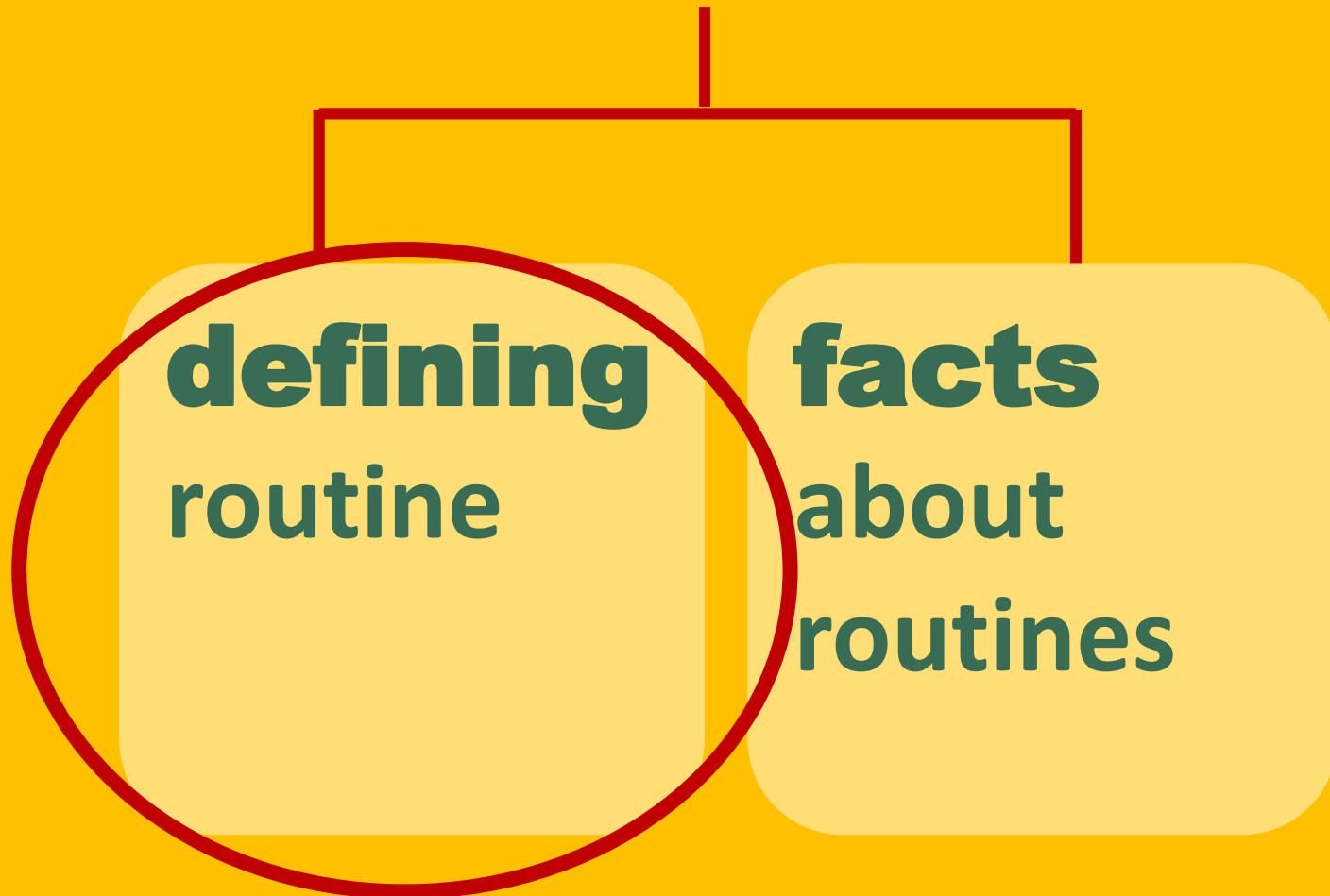
2. Pitfalls of routines

How teacher's routines may lead to unintended results

3. Controlling routines

against the unintended mattering

Routines



**In most life situations,
we know what to do –
we are able to act in an
immediate manner**



25 March 22



MSU - devil in details - Sfarid



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**In most life situations,
we know what to do –
we are able to act in an
immediate manner**

**Where does this
ability come from?**

When you **need to act**, what is it that makes you able to **decide on-the-spot** what to do?

Experience!!!

When you find yourself in a situation in which you feel obliged to act,

you tend to recall a past situation sufficiently similar to the present one to justify doing now what was done then.

When you **need to act**, what is it that makes you able to **decide on-the-spot** what to do?

Experience!!!

When you find yourselves in a **task-situation (TS)**

you tend to recall **a precedent**

conclusions

- All you do in an immediate, competent way involves **replications** of your own or somebody else's **past actions**

Prediction & simulation

projecting past
experience into
future

reproducing
your past state

conclusions

- All we do in an immediate, competent way involves **replications** of one's own or somebody else's **past actions**
- The repetitions create **patterns of action** that is, **routines**

routine

is a pattern of action we recall in task-situation

What aspects of the precedent must be preserved?

task

routine

=

+

What past way of acting can help in executing this task?

procedure

routine

pattern of action we
call in task-situation

General
descriptions

What must
happen

task

routine

=

+

how it can
happen

procedure

routine

Is a pattern of action we recall in task-situation

Depends of task-situation and the person

task

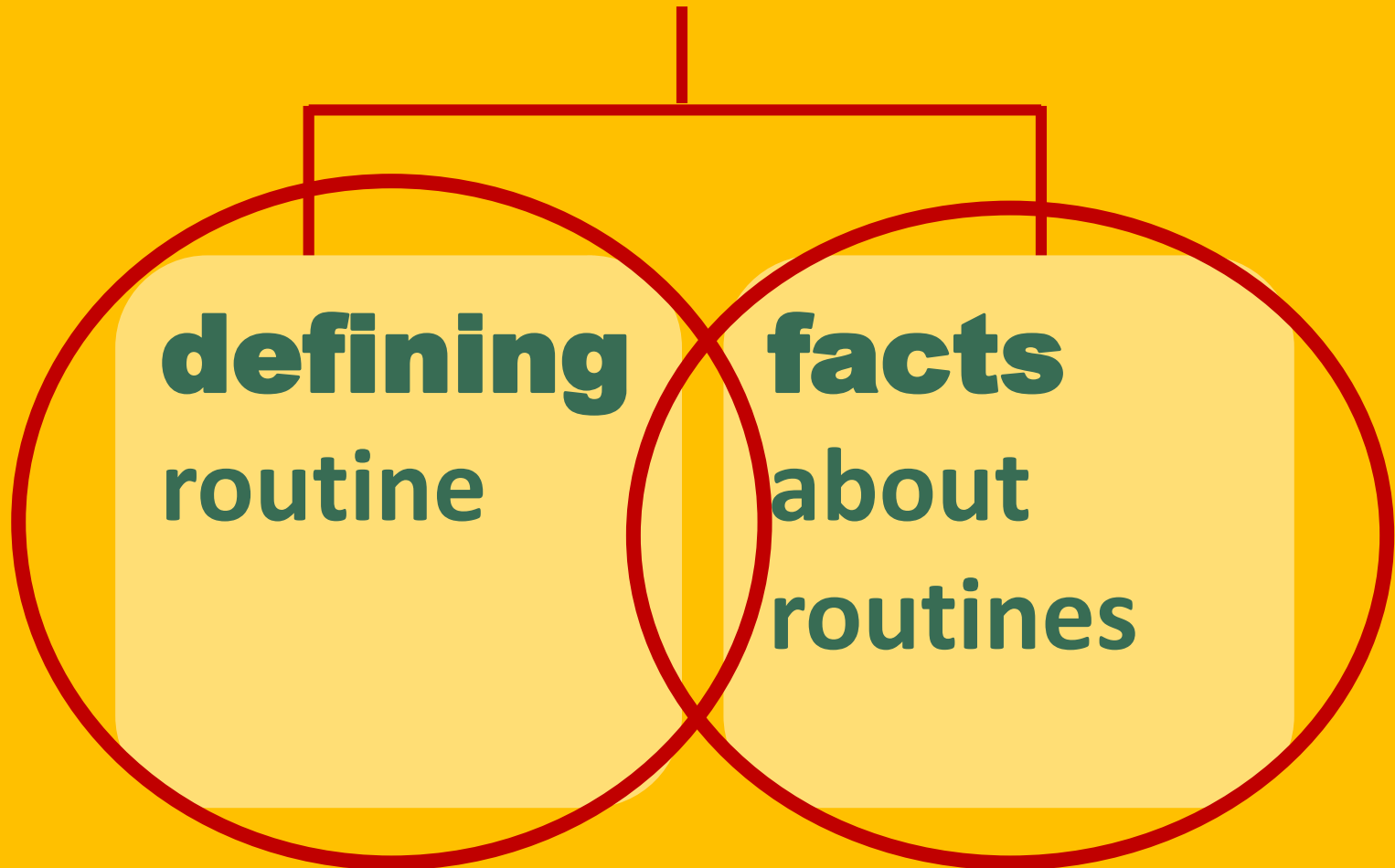
routine

=

+

procedure

Routines



Facts about routines

- ❖ Routines are **recursive** constructs



March 22



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25 March 22

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Routines are recursive constructs - example

Problem-solving teacher-student interaction

Task: Make sure the student is able to solve this type of problem

Pose a problem

Evaluate the student's ability to solve

**Accordingly, choose a routine
(eliciting? telling?)**

Implement the chosen routine

Routine

Routine

Routines are recursive constructs - example

Problem-solving teacher-student interaction

Task: Make sure the student is able to solve this type of problem

Routine

Pose a problem

Evaluate the student's ability to solve

Accordingly, choose a routine (eliciting? telling?)

Implement the chosen routine

Observe & assess the student's performance

Predict her future ability to cope

Routine

Facts about routines

- ❖ Routines are **recursive** constructs
- ❖ Routines come in **different sizes**

Routines come in different sizes

XL

L

M

S

XS

practice

atomic routine

lesson planning

reacting to noise

managing classroom discussion

preventing simultaneous talk

introducing new topic or concept

a confirmatory response

Routines come in different sizes

XL

L

M

S

XS

practice

these routines often remain unnoticed

atomic routine

In PD, we tend to care about the L or XL routines (practices).

We pay relatively little attention to the atomic

introducing new topic or concept

evaluating student's answer

Facts about routines

- ❖ Routines are **recursive** constructs
- ❖ Routines come in **different sizes**
- ❖ Our routines constitute a tightly interconnected **system**

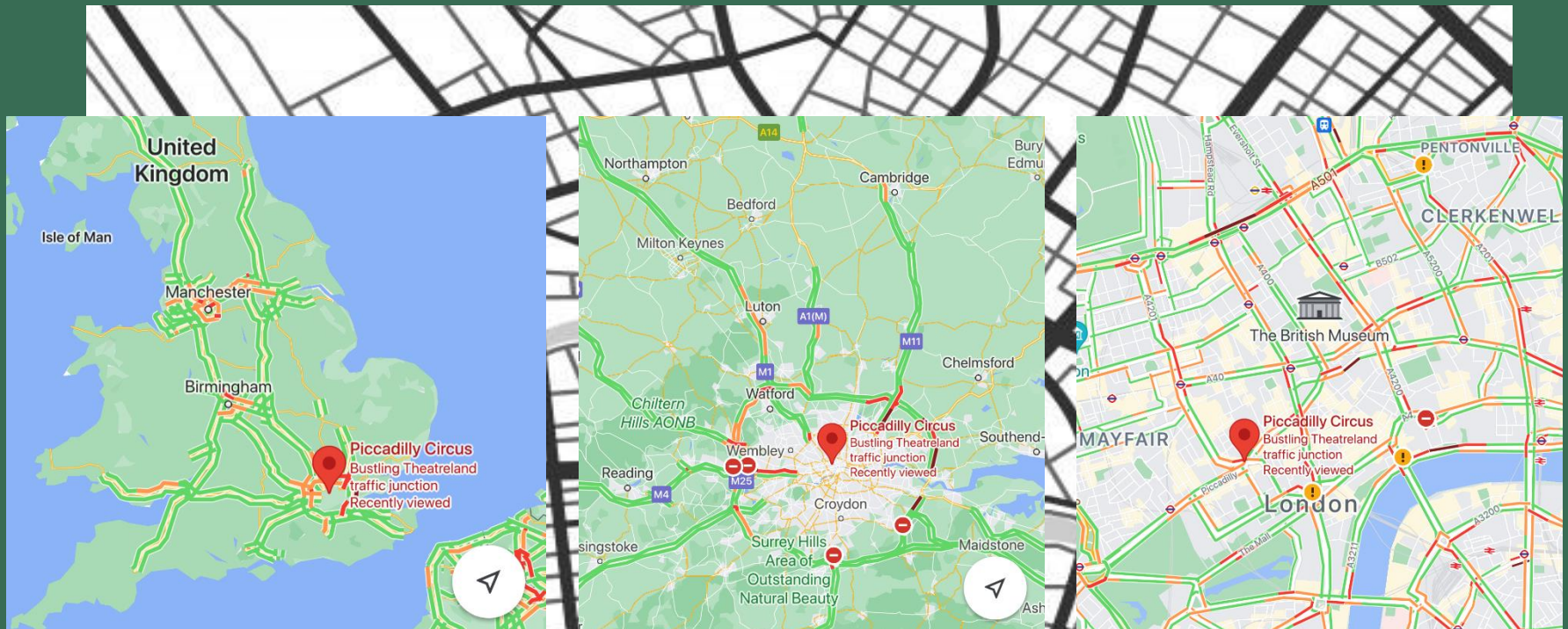
Facts about routines

Our **routines** are like our **routes**: they constitute a tightly interconnected, **fractal-like system**



Facts about rout(in)es

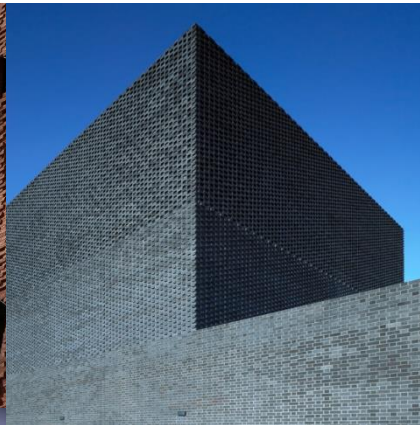
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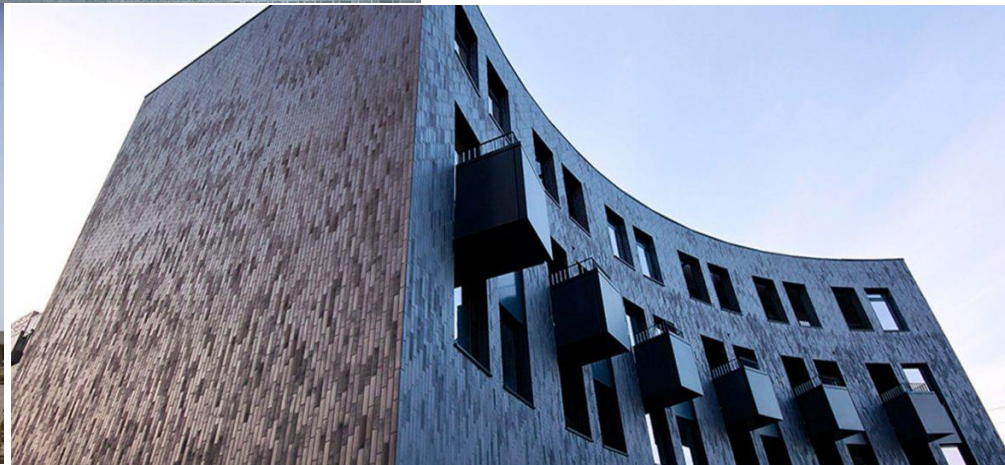
Facts about routines

- ❖ Routines are **recursive** constructs
- ❖ Routines come in **different sizes**
- ❖ Our routines constitute a tightly interconnected **system**
- ❖ The fact that we act in routinized ways does not preclude **creativity**

We build our actions from available routines



just like architects
build original
buildings
from building blocks
available in the
market



Anna Sfard - Hans Freudenthal
Medal 2007

Facts about routines

- ❖ Routines are **recursive** constructs
- ❖ Routines come in **different sizes**
- ❖ Our routines constitute a tightly interconnected **system**
- ❖ The fact that we act in routinized ways does not preclude **creativity**
- ❖ Routines are a **doubly-edged sword**

Routines, like our routes,

are
indispensable
for teaching

but may also be
dangerous

Plan

1. Teachers' routines

What they are & where they come from

2. Pitfalls of routines

How teacher's routines may lead to unintended results

3. Controlling routines

against the unintended mattering

Pitfalls of routines

```
graph TD; A[Pitfalls of routines] --- B[of routines inception]; A --- C[of recruiting routines in task-situation]; A --- D[of reconstructing other people's routines on the basis of their performance];
```

of routines
inception

of **recruiting**
routines in
task-
situation

of **recon-**
structing other
people's routines
on the basis of
their performance

Pitfalls of routines' **inception**

Invent?

emulate?

do what you
learned in PD

General Laws underlying our actions

The Law of Minimizing Effort (LoME): "If there are several ways of achieving the same goal, people will eventually gravitate to the least demanding course of action.."

(Daniel Kahneman)



Pitfalls of routines' **inception**

emulating rather
than active recalling
or inventing

This happens
mainly involuntarily

EXAMPLE: teachers' well-known tendency
for **doing what their teachers did.**

General Laws underlying our actions

The Law of Minimizing Effort (LoME): "If there are several ways of achieving the same goal, people will eventually gravitate to the least demanding course of action.."

(Daniel Kahneman)



The Law of maximizing Acceptability (LoMA):
People tend to opt for what is expected to maximize social reward or minimize punishment.

Good → popular

Popular → good?

Pitfalls of routines' **inception**

emulating rather
than active recalling
or inventing

This happens
mainly involuntarily

EXAMPLE: teachers' well-known tendency
for **doing what their teachers did.**

PITFALL: unknowingly, we may be
emulating unhelpful routines.

Pitfalls

```
graph TD; Pitfalls --> Pitfall1[of routines inception]; Pitfalls --> Pitfall2[of recurring routines in task-situation]; Pitfalls --> Pitfall3[of reconstructing other people's routines on the basis of their performance];
```

of routines
inception

of **recur-**
iting
routines in
task-
situation

of **recon-**
structing other
people's routines
on the basis of
their performance

Recruiting a routine in a task-situation, TS

THE MECHANISM:

You do it in two steps, usually
without our being aware of this

Subject to **LoME** & **LoMA**

Recruiting a routine in a task-situation, TS

STEP 1:
The choice of
precedent- search-
space (**PSS**)

For instance, PSS will
be composed of only
those past events that
involved **the same kind**
of **objects/persons**
as the present TS

Recruiting a routine in a task-situation, TS

STEP 1:
The choice of
precedent- search-
space (**PSS**)

There is a set of
relevant **stories** that
are true for them all

For instance, PSS will
be composed of only
those past events that
involved **the same kind**
of **objects/persons**
as the present TS

Routines are recursive constructs - example

Problem-solving in teacher-student interaction

This kind of choice is often made with the help of grades of diagnoses (e.g. of “learning disability” or “giftedness”)

the student is able to solve this type of problem

Pose a problem

Evaluate the student's ability to solve

Accordingly, **choose a routine** (eliciting? telling?)

Implement the chosen routine

Observe & assess the student's performance

Predict her future ability to cope

“clueless” students

Recruiting a routine in a task-situation, TS

STEP 1:
The choice of
precedent- search-
space (**PSS**)

For “clueless”: Telling
rather than eliciting

STEP 2:
In that PSS,
find past event
that you see as
the best fit for
the present TS

Pitfalls of the routine's recruitment

choosing PSS

Choosing by **wrong category identifiers** e.g.
by ethnicity, race, gender
SES, appearance,

prejudice

oppression

injustice

inequity

Pitfalls of the routine's recruitment

choosing PSS

Choosing by **wrong category identifiers** e.g. by ethnicity, race, gender, SES, appearance,

This choice is often made **unconsciously**, influenced by LoMA

prejudice

oppression

injustice

inequity

PSS too wide

Pitfalls of the routine's recruitment

choosing PSS

Choosing by **wrong category identifiers** e.g.
by ethnicity, race, gender
SES, appearance,

PSS **too wide**

PSS **too narrow**

Recruiting a routine in a task-situation, TS

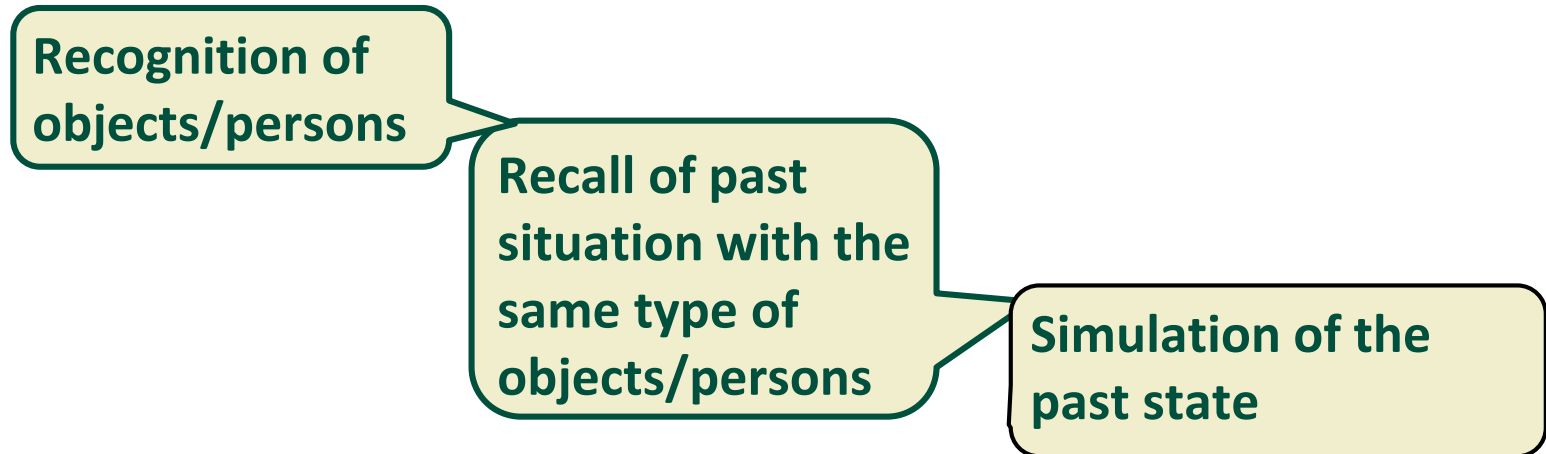
STEP 1:
The choice of
precedent- search-
space (**PSS**)

There is a set of
relevant **stories** that
are true for them all

For instance, PSS will
be composed of only
those past events that
involved **the same kind**
of **objects/persons**
as the present TS

Your PSS will be restricted to past situations
**in which the discourse is the
same as in those stories.**

Searching for a precedent in task-situation



Situated action cycle
(Larry Barsalou)

Searching for a precedent in task-situation

(Situating action cycle, Larry Barsalou)

Recognition of
objects/persons

Recall of past
situation with the
same type of
objects/persons

**discursive
stagnation**

Simulation of the
past state

– return to the past
discourse

Situating action cycle
(Larry Barsalou)

Pitfalls of the routine's recruitment

choosing PSS

Choosing by **wrong category identifiers** e.g.
by ethnicity, race, gender
SES, appearance,

PSS **too wide**

PSS **too narrow**

choosing a precedent

many procedures for one task

'Generosity' of our routines' system

Just as any city destination may be reached through **different routes**

generosity

so can any task be performed with the help of **different routines**

Recruiting a routine in a task-situation, TS

STEP 1:
The choice of
precedent- search-
space (**PSS**)

What counts as
“the best fit”?

STEP 2:
In that PSS,
find past event
that you see as
the best fit for
the present TS

Pitfalls of routines' recruitment

choosing PSS

Choosing by **wrong category identifiers** e.g. by ethnicity, race, gender, SES, appearance,

PSS **too wide**

PSS **too narrow**

choosing a precedent

many procedures for one task

Because of the LoME, **the least onerous routine** is often chosen

especially in the classroom, where **on the spot decisions** are needed

These **most frequented routes** may be shortcuts, good only for the **specific task**.

Pitfalls of the routine's recruitment

choosing PSS

Choosing by **wrong category identifiers** e.g. by ethnicity, race, gender SES, appearance,

PSS **too wide**

PSS **too narrow**

choosing a precedent

many procedures for one task

Because of the LoLE, **the least onerous routine** is often chosen

“the main road”

automated

Pitfalls of the routine's recruitment

choosing PSS

Neuroscientists:
This is how people learn

category identifiers e.g.

Establishing
a rout(in)e means
tuning and **pruning**:
strengthening some
neuronal connections
(synapses) and
removing other ones.

plasticity of brain

choosing a precedent

many procedures for one task

Because of the LoLE, the least
onerous routine is often chosen

“the main road”

automated

The main pitfall of routinization

automated routines

involuntary

often used by the performer **unconsciously**

thus **uncontrollable**
and **resilient**

The teacher's automatic
evaluative responses
build students' identity



Pitfalls

of routines
inception

of **recur-**
iting
routines in
task-
situation

of **recon-**
structing other
people's routines
on the basis of
their performance

In the classroom, all the participants have to retrieve other participants' routines from their performances

Students figure out teacher's task and procedure from her performances

The teacher reconstruct students' tasks and procedures from their performances

What's the task the kid had in mind?

What's the task the teacher had in mind?



Communicational gap



dreamstime.



Teacher-student conversation

Teacher:

So, what is? [writes $\frac{1}{3} \cdot 12$]

Teacher-student conversation

Teacher:	So, what is? [writes $\frac{1}{3} \cdot 12$]
Student:

Teacher-student conversation

Teacher:	So, what is? [writes $\frac{1}{3} \cdot 12$]
Student:
Teacher:	Try again, one third times twelve

Teacher-student conversation

Teacher:	So, what is? [writes $\frac{1}{3} \cdot 12$]
Student:
Teacher:	Try again, one third times twelve
Student:	I think.... Don't know...

Teacher-student conversation

Teacher:	So, what is? [writes $\frac{1}{3} \cdot 12$]
Student:
Teacher:	Try again, one third times twelve
Student:	I think.... Don't know...
Teacher:	Once again, one third of twelve

Teacher-student conversation

Teacher:	So, what is? [writes $\frac{1}{3} \cdot 12$]
Student:
Teacher:	Try again, one third times twelve
Student:	I think.... Don't know...
Teacher:	Once again, one third of twelve
Student:	oh..... It's four!

Teacher-student conversation

Teacher:	So, what is? [writes $\frac{1}{3} \cdot 12$]
Student:
Teacher:	Try again, one third times twelve
Student:	I think.... Don't know...
Teacher:	Once again, one third of twelve
Student:	Ahm..... It's four
Teacher:	Great. See, when you think about it, you know how to do it!

Teacher-student conversation

He tries to multiply 12 by $\frac{1}{3}$, but is not yet skillful in the procedure



Teacher-student conversation

Teacher:	So, what is? [writes $1/3 \cdot 12$]
Student:
Teacher:	Try again, one third times twelve
Student:	I think... Don't know...
Teacher:	Once again, one third of twelve
Student:	Ahm...
Teacher:	What do you think about

This word and symbol evoke
numerical discourse

Teacher-student conversation

Teacher:	So, what is? [writes $1/3 \cdot 12$]
Student:
Teacher:	Try again, one third times twelve
Student:	I think.... Don't know...
Teacher:	Once again, one third of twelve
Student:	Ahm..... It's four
Teacher:

This word evoked
discourse on parts & wholes

Teacher-student conversation

Teacher: So, what is? [writes $\frac{1}{3} \cdot 12$]

Student:

Teacher: Try again, one third times twelve

Student: I think.... Don't know...

Teacher: Once again, one third of twelve

Student: Ah... It's four

Teacher: Great. See, when you think about it, you know how to do it!

**numerical
discourse**

**discourse
on parts & wholes**

Teacher-student conversation

He tries to multiply 12 by $\frac{1}{3}$, but is not yet skillful in the procedure

First, the teacher wanted me to do an “exercise”. This I don’t know. But now she asks what how much cookies I would end with if there were two other kids and 12 cookies altogether



Plan

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What they are & where they come from

2. Pitfalls of routines

How teacher's routines may lead to unintended results

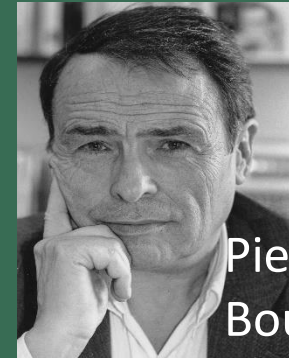
3. Controlling routines

against the unintended mattering

Teachers' routines - summary

- ❖ Routines are routers created by walking.
- ❖ In building the routines we often reproduce patterns characteristic of our sociocultural niche.
- ❖ Many of them become automated.

Teacher's automated routines



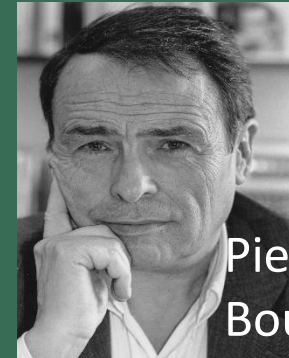
Pierre
Bourdieu

habitus

"...system of acquired dispositions..."

**society
written into the body,
into the biological individual"**

Teacher's automated routines



Pierre
Bourdieu

Teacher's habitus

"...system of automated routines

teaching community
written into the body,
into the biological individual"

Teachers' routines - summary

- ❖ Routines are routers created by walking.
- ❖ In building the routines we often reproduce patterns characteristic of our sociocultural niche.
- ❖ Many of them become automated.
- ❖ Once created, our routines are difficult to change.
- ❖ The *imperceptible automated* routines are the **most dangerous of all.**

Teachers' routines - summary

❖ Routines are routers created by walking.

❖ In the routines we often reproduce
sociocultural niche.

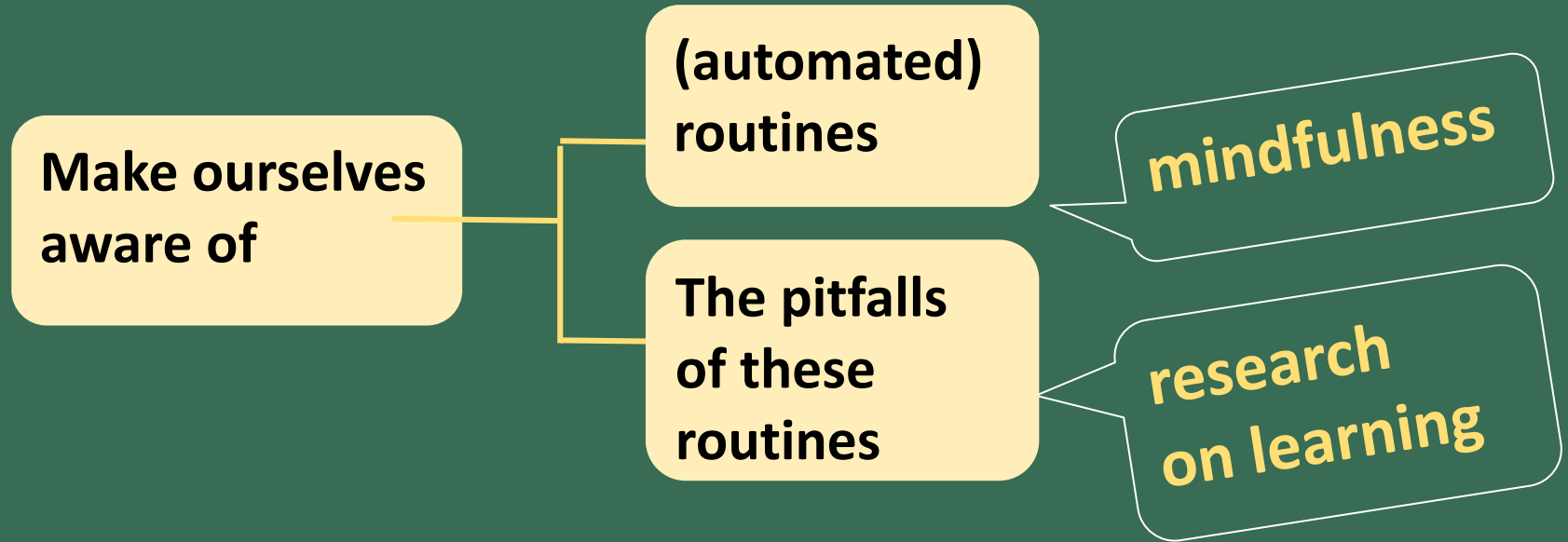
❖ Many

What to do?

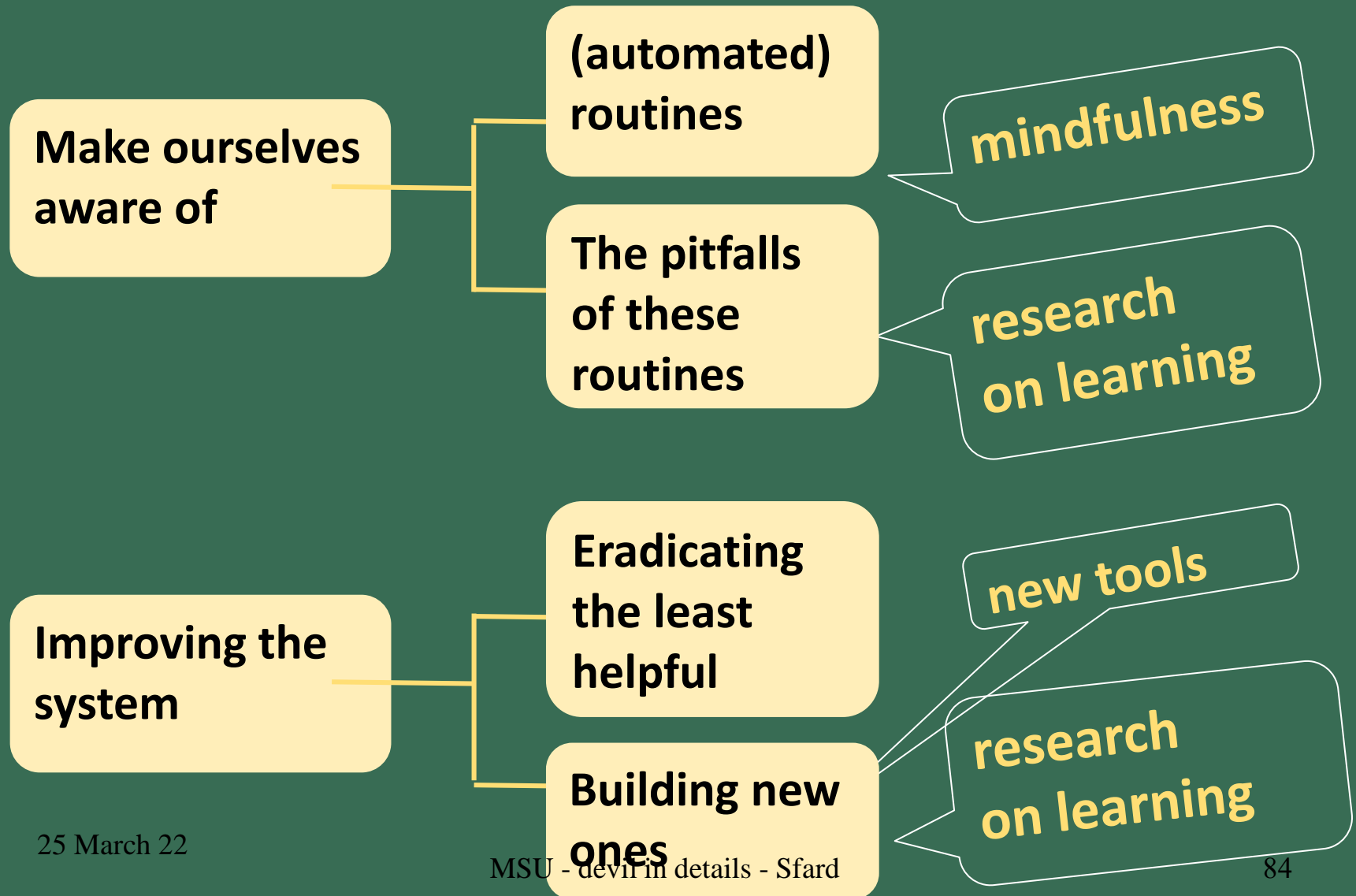
❖ Once created, our routines are difficult to change.

❖ The *imperceptible automated* routines are the most dangerous of all.

Teachers' routines – how to improve them



Teachers' routines – how to improve them



Something to keep in mind

A small step for the **teacher** may be a huge step for the **student**.

Something to keep in mind

A small step for the **teacher** may be a huge step for the **student**.

No educational reform may succeed unless teachers take care of their **atomic routines**