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Prologue 4

The routes we walk are made by walking: What it is that we rehearse and how we do it

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> We usually use the word intuition – sometimes also judgment or even creativity – to refer to [the] ability of experts to respond… almost instantaneously.
>
> – Herb Simon

My first-ever stint with classroom teaching was a formative experience. I had just completed my first year as a mathematics student when I was asked to replace a secondary mathematics teacher who had unexpectedly quit her job. Seeing this as an opportunity to improve my faltering financial status, I complied. Although I had never taught before, I believed I would manage. I am pretty competent in secondary mathematics, I told myself, and it is surely all I needed to teach.

Little did I know, though. My first encounter with a class was quite a disaster. I remember myself standing speechless in front of thirty youngsters waiting for me to open my mouth. When I was eventually able to emit a sound, sentences came out reluctantly, like water from a broken tap. At that moment, I realised that I had never spoken mathematics with anybody but myself (with my teachers, I corresponded about mathematical objects in a written code).

This traumatic experience put me on the path I have been following ever since then. I began a life-long quest for answers to two simple questions: *What makes the teacher able to act on the spot without deliberating? How does she develop this ability?*

In this book, dealing with the role of rehearsals in ushering prospective teachers into their professional practices, I will try to summarise what we have learned about these two issues so far. In a nutshell, my current answer to the first question may be presented in one word: *routine*. In this paper, this last word is to be understood as referring to a known form of action to which a person returns whenever in a situation, reminding her of its past applications. A rich repertoire of well-developed professional routines is the basis of the expert teacher's smooth functioning.

It is the second query where the hero of this volume, the *rehearsal*, enters the scene: rehearsing may be the best way to introduce a new routine to a future teacher who does not yet have fully fledged access to the school classroom. And yet, the effectiveness of rehearsing as a method for developing a repertoire of routines may be obstructed by the phenomenon known as the *situativity of learning*. Armed with recent insights from cognitive neuroscience, combined with what is known about the workings of social factors, I will try to fathom the mechanisms behind this phenomenon, and propose techniques for maximising the benefits of rehearsing.

What makes the teacher able to act on the spot without deliberating?

Consider the following general truth: In the majority of familiar life situations, not just in the classroom, we know what to do – we are able to act in an immediate, instinctive manner. Whether we bump into a friend in the street, shop in a supermarket, stand at the whiteboard, or try to rest, we know what to do without being told, and without deliberation.

The first of my above two questions can thus be generalised: *When you are in a familiar situation in which you need to act, what is it that makes you able to decide on the spot what to do*? A moment of thought and you realise that the source of this immediate action is… your *experience*. It is what you, or other people, did in the past in a similar situation that you are likely to repeat now. And to say it in more detail, 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, whether by yourself or by others.

To say it more succinctly, let me replace the words 'situation in which you feel obliged to act' with the term *task-situation* and 'a past situation sufficiently similar to the present one to justify doing now what was done then, whether by yourself or by others' with just one word: *precedent*. What I just said in a long, complex sentence can now be stated in a much shorter and clearer one: *When you find yourself in a task-situation, you tend to recall a precedent.*

Indeed, we go through our lives repeating our own and other people's past actions. The important conclusion follows from here: The repetitions create patterns of action. It is such a recurring way of doing things that we call 'routine'. You recognise a routine by its two elements. First, there is the *task*, the set of all those elements of the precedent event that we wish to preserve, or to return to now. Then, there is the *procedure*, something that was done in the precedent situation and is now deemed helpful also in executing the present task. In simpler words, the *task* is something that must happen as the result of the routine performance, and the procedure answers the question of how it will happen. In deciding about tasks and procedures, we draw on precedents.

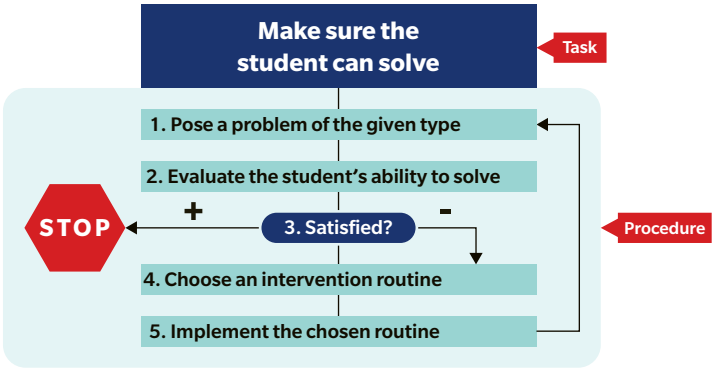
While doing this, we need to remain alert to two facts. First, our performance and its results will always differ from the previous ones in some respects, because the present task-situation, although similar to the precedent one, is

still different. Thus, both the task and the procedure are general *descriptions* of action, detectable in specific performances, but not identical with them. These are general schemes of action, performable in a range of situations. Like any prescription, whether algorithmic or heuristic, they may be applied to numerous inputs.

Second, neither the task nor the procedure is a free-standing construct. These two are products of individual interpretations of task-situations, and as such, they depend on both the situation and the interpreter. Two people faced with seemingly the same task-situation may see themselves as charged with very different tasks.

Let me illustrate all this with an example of a teaching routine. Suppose a mathematics teacher is tutoring a student (see e.g. Heyd-Metzuyanim, 2013). The flowchart in Fig. P4.1 presents schematically the sequence of moves the teacher is likely to undertake in this one-to-one interaction. The *task* she probably has in mind is to ensure that the learner becomes capable of solving a certain family of problems. Her *procedure*, implemented every time a new type of problem is to be learned, begins with posing a question (see step 1 in Fig. P4.1), and watching the girl's subsequent actions while also evaluating her ability to solve (step 2). If the teacher feels satisfied with what the student has done (see the left arrow from the diamond shape 3 symbolising the act of decision--making), she stops and moves on to another family of problems, where the routine <1,2,3,4,5> will be performed again. If not (see the right arrow), she chooses a sub-routine for intervention (step 4). It can be a straightforward 'telling' or an attempt at eliciting the student's own ideas. The sub-routine is then performed (step 5), after which the teacher returns to the stage of posing a problem (step 1). She would now choose a question from the same family as the previous one, so as to be able to check whether the desired learning has occurred. If satisfied by the girl's performance in the new implementation of the procedure (step 3), she would move to a problem of a different kind, and apply the routine <1,2,3,4,5> again. If not, she will continue to steps 4 and 5.

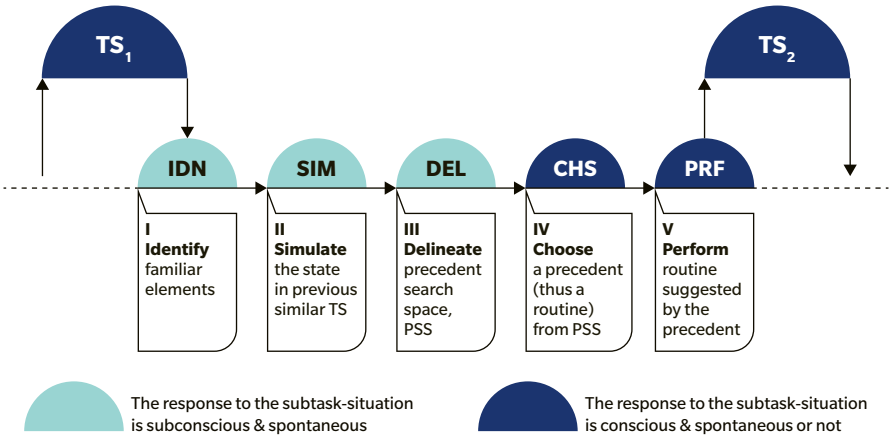
Figure P4.1



Let me mention some important features of routines (more can be found in, e.g., Sfard, 2023). To begin with, *routines are recursive constructs*: each of them is built from parts that are routines in themselves, possibly also useful as building blocks of other compound routines. As can be understood from here, *routines come in different sizes*. The smallest, simplest routines, those that cannot be decomposed and are performed in a single step, are called *atomic*. Large ones, such as the one in Fig. P4.1, or those for coordinating whole-class discussions, and monitoring students' group work, are often referred to as *practices*. In professional development (PD) courses, we tend to care about the latter (practices), but not necessarily about the former (atomic).

Further, every teacher has her own constantly developing set of routines, which are usually tightly interconnected and, as such, *constitute a network*. Finally, *the fact that we act in routinised ways does not preclude creativity*. This claim may sound paradoxical, but it becomes more convincing when we realise that *routines are the building blocks of all our activities, including those that are new to us*. This last point will become clearer when some thought is given to the question of how one chooses from her network-like repertoire of routines while building her actions.

Figure P4.2



When in a task situation in the classroom, an experienced teacher makes such choices in few very brief steps, of which she remains mostly unaware. The diagram in Figure P4.2 schematically presents these moves in a structure that has been called an *action-cycle*, because the sequence repeats itself time and again as long as a person remains active. In step 1, the teacher automatically *identifies* familiar objects, verbs, and people that, for her, define the task-situation (she notices these characteristics because she perceives them as relevant to her current needs; with Gibbson (1966), we call them *affordances*). As we learn from cutting-edge neuroscience, the recognition of all these situational elements instantaneously leads her to step 2, that of *simulation* (Barsalou, 2009). In our present context, simulation means that her whole organism returns to the bodily, cognitive, and emotional state in which she was in her previous encounters with all these elements. It is as if she was predicting that what was done then will also be done now. In step 3, the one of *delineating*, a 'precedent search space' (PSS for short) is determined. It consists of past task situations – or classroom moments – similar to the one in which the teacher is now. These three first steps are usually fully subconscious.

This may change now, in step 4, when the teacher scans PSS, searching for a suitable precedent. The reduction of the search to PSS is what makes this task feasible. The choice can be made automatically, or in a reasoned, conscious

way. Equipped with a precedent, the teacher can now, in step 5, interpret the task-situation, that is, decide about the task she is supposed to perform, and the procedure with the help of which she will do this. The procedure can be complex and may lead her through several interim task-situations, each of which will present her with its own sub-task and will dictate its own round of steps 1 to 5. The sub-tasks, in turn, may also be complex and require the execution of their own sub-procedures. The original task will be completed when the teacher, in this nesting of sub-tasks and sub-procedures, reaches atomic routines, those that she can perform in a single step.

When all this is done, the circle closes. The completed cycle leaves the teacher with some products – for instance, in the form of a new question to be presented to students – and thus in a new task-situation, which will be followed by a new round of actions from 1 to 5. Her overall activity in the classroom will be a long chain of such cycles. The more experienced she is in the performance of the routine, the smoother, and more rapid, the corresponding action cycle. According to neuroscience, the recurrent performances of a routine pave the neuronal path along which these performances are produced. Eventually, the path turns into the king's road, one with which no other trajectory can compete. The iterated pattern of action becomes the default option for a given task-situation. It is now chosen *automatically*, that is, without the need for the deliberative stage 4 ('choose') in the action cycle. It is *an automated* routine that every preservice teacher wishes to be equipped with before completing her PD course. But can it really happen? If yes, then how? To answer this, let me address my second question.

How does the teacher develop her professional routines?

So, what are the origins of routines? Imagine yourselves in a task-situation in which you have never before participated *as an actor.* Say, you are a novice teacher facing a class for the first time. You have several options. You may seek other people's help, you may try to do what you learned in PD, and you may, if possible, emulate the performance of an experienced teacher whose actions you had an opportunity to observe in a similar task-situation.

But you may also try to invent your own way of acting. Once upon a time, as an accidental and entirely unprepared teacher, I had no verbal advice to rely on and no instructions to follow, but I could either emulate my own teachers or try to derive new ways of acting from my knowledge of mathematics, combined with my own experience as a learner.

But whatever trajectory I chose, I had recourse to my existing routines: I was building new ways of acting from the basic steps in which I was already adept at that time.

So far, I have sketched the different ways in which a new habitual way of doing things may start budding. But how does such an emerging pattern turn into a fully fledged routine? For this, a number of similar performances in similar task-situations is necessary. Research has helped us to assess the approximate number of necessary repetitions: '[S]tudies have shown it takes, on average, 20 separate instances of practice before a teacher has mastered a new skill, with that number increasing along with the complexity of the skill' (Joyce & Showers, 2002). Thus, just like the routes we walk are made by walking, so are teaching routines made by teaching.

When put this way, things appear simple. Once you have a procedure, whether copied from your own teachers, explained to you by others, or invented by yourself, all you must do to fully routinise your actions is implement this procedure again and again. But this is not as simple as it sounds. Indeed, we seem to have a paradox here: on the one hand, to develop a routine, you have to gain much experience in actual teaching; but on the other hand, how can you teach without already having this experience?

This paradox, and the resulting inherent difficulty of the task, may be the reason why teacher preparation, as practised these days around the world, evokes much discontent. This sentiment can be found, for instance, in the already more than ten-year-old, but still relevant, report on PD by the US National School Boards Association's Center for Public Education. According to the *Washington Post* article with the telling title, 'Why most professional development for teachers is useless?'[1], the authors of the report ventured the diagnosis: 'The reason traditional PD (professional development) is ineffective

1 https://www.washingtonpost.com/news/answer-sheet/wp/2014/03/01/why-most-professional-development-for-teachers-is-useless/

is that it doesn't support teachers during the step of learning with the steepest learning curve: implementation.' The step of *implementation* is exactly the one in which I am now interested: this is the step of practising, that is, of using the budding routine in teaching.

So, how can preservice teachers be helped to turn a budding routine into a fully fledged one? How can we ensure that she can practise when not yet fully competent in identifying the opportunities for using a given sequence of actions, and when her performance of the sequence is still shaky, and potentially full of errors? Letting her enter the classroom may not be in the children's best interest. So, what can she do?

Yes, you guessed it: she may rehearse it in front of her colleagues. The word *rehearsal*, borrowed from the discourse of theatre, where it means 'a private performance or practice session preparatory to a public appearance'[2], signals that the routine would be performed in circumstances different from those in which it is meant to be used in actual teaching. Thus, rather than being held in a school classroom, it will happen in the university hall, and rather than involving interaction with school children, it will be performed in front of fellow students playing the role of students. Sounds ingenious and simple – but is it?

As I will try to explain now, the change of the audience and scenery is not a benign move and may affect the effectiveness of the rehearsal.

The challenges of rehearsals

Whereas it is quite obvious that rehearsing a procedure may help you become proficient in its *performance*, it is not at all evident that it will make you fully prepared to *recruit* this procedure whenever appropriate.

Indeed, a long series of research studies has shown a rather disturbing phenomenon: routine developed in task-situations of one type, say in a school setting, is unlikely to be recruited in task-situations of another type, say in your local grocery store, even if it could be helpful. This message has been

2 https://www.merriam-webster.com/dictionary/rehearsal

corroborated time and again in a long series of studies conducted in widely varying social and cultural environments. In particular, it was shown that even those who have graduated from school with a satisfactory command of mathematical routines rarely use these routines in everyday settings, such as supermarkets (Lave, 1988), or workplaces (Scribner, 1997).

Researchers summarised these and similar findings as showing the *situativity of learning*, with this expression signalling that

> [t]he activity in which knowledge is developed and deployed… is not separable from or ancillary to learning and cognition. Nor is it neutral. Rather, it is an integral part of what is learned. Situations might be said to co-produce knowledge through activity. Learning and cognition… are fundamentally *situated*. (Brown et al., 1991, p. 32; emphasis added).

Aware of this phenomenon, we seem to have good reason to fear that PD graduates, once they find themselves in school, may tend to shun the routines they learned and rehearsed in the university. This would mean that rehearsals are less effective as a means of teacher preparation than we would wish them to be.

To be able to counter the impact of situativity, we have to understand its sources. For this, let us return to the activity cycle (see Fig. P4.2) and look at the way routines are recruited in task situations. A closer glance will reveal quite a few factors likely to obstruct the choice of the rehearsed routine.

To begin with, the simulation performed in step 2 will prove unhelpful if it filters out the university experiences. You cannot defend yourself against such omission because the simulation, and thus also the act of delineating PSS (step 3), are subconscious and thus cannot be controlled. Unfortunately, in the transition from rehearsals to authentic teaching situations, the chances of ending up with an unhelpful PSS are quite high. The elements that, for the PD graduate, define school situations are quite different from those to which she got used in the university, where she rehearsed the routine. Above all, her task as a schoolteacher is very different from the one she faced while rehearsing. Indeed, in school, the teacher strives to introduce children to something they do not yet know, but when she was in the university and rehearsed a relevant routine in front of her peers, she just aimed to manifest her command of this routine. After all, it was a pretend game, in which the participants acted as if

they were learning something they already knew. Obviously, the university and school contexts evoke different reactions and carry different risks. Because of these differences, the teacher, in the subconscious process of simulation, is unlikely to associate the school task-situation in which she is now with the allegedly 'equivalent' situation in which she was at the time of a rehearsal.

Even if the rehearsed routines did manage to sneak through the filter of simulation and are now a part of the teacher's PSS, in the subsequent step 4 she may fail to opt for any of them because of two principles that tacitly govern her choices.

The first of these principles, to be called here *the Law of Minimising Effort (LoME)*, has been formulated by the recently deceased Nobel-prize-winning psychologist, Daniel Kahneman: *'If there are several ways of achieving the same goal, we tend to opt for the least demanding course of action.'* The primacy of the least onerous option stems from your organism's natural tendency to optimise the expenditure of energy. It means that whenever in the situation of choice, you tend to opt for the shortest, least onerous route. Only too often will the winning candidate be an idiosyncratic shortcut, made possible by the specificities of a given situation and applicable exclusively to this situation. The PD graduate will tend to choose the shortened course of action time and again, and its resulting automation will reduce the appeal of the rehearsed routine even further.

Because of another choice-guiding principle, this time related to our social rather than biological needs, the teacher may favour her colleagues' routines over those she rehearsed in PD courses. Named *the Law of Maximising Acceptability (LoMA)*, this principle may be formulated as follows: 'We tend to choose ways of acting that seem to us likely to maximise social rewards and minimise punishment.' As teachers, we choose what our institution expects us to choose, or what we guess would be the choice of a revered colleague. Above all, we gravitate towards hegemonic discourses, and thus towards routines of those whom we consider as 'the owners' of these discourses. Finally, we tend to opt for what is popular, taking popularity as evidence of the superiority of the given option, and we rarely admit that the reverse may be true: that we consider something superior only because of its popularity.

To sum up, the answer to the previously asked question 'Why situativity of our routines?' can be stated as follows: The main reason is our subconscious reliance on simulation, combined with our tendency to minimise effort and

maximise the rewards for our actions. This insight may help in counteracting situativity.

Thus, one of the self-imposing conclusions is that, to increase the effectiveness of rehearsals, teacher educators may try to make student-teachers aware of the tacit workings of LoME, and LoMA. Future teachers can also be explicitly encouraged to oppose the impact of these two principles. For this, they need to exercise mindfulness, critical thinking, and open-mindedness. All these skills are necessary if the teacher is to be able to counteract the pull of the crowd, and resist the appeal of thrifty, automatic solutions.

Interweaving staged and authentic performances of the desired teaching routines, already from the outset, seems to be yet another action likely to have a positive impact on the effectiveness of rehearsals.

How all this can be done, and whether it will have the desired effect, is still an open question, requiring careful theoretical analysis and rigorous empirical examination. I stop here, leaving the due considerations to other contributors to this anthology.

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