Farewell speech Utrecht University, May 31, 2018

We cannot make it easier ... but we can make it more fun

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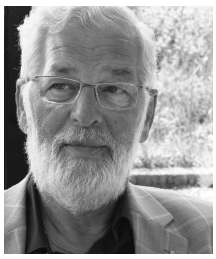
Catharijnesingel 60, 39 years ago

When I entered this door for the first time more than 39 years ago, I couldn't have thought that my whole working life would pass with one, and the same, educational programme[1] I got a temporary job in a science area for which I was not trained or knew anything about: pharmacology. During my master-programme my subjects had been Experimental Developmental Biology (at the Hubrecht Laboratory), Embryology and Animal Physiology, and it was planned to pursue a PhD in Brittany, France, studying the embryology of Dentalium. Unfortunately that project couldn't continue due to the beaching of the Amoco Cadiz on the coast of Brittany on March 16, 1978. The image of a super tanker, where any change of direction has to be planned timely and where careful steering and small tow-boats are needed to prevent disasters, has haunted me when I became the curriculum coordinator and Director of Education many years later.

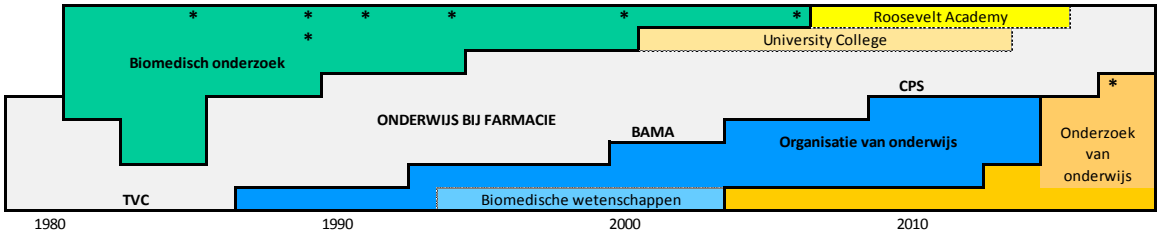


I have asked myself, how Lowie Jager (1943-2015) dared to give me the task to develop and present a Pharmacology course for Pharmacy students in year-5. The department of pharmacology at that time consisted of an extra-ordinary professor (Bob van Noordwijk, who we were of course not allowed to call 'Bob'), two pharmacists (Jos Koomen, Jelle Schuringa), a 'smooth muscle' physiologist (Lowie) and two technicians (Gerard

[1] If I remember well, two details are lacking in this picture of the entrance as it has been reconstructed in the University museum: a red door bell in the right-hand door-post and a metal plate on the door, which you had to kick violently to open the door, while pressing the door bell.

Hofman, Hans Schevers). I was given the task to implement a conceptually new course, including preparation, practical organization and the writing of course scenarios. The design of the course involved the pharmacological identification of two 'white powders' (coded A and B), using classical pharmacological experiments, such as an Hippocratic screening (using live mice), in vivo blood pressure (rat), isolated Langendorff heart (rat) and cervical ganglion - nictitating membrane (rabbit) preparations, followed by formulating an explicit hypothesis in terms of pharmacological targets (receptors). In the next two weeks several in vitro experiments (small intestine, colon, atrium, vas deferens, diaphragm, hind quarter perfusion) are used to construct dose-response curves and to determine pD2 (agonists) and pA2 (antagonists) values for drug A, drug B, and prototype drugs for the different receptor subtypes in the in vitro preparations. All in all a challenging course for students, teachers and support staff, where students learned to 'think as a pharmacologist'. Physiology, receptor pharmacology and pharmacotherapeutic applications were learned by doing.

I have always considered my experience with implementing this course as a 'critical incident', which was a determining factor in the way I view the use of authentic assignments for learning. Many were to follow!



In general I am not inclined to look backward, but at this moment that I have more 'past' than 'future' I like to make an exception. Because I have done so many different things during my career at the Department of Pharmaceutical Sciences and the honours colleges in Utrecht and Middelburg, it would be very hard to try to be complete.

I will NOT talk about the biomedical research in which I have been involved in the 80-ies and 90-ies. Not because I think that's not important, but because most of that work is documented in scientific publications, several PhD theses and even reflected in the Pharmacology department itself, as two of my former PhD students (Frank Redegeld, Aletta Kraneveld) are now my direct colleagues.

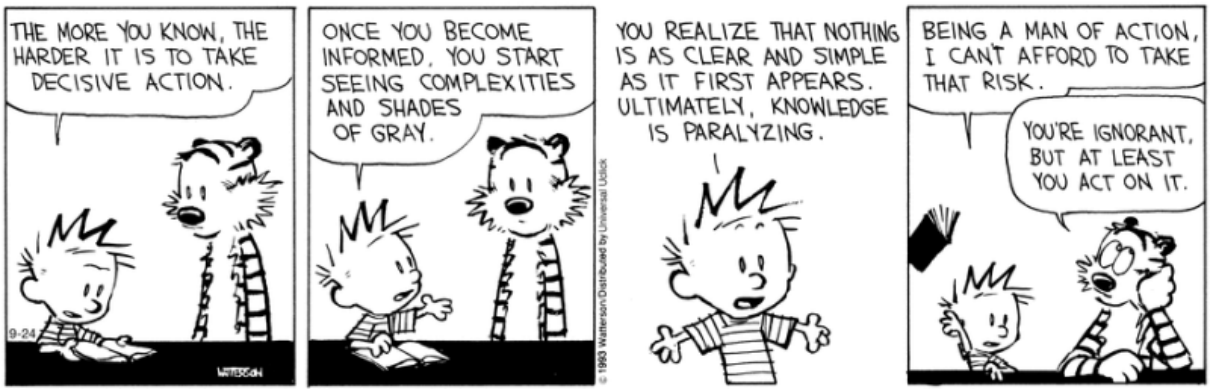
I will also NOT talk about the 'rollercoaster' of 1983, when the Faculty of Pharmacy was likely to be closed down as a consequence of a national reorganization of university structure by the Ministry of Education[2]. After half a year of publicity campaigns by the faculty and playing games by policy makers and politicians, the Department of Dentistry was suddenly exchanged for Pharmacy. Utrecht got all the Pharmacy students, and some teachers from

[2] See for a political analysis of this reorganization an article (in Dutch) by Jacques Wallage, at that time a member of the lower house of parliament: Operatie Taakverdeling aan de Nederlandse Universiteiten en Hogescholen. Taakverdeling en concentratie in het wetenschappelijk onderwijs. *Ons Erfdeel 27, 367-374 (1984).*

Amsterdam and moved, years later and after an expensive rebuilding, to the former Dentistry building.

I WILL try to explain, what I have learned over the years about higher education by being involved in higher education, and I will make some critical observations. In have been involved myself in these subjects, have thought about it, and even have done some research in these areas. Many of you attended the symposium during the last few hours and heard what some specialists said about the learning of students, about the role of teachers and about teacher professionalization. These specialists already illustrated that many aspects of higher education are not 'easy', but I like to reiterate the same aspects in my farewell speech. At the end I will explain how I 'made sense' of all the changes I have been involved in - in the beginning rather unconscious, but gradually more and more self-conscious. The story becomes, in this way, a reflection of my personal journey during the past 40 years. I learned a lot myself and hope that my colleagues will benefit from this talk.

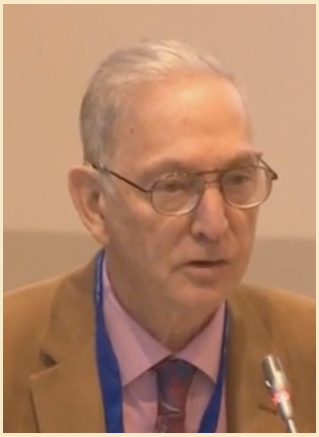
A goal for the University



Learning is not easy. If we accept that the goal of a University is to deliver competent researchers and other professionals, we expect that at student at the end of the programmed is able to function in a suitable job with a reasonable measure of independence and respecting the habits, rules and limitations that go with the job. We know, of course, that in many professions such as education and health care continuous education and training is necessary. It is expected of a recent graduate that he/she will keep on developing, both with respect to content of the profession and with respect to personal competences. For the recently graduated pharmacist in the Netherlands this means a specialization to community pharmacists or hospital pharmacist. Thereafter, an even larger array of professional education courses is available; we expect an attitude to become a 'life-long learner'.

We expect a recent graduate not only to be knowledgeable about the 'facts' or the way to verify them, but also that he/she is aware of the context of these facts and the way they are obtained. Moreover, they are expected to know the limitations and the reliability of the

conclusions, which are based on these observations. It is clear that in the social ad medical sciences different, and sometimes conflicting, explanatory models or theories can be used to interpret observations or measurements. Models can be more (or less) reliable, and the interpretation of research results will depend on relevant theoretical frameworks, models or 'constructs'.



"There are essential differences between the craft work of scientific research and other sorts of human activities. For the objects of scientific inquiry are of a very special sort: ***classes of intellectually constructed things and events****. Their difference from the objects of handicraft production, or even of ordinary discourse and action, gives scientific knowledge its special power, and makes scientific inquiry a particular complex and delicate social activity."*[3]

Jerome R. Ravetz
James Martin Institute for Science and Civilization, Oxford

Although this may not be directly evident to everyone, also the natural sciences use theories and models for the interpretation of research results. Absolute facts do not exist, but only more or less generally accepted (and learned) interpretations of what has been observed or measured using certain theories and/or concepts[4]. At the end of an academic programme a student is expected to have mastered these concepts, and to be familiar with the related possibilities and limitations. The student has learned the context, the concepts, the jargon and the 'language' of the profession and is able to communicate with fellow-professionals without too many misunderstandings. We expect that a graduated student is able to reason in a 'contextual relativistic' way.

It may be useful to illustrate the concept of 'contextual relativistic reasoning' with a few examples:

1. The phenomenon 'light' in physics can be explained using two different theories. In one theory (Christian Huygens) light is described as a wave phenomenon, in the other theory (Isaac Newton) as particles. Observations as interference of coloured light can be analysed and explained with the wave-theory, but other observations as reflection of light are more easily explained with the particles-theory. Nowadays we know that light in some aspects

[3] Cited from: Scientific Knowledge and its Social Problems, Penguin (1973), p.109. The photograph was taken from a video-recording of a workshop at Ispra (Italy), 3 March 2016.

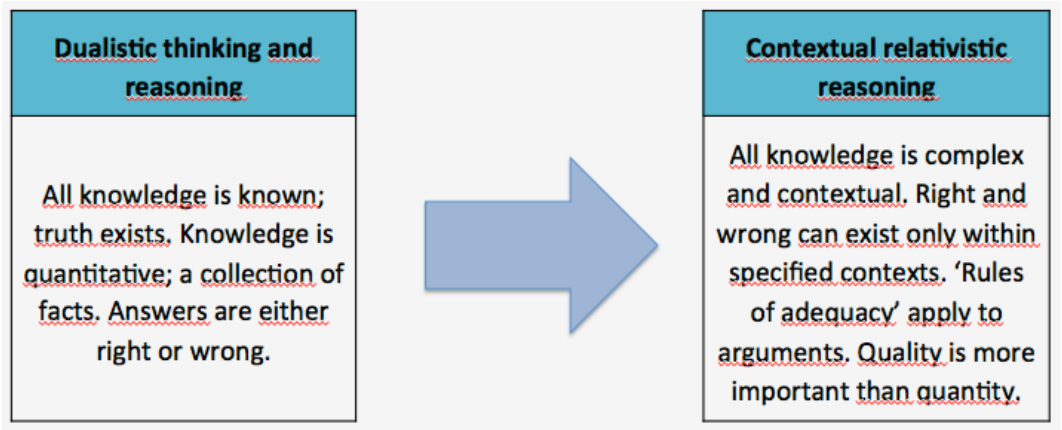
[4] The English philosopher Jerome Ravetz describes scientific work as crafting 'intellectually constructed objects'. In this view scientific work is distinct from other human activities such as crafting physical objects and day-to-day conversations and actions. The combination of observing, measuring and interpreting data in the context of a scientific theory makes scientific enquiry an extraordinary complex and delicate social activity, where attention and care for quality of the research process must have the highest priority. See Ravetz JR: Scientific knowledge and its social problems. *Penguin Books, Harmondsworth, England (1973)* en Ravetz J: Keep standards high. *Nature 481, 25 (2012).*

behaves as particles (in the sense of exactly located distinct 'things') and in some aspects as waves. This means, that everyday models as the billiard balls or water waves both are inadequate. Depending on the context of the observation, which must be explained, the first or the second theoretical model is used.

2. In medicine not many diseases are discussed more than the chronic fatigue syndrome (ME/CFS). Because it has been extremely difficult to identify a biological cause, ME/CFS was for a long time not recognized as a 'disease' from a biomedical standpoint. In the Netherlands ME/CFS was only recently recognized (March 19, 2018) by the Health Council of the Netherlands, using a medico-psychological way of thinking. This opened the possibility to combine physical and psychological complaints and to develop a practically effective treatment plan for tis condition.

At the start of an academic study students undoubtedly have experienced contextual relativistic reasoning in a number of life-domains, which makes it possible to interpret observations in different ways, but in many scientific subjects knowledge is limited to making a distinction between correct and wrong answers fitting in one-and-the-same explanatory theory. We call this way of reasoning 'dualistic'. Answers are only 'correct' or 'wrong' and are not dependent on the context or the explanatory model used.

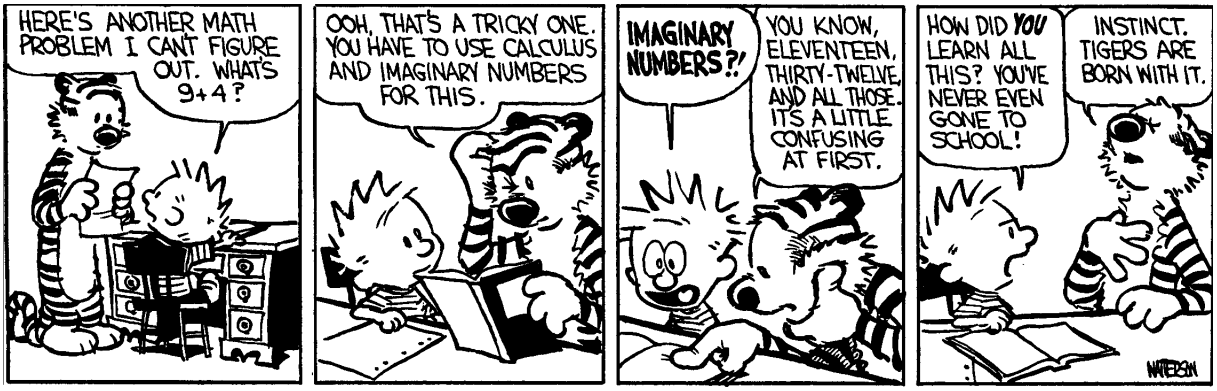
Study programmes ideally are designed in such a way, that students are helped to make the transition from dualistic reasoning to contextual relativistic reasoning[5]. For many students making this transition is a difficult process, but the educational design of a curriculum can be optimized to help students as good as possible to make this transition. Not only content is important, but also other aspects of the teaching-learning environment such as educational formats, scheduling, rules, facilities and the role taken by teachers and tutors. In what follows I am going to illustrate how difficult this individual cognitive development process is, and I will describe what the consequences must be for the roles of teachers and educational management.



[5] On the micro-level (in disciplinary contexts) similar 'conceptual change' problems have been identified and described. Students have to make a change form dualistic correct-wrong thinking to the use of context-specific reasoning, referring to suitable explanatory theories and models.

We cannot make it easier ..... for students

Quality of learning



William G. Perry Jr. (1913-1993) has investigated cognitive development of students in higher education thoroughly in students of Harvard University[6,7]. Although this concerns the specific environment of a 'liberal arts and sciences' college, Perry's 'scheme of intellectual development has been used successfully to describe the cognitive development of students in other higher education environments, such as engineering and chemistry. Based on a large number of detailed student interviews Perry, Knefelkamp and Cornfeld formulated a 9-stage developmental scheme, of which mainly the stages 2 to 5 are relevant for undergraduate education. Developmental stages are distinguished on the basis of the students' conceptions about learning, about their own role and their expectations about the teachers' role.

A dualistically thinking student assumes that 'truth' exists and that studying involves 'hard working' to learn all the facts[8]. After some time the student learns that 'the truth' is incomplete and/or uncertain, and he/she expects that an 'authority' (i.e. teachers, books) supplies answers and creates clarity. The student searches for explanations and ways of thinking that are used by authorities, but they also find out gradually that not all authorities or

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[6] Perry WG: Forms of ethical and intellectual development in the college years. A scheme. Jossey-Bass, San Francisco CA, 1999 (re-edition of the original book from 1970). See also Finster DC: Developmental instruction. Part I. Perry's model of intellectual development. J.Chem.Educ. 66,659-661 (1989).

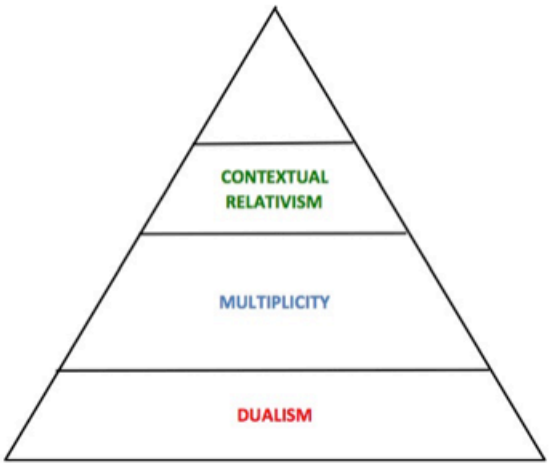
[7] Apart form Perry's model, other theoretical models are in use, such as the 'Women's way of knowing' model (Belenky *et al.*), the 'Epistemological reflection' model (Baxter Magolda), the 'Reflective judgement' model (King en Kitchener) and the 'Argumentative reasoning' model (Kuhn). All these models have parallel characteristics. For a direct comparison see Felder RM & Brent R: The intellectual development of science and engineering students. Part 1: Models and challenges. J. Engin. Educ. *93, 269-277 (2004)*; Richardson JTE: Epistemological development in higher education. *Educ. Res. Rev. 9, 191-206 (2013)* and Zhu J & Cox MF: Epistemological development profiles of Chinese engineering doctoral students in U.S. institutions: An application of Perry's theory. *J. Engin. Educ. 104, 345-362 (2015).*

[8] The short descriptions of Perry-levels in the tables are taken from Finster DC: Developmental instruction, part II. Application of the Perry Model to General Chemistry. *J.Chem. Educ. 68, 752-756 (1991).* The scheme of the transition process is taken from Finster DC: Developmental instruction, part I. Perry's model of intellectual development. *J.Chem. Educ. 66, 659-661 (1989).*

sources have the same opinion. This stage is called 'multiplicity' reasoning, where the student mainly needs to learn relevant concepts. They must learn to apply the disciplinary rules and argumentations in solving tasks and problems, drawing conclusions and taking positions. Often in the beginning extensive support (scaffolding) is needed. As development progresses, explanatory concepts become better internalized and the student acquires the capability to assess whether his/her own reasoning follows the rules and procedures, which are relevant in the context at hand. They become able to evaluate whether a conclusion can be supported by the observations or facts: the stage of 'contextual relativism'.

Perry 1970	stages	Perry position
COMMITMENT within relativism	developing commitment	9
	commitment orientation	8
	initial commitment	7
RELATIVISM	commitment foreseen	6
	relativism correlate	5
	relativism subordinate	4b
	mutiplicity correlate	4a
DUALISM	multiplicity subordinate	3
	multiplicity prelegitimate	2
	dualism	1

Intellectual development (Perry 1970)



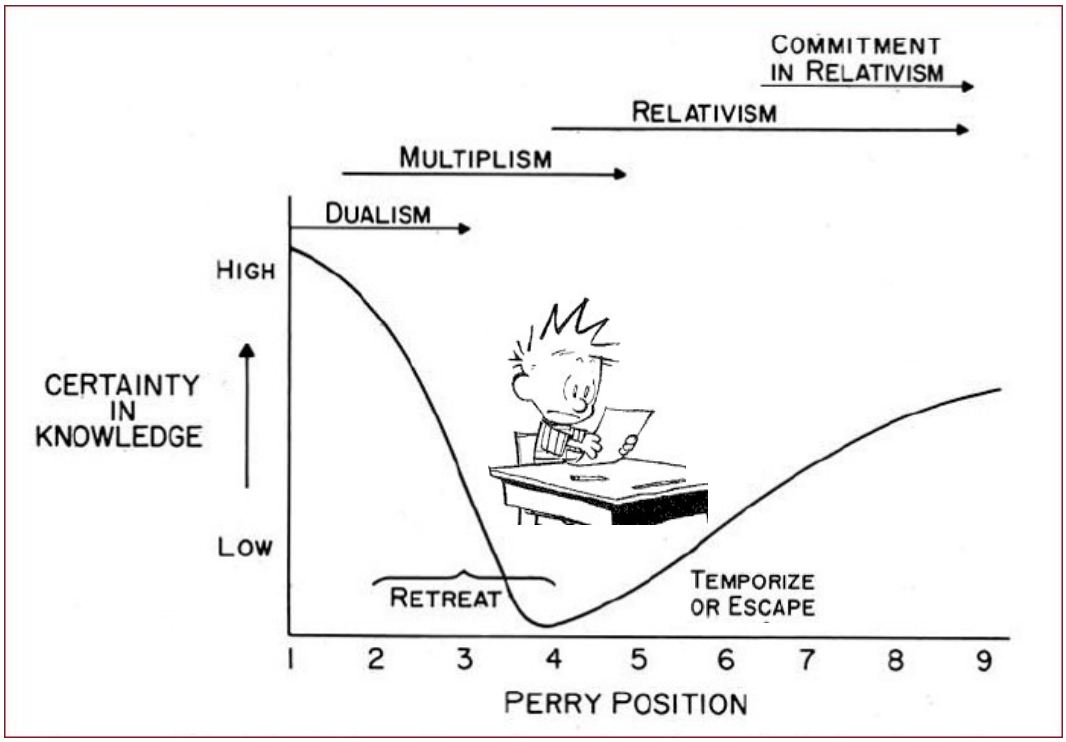
Student epistemology (Moore 2002, Zhu 2015)

	Dualism (Perry 2)	Early multiplicity (Perry 3)	Multiplicity (Perry 4)	Relativism (Perry 5)
Conception of knowledge	Truth exists. All knowledge is known	Truth exists, but is incomplete	Some uncertainty exists. **Authorities must supply guidance and context**	Complex and contextual. Rules apply for 'adequate arguments'
Role of the student	Work hard, receive information	Learn how to learn. Express oneself well	Confront and challenge. **Learn "how they want us to think"**	Exercise and apply the rules. Use different perspectives

The transition from dualistic thinking (stage 2) to relativistic thinking (stage 5) often is problematic, because is involves increasing uncertainty of students about their own knowledge and expected role, expressing itself in questions about assessment criteria. The need for feedback changes from concrete questions about 'correct' or 'wrong' answers towards questions about underlying concepts and the argumentations, which follow logically. A shift is observed from attention for content to attention for processes and procedures.

A problem in recognizing this transition follows from the extensive inter-individual differences between students, both in initial Perry-level as in the way they pass through the

different stages. Every student follows an individual trajectory that can be fast or slow, smooth or with hurdles, more or less complete, etc. In all studied cases the transition appears to be not very fast, and the transition from stage 2 to 5 occurs typically in the second half of the bachelor programme or the early master programme. Some students, who struggle with the transition process[9], remain in the dualistic stage and resist the intellectual challenge of making the transition to relativistic thinking. This can result in a temporary stand-still ('temporize' in the figure) or a refusal to take responsibility for his or his or her own learning process. In course evaluations uncertainty about assessment criteria of tests is diagnostic for students in this transitional stage.



Because of the large inter-individual differences[10], the described crucial transition in am academic career is not easily recognized in large-scale education. In a small-scale teaching-learning environment, with a well-organized tutorage, individual differences can be easier recognized. In large-scale education students simply succeed or fail, in small-scale education individualized support is possible if teachers, tutors and student advisers are equipped to do so.

If we cannot make it easier ..... can we make it more fun?

That is not so easy. Limited time makes it impossible for me to discuss this otherwise than by suggesting that one of the most important things is to prevent that students become dé-motivated by their learning experience. Therefore, three important conditions needs to be met, which can be derived from the Self Determination Theory (SDT):

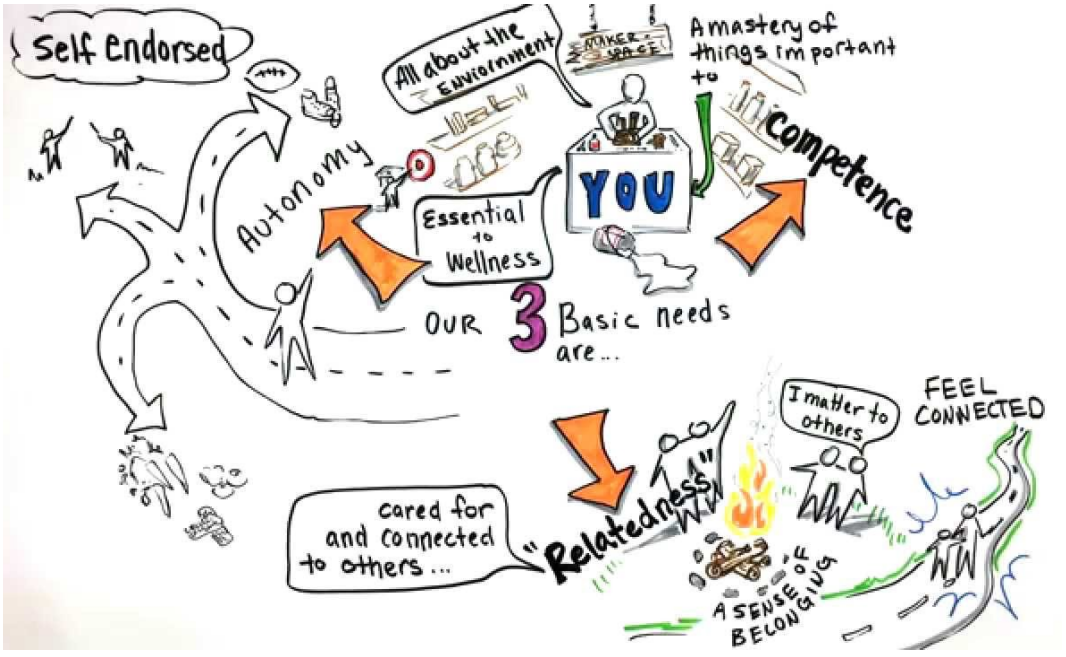
[9] This transitional process sometimes has parallels with a mourning porcess. See Kloss RJ: A nudge is best. Helping students through the Perry scheme of intellectual development. *Coll. Teach. 42, 151-158 (1994)*.

[10] See Felder RM en Brent R: Understanding student differences. *J. Engin. Educ. 94, 57-72(2005)*.

1. The education must be challenging, but not tóó difficult. The student must feel competent to bring the assignments or tasks given to a satisfying result with the available support. In terms of Perry's model it can be said that a task at the Perry+1 level offers enough challenge to make a following developmental step. Other ways of saying the same thing is that there should be 'constructive friction' (Vermunt) or that the assignments must remain in the 'proximal zone of development' of the student (Vygotsky). If the challenge becomes too big, the teacher operates outside the students' zone of proximal development, resulting in a 'destructive friction', instead of a constructive friction. The result will lead to dé-motivation.

2. The students must have that feeling that the task given can be carried out with a certain amount of freedom and liberty to use their own planning. In terms of the SDT the student experiences 'autonomy' and a sense of his/her own responsibility. Both on the level of curricular constituents (e.g. courses) and the curriculum as a whole the student must feel enough autonomy in order not to become dé-motivated. In my experience micro-management and over-detailed planning and deadlines, which does not respect interindividual differences, can turn out negatively.

3. The student must experience a sense of relatedness to (fellow) students and teachers. This can be organized by letting students work together on collaborative projects, by adequate teacher support or role modelling.



Attention for these three motivational aspects of a teaching-learning environment can contribute to a feeling of 'fun' among students. In the past many suggestions have been done for teaching formats which are suitable for helping students making the transitions in Perry's scheme[11]. Nowadays, all kinds of computer-supported education, serious gaming and blended

[11] See for example Finster DC: Developmental instruction. Part II. Application of the Perry model to general chemistry. *J. Chem. Educ. 68, 752-756 (1991)*; Kloss RJ: A nudge is best. Helping students through the Perry

learning, just to name a few, can be added. With all these educational formats it is always advisable to maintain a balance between competence, autonomy and relatedness, and to stay within the zone of proximal development.

A last element for the quality of learning I like to mention that students must always feel that the assignments and tasks are relevant for their chosen programme. For a professional programme (such as pharmacy or medicine) this is relatively easy because assignments and tasks can directly be derived from the profession. In early years of the curriculum part-tasks can be used in the curriculum, in later years more complex 'authentic' tasks or 'entrustable professional activities' can be incorporated. In the research-oriented pharmaceutical sciences programme, which was designed in our department from 2010 onwards, a similar principle was used by placing students in the role of a researcher right from the beginning of the curriculum. Inquiry-based learning was used as a design principle in this case[12].

We cannot make it easier ..... for teachers

Quality of teachers

Above I have paid much attention to the learning process of students and the developmental process during their University career. There are important implications for the teachers' task, which consists mainly of designing education and instructing or coaching of students. If we think of the consequences of what has been mentioned above, it will be clear that the educational formats and the way students are instructed or coached must be related to the Perry-level of the (individual) students. It will be clear that educational formats that are suitable for the beginning of a study programme are not necessarily suitable for later stages, and vice versa. For course designs it means that it is advisable to consider explicitly the

scheme of intellectual development. *Coll. Teach. 42, 151-158 (1994)* and Felder RM & Brent R: The intellectual development of science and engineering students. Part 2: Teaching to promote growth. *J. Engin. Educ. 93, 279-291 (2004)*.

[12] Meijerman I, Nab J & Koster AS: Designing and implementing an inquiry-based undergraduate curriculum in pharmaceutical sciences. *Curr. Pharm. Teach. Learn. 8, 905-919 (2016)*.

developmental stage, for which a particular course is aiming. In the Education Guidelines of our University that is – implicitly – expressed by making a distinction between courses at introductory (100), in-depth (200) and advanced (300) level. In almost all curricula there is attention for a 'concentric' development of knowledge and skills, sometimes in the form of longitudinal learning tracks. Unfortunately, an explicit framework or instructions for desirable course characteristics at these three levels, in terms of cognitive level aimed at, is largely lacking.

When developing or updating courses, an important task for teachers is to evaluate whether a course stimulates the desired student development. Here 'Perry scheme of intellectual development' can be an important frame of reference. It is particularly important to take care that not too large a 'mismatch' is occurring between the course level and the Perry-level of the participating students. Apart from the content of the course, the educational formats should continuously challenge the students to make a next step in their development: the Perry+1 rule[13].

	Dualism (Perry 2)	**Early multiplicity (Perry 3)**	**Multiplicity (Perry 4)**	**Relativism (Perry 5)**
Conception of knowledge	Truth exists. All knowledge is known	Truth exists, but is incomplete	Some uncertainty exists. **Authorities must supply guidance and context**	Complex and contextual. Rules apply for 'adeqaute arguments'
Role of the student	Work hard, receive information	Learn how to learn. Express oneself well	Confront and challenge. **Learn "how they want us to think"**	Exercise and apply the rules. Use different perspectives
Role of the teacher	Authority; source of knowledge	Models the process for finding truth	Sets the context. **Models the way of thinking**	Guide and consultant; source of expertise

For teachers the existence of relatively large inter-individual differences between students (in one-and-the-same course) is a complicating factor, because students at different Perry-levels expect (and need) a different teacher role. Teachers, therefore, should be able to recognize the Perry-level at which students are functioning, and they should be flexible in their way of supporting and giving feedback to students. The support and feedback is partly dependent on the course design, but at the micro-level of supporting individual students a teacher must be able to adapt feedback to the individual needs of students. This is virtually impossible in large scale education, and maybe possible to a certain extent in small scale education[14].

[13] In engineering programmes an indirect way of characterizing the Perry-level of students is frequently used: the Moore and Fitch's Learning Preference Inventory (LPI). In this inventory, the students' teaching format preference is used as a proxy for their Perry level. See Moore WS (2002): Understanding learning in a postmodern world: Reconsidering the Perry scheme of intellectual and ethical development. In Hofer BK & Pintrich PR (eds.): *Personal epistemology: The psychology of beliefs about knowledge and knowing, pp. 17–36, Mahwah, NJ: Erlbaum (2002).*

[14] Research has shown that congruence between epistemic positions of students and teachers leads to higher satisfaction of students (and teachers) and a higher learning gain. It is also found that students in learning groups, which are homogeneous by Perry levels, are more satisfied with collaborative learning than students

A mismatch between the Perry-level, aimed for in a course, and the Perry-level of participating students can lead to dissatisfaction of students, and this can result in negative course- or teacher-evaluations by students. When large differences between students exist, part of the students may evaluate a course as 'good', while other students evaluate the course as 'inadequate' because the teacher support given is not consistent with the students' expectations. A dualistically reasoning student (Perry 2) will face trouble in a course, which is designed to challenge students to make the transition to contextual relativistic reasoning (Perry 4-5).

I can illustrate this from my own experience with a Pharmacology course at University College Roosevelt in Middelburg[15]. The course is designed with an emphasis on higher level thinking and learning and has a relatively open structure in which a combination of lectures, assignments, textbook, additional reading material and a complex group project are used to stimulate (or force) students to use these resources for constructing their own conception of the field of pharmacology. Whether students are able to apply their knowledge constructs is tested by a combination of a written report (resulting from the project) and two individual exams. It is expected that the students are well-developed self-regulating learners, which are able to define their own learning objectives and have the skills to search, find and identify relevant learning material. Some guidance is given by referring to relevant chapters in the textbook and by training in interpreting pharmacological experiments from primary literature[16].

		scale from 1 to 5		
	Evaluation question	**course evaluation (mean)**		**significance**
		'bad'	'good'	(t-test)
1	I learned a great deal	2.50	4.00	$p < 0.001$
2	Active student participation was encouraged	2.17	3.25	$p < 0.05$
3	My critical thinking was stimulated	3.33	4.00	n.s.
4	The requirements were clear	2.17	3.75	$p < 0.01$
5	The grading criteria were clear	2.67	4.00	$p < 0.05$
6	I was provided with feedback on my individual work	2.83	5.00	$p < 0.01$
7	The instructor was available for individual guidance	3.20	4.00	n.s.
8	How actively engaged were you in this course?	2.67	3.50	n.s.
	The final grade you expect in this course is	3.00	2.75	n.s.

in heterogeneously composed groups. See Lovell CW & Nunnery J: Testing the adult development Tower of Babel hypothesis: Homogeneous by Perry position collaborative learning groups and graduate student satisfaction. *J. Adult Devl. 11, 139-150 (2004)*.

[15] My colleague dr. Anneke van Houwelingen has similar experiences withthis course in University College Utrecht (UCU).

[16] The course design and a critical reflection on the educational design, the content and the outcomes of this course has been published: SCI 337, Problem-Based Learning Course Portfolio. Published online by the Center of Teaching, Learning and Scholarship (CTLS), Samford University, Birmingham, Alabama, USA (2004). For the training in interpreting scientific literature see Hoskins SG, Lopatto D en Stevens LM: The C.R.E.A.T.E. approach to primary literature shifts undergraduates' self-assessed ability to read and analyze journal articles, attitudes about science, and epistemological beliefs. *CBE Life Sc. Educ. 10, 368-378 (2011)*.

Course evaluations were mixed. Part of the students evaluated the course as 'good' (4 or 5 on a 1 to 5 scale), part as 'bad' (1 or 2 on the same scale). The mean evaluation (± sd) was 2.90 ± 0.72. When we are studying the student evaluations in more detail, we can understand why these student opinions are so divergent. The 'bad'-evaluators tend to have experienced less learning, felt less activated, had less understanding of the course requirements and grading criteria, and experienced less feedback. From an analysis of open comments it appears that with respect to the content of the course, 'bad'-evaluators appear to have difficulty with the training-sessions and have specific expectations about 'pharmacological' knowledge, which appear not to be fulfilled. They also appear to think that the teacher should organize learning or studying and that learning is only considered useful when directly being tested during the course. A few of these students are not prepared (or able) to acquire knowledge in fields, which they themselves experience as inadequate. Clearly, during the course "maximizing challenge" conflicts with "maintaining a positive relationship with students" and "maintaining student enthusiasm"[17].

In this case clearly a mismatch exists between the course design (aimed at Perry 4-5 level) and part of the participating students (those that evaluated the course as 'bad'). The course was outside the 'zone of proximal development' of these students.

An interesting question is of course what the consequences should be of such an observation. Is the course too demanding and must it be adapted to satisfy the lower Perry-level students? Or is the course level right, given its position in the curriculum, and should something be improved in the preparation of the students before they are allowed to participate in this course?

It will be clear that dealing with inter-individual differences between students can be tricky for teachers and that tension can exist between the desire to maximally challenge students on the one hand and to keep students 'on board' and satisfied, on the other hand.

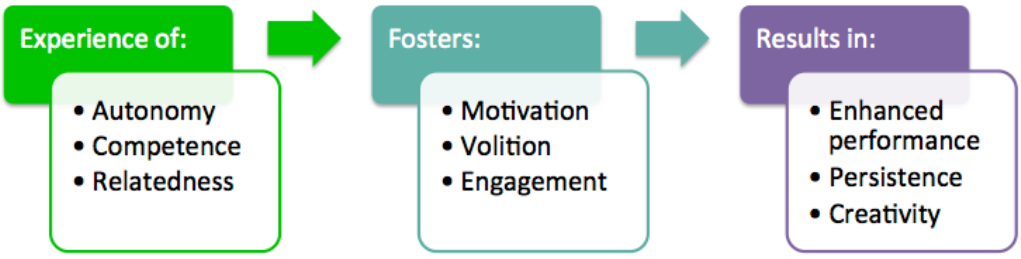
If we cannot make it easier ..... can we make it more fun?

Teachers, just as students, need to be motivated for the work they are supposed to do, but most teachers in higher education are faced with a cognitive development trajectory 'as a teacher', in which they go through the same developmental stages as described above for students. When they begin their teaching-career most of them are at lower Perry levels with respect to their thinking about education. They usually are not trained as a teacher, but as a researcher in a specific knowledge domain and their ideas about 'good' or 'bad' teaching is mostly formed by their own experiences. Only by going through a professional development trajectory (Basic Teaching Qualification, Senior Teaching Qualification, Center of Excellence for University Teaching) they learn the major educational concepts, and can make the transition from dualistic thinking to contextual relativistic thinking.

In order to make it more 'fun' for teachers, it is important that they have the opportunity in their working environment to keep on developing. They must have the feeling to be

[17] See Scager K, Akkerman SF, Pilot A, Wubbels T: Teacher dilemmas in challenging high-ability students in higher education. *Teach. High. Educ. 22, 318-335 (2017)*.

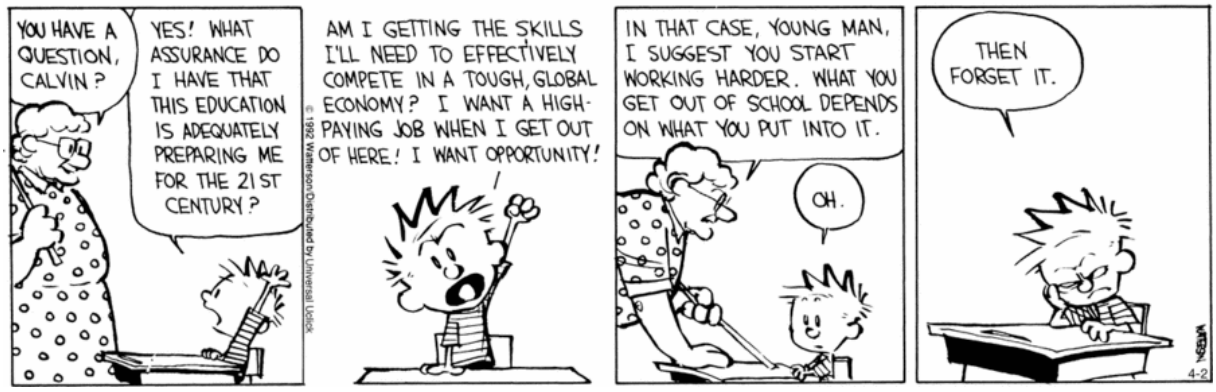
competent and to be given the opportunity to learn in those fields, where they don't have that feeling. But every teacher is different, has a different background and different experience. Development trajectories must, therefore, be highly individualized to satisfy their sense of autonomy. Finally, it is essential that teachers don't feel, that are 'left on their own'. Creating



informal and formal networks ('communities of practice') and other forms of 'relatedness' can contribute importantly to their sense of well being. The Self Determination Theory is a good advisory framework when developmental trajectories are planned for teachers, just as it is a good framework for designing student curricula[18].

We cannot make it easier ..... for the organisation

Quality of education



The most important task of the organisation is to develop a curriculum, which in my view should be a continuous process. Evaluating the curriculum as a whole is complicated and it is questionable which data are needed for curriculum improvements. In what follows I would like to suggest that a University must go further than just evaluating student satisfaction. 'Hard core' educational research is necessary to find out whether the curriculum actually attains the goals it strives for.

[18] The figure is based on Deci EL & Ryan RM: The "what" and "why" of goal pursuits: Human needs and the self-determination of behaviour. Psychol. Inquiry 11, 227-268 (2000).

Which data are needed to evaluate the quality of the education? In my opinion feedback about the learning of students is primarily needed. Student evaluations of teachers and/or courses are usually available, but I must say that these evaluations – regrettably – do not give the information I would seek for. The reliability [in a statistical sense] of student evaluations is extremely low and from research it appears that no relation exists between course-evaluations by students and learning by the same students[19]. There are even publications suggesting that long-term learning is mostly facilitated by teachers that receive relatively low student evaluations. An explanation of this counterintuitive finding can be found in the creation of 'cognitive frictions' by these teachers: in the short term a teacher makes his/herself not very liked, but on a longer term the motivation to learn may be increased. By making assignments or tasks more complex the short-term performance decreases, but it is very well possible that learning on the long term is enhanced by stimulation of metacognitive processes and self-regulated learning[20]. Short-term performance does not necessarily fosters the desired long-term learning effect[21]. Based on these observations several authors have argued against the use of student evaluations as a tool for improving the quality of higher education[22,23].

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[19] Research by Feistauer and Richter demonstrates that the variability in course evaluations can be explained by variation between courses, teachers and students to approximately equal extent (10-15% explained variance each). An even larger part is explained by student-teacher interaction (25-30% explained variance). From a re-analysis of several meta-analyses Uttl *et al.* have concluded that no statistical significant correlations exist between student-evaluations of teachers and teaching effectiveness. See Feistauer D & Richter T: How reliable are students' evaluations of teaching quality? A variance components approach, *Assessm. Eval. High. Educ. 42, 1263–1279 (2017)* and Uttl B, White CA & Gonzalez DW: Meta-analysis of faculty's teaching effectiveness: Student evaluation of teaching ratings and student learning are not related. *Stud. Educ. Eval. 54, 22–42 (2017)*.

[20] Kornell N & Hausman H: Do the best teachers get the best ratings? Front.Psychol. 7, article 570 (2016). Online available on https://doi.irg/10.3389/fp-syg.2016.00570. Bjork *et al.* make a distinction between students' immediate performance and long-term learning effects, and illustrate how mis-conceptions of students and teachers about learning can negatively affect the actual learning. See Bjork RA, Dunlosky J & Kornell N: Self-regulated learning: Beliefs, techniques, and illusions. *Annu. Rev. Psychol. 64, 417-444 (2013)*.

[21] Zie voor het onderscheid tussen leren ('learning') en presteren ('performance') Soderstrom NC & Bjork RA: Learning versus performance: An integrative review. *Perspec. Psychol. Sc. 10, 176-199 (2015)*. Zij laten duidelijk zien dat omstandigheden, waarin veel fouten gemaakt worden, vaak het grootste leereffect hebben: *"Finally, given that the goal of instruction and practice … should be to facilitate learning, instructors and students need to appreciate the distinction between learning and performance and understand that expediting acquisition performance today does not necessarily translate into the type of learning that will be evident tomorrow. On the contrary, conditions that slow or induce more errors during instruction often lead to better long-term learning outcomes, and thus instructors and students, however disinclined to do so, should consider abandoning the path of least resistance with respect to their own teaching and study strategies"* (pag. 193).

[22] After a detailed description of the 'pros' and 'cons' of using evaluations by students as a means for quality improvement in higher education, Darwin comes to the following conclusion: *"The challenge is for higher education institutions committed to quality learning to consider moving beyond their familiar conventional approaches centred on student ratings alone and to investigate deeper and more qualitative engagement with the student voice"* (page 21). See Darwin S: What contemporary work are student ratings actually doing in higher education? *Stud. Educ. Eval. 54, 13-21 (2017)*.

Student evaluations do give information about their satisfaction, but this is only one aspect that can be used to draw conclusions about the quality of a course or other curriculum constituent. Apart from student evaluations, more ingredients are needed to evaluate the quality of education, of which consistency between the design and implementation of the course and the desired learning effect is an important aspect. In practice this means that all aspects of the teaching-learning environment, including the teachers' role, must stimulate the student continuously to keep on developing in the desired direction. If this is the case, we speak of 'constructive alignment'[24].

TABLE 3 | Activities that seem likely to increase difficulty and long-term learning but decrease teacher ratings (based solely on the authors' intuition).

Broaden the content being covered and include difficult concepts.
Focus on concepts that will be relevant beyond the current course.
Require students to struggle with the concepts they are learning (e.g., during lecture).
Give frequent quizzes.
Mix different kinds of problems together.
Assign relatively difficult problems in homework and class.
Do not circumscribe what students should study to prepare for their exams.
Give cumulative exams.

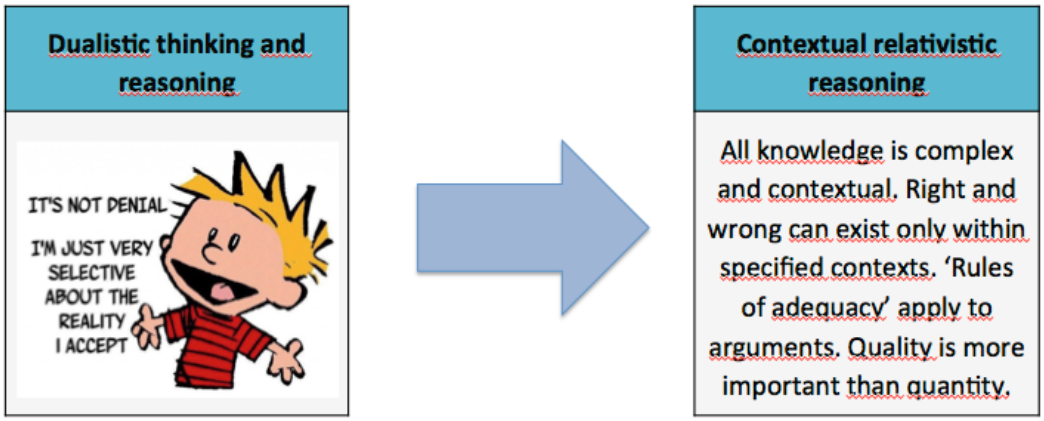
Another reason exists why student evaluations have limited value for quality control resides in the observation that student evaluations only are sensible if it is established independently that teachers and students have a shared vision on the goals and the implementation of the educational format used. When we introduced in 2001 problem-based learning (according to the Maastricht 7-jump model) in our Pharmacy curriculum, we quickly found out that student evaluations could only be interpreted in a sensible way when we first checked whether the student understood the intention of the problem-based learning.

It will be clear that I would like to see whether the curriculum facilitates the transition from dualistic thinking to contextual relativistic thinking. I use the word 'facilitates' consciously because I have learned during the last years that the transition process 'happens' in the students themselves. The teaching-learning environment, of which the teacher is an integral part, cannot enforce this change to happen. Designing a curriculum requires great care, where

[23] Lodge and Bonsanquet argue that the goal of education must be to improve performance in the long run and that educational sciences should play a crucial role in investigating teachng effectiveness: "*Without taking into account the results of rigorous and controlled experiments from the science of learning literature, governments and institutions will remain at the mercy of performance indicators that at least lack validity and at worst are actually forcing academics to teach in a way that is detrimental to long-term retention and transfer of knowledge"* (page 15). See Lodge JM & Bonsanquet A: Evaluating quality learning in higher education: reexamining the evidence. *Qual. High. Educ. 20, 3-23 (2014)*.

[24] Biggs J & Tang C: teaching for qaulity learning at university. What the student does (4th ed.), *Society for Research into Higher Education & Open University Press, McGraw Hill, New York 2011*.

a balance must be found between continued stimulation for further development (ZPD, cognitive frictions, Perry+1) and causing dé-motivation. Again, I use the term 'de-motivation' consciously because too much teacher control easily can have that effect.



Unfortunately, very little research has been done in higher education on the longitudinal development of cognition using Perry's scheme or related epistemological theories. This picture illustrates, that in engineering students in the USA the development from Perry-3 to Perry-5 happens mainly between the first and the fourth year of the study programme, but at the same time it illustrates that inter-individual variation between students is extensive[25]. More recent research, using slightly different methodology, confirms this picture: relatively minor differences between study years in combination with a large inter-individual variation between students in the same year[26].

[25] Wise *et al.* used interviews to characterize the Perry-level of students in USA 'engineering' porgrammes, between the years 1996 and 2000. See Wise JC *et al*: A report on a four-year longitudinal study of intellectual development of engineering undergraduates. *J. Adult Devl. 11, 103-110 (2004)*. A more recent overview of the epistemic development of medical students is published by Eastwood JL *et al:* Epistemic cognition in medical education: a literature review. *Int. J. Med. Educ. 8, 1-12 (2017).*

[26] In recent years renewed efforts are made to analyze the cognitive development of students in a quantitative way with existing or newly-developed questionnaires. In all published studies similar trends (from absolutistic thinking, via multiplisistic thinking, to relativistic thinking) are discernible, but with extensive inter-individual variability. Recent literature is available form engineering (Zhu), chemistry (Dai), psychology (McGinnis) and mixed (Faria) educational programmes. See Zhu J & Cox MF: Epistemological development profiles of Chinese engineering doctoral students in U.S. institutions: An application of Perry's theory. *J. Engin. Educ. 104, 345-362 (2015)*; Dai T & Cromley JG: The match matters: examining student epistemic preferences in relation to epistemic beliefs about chemistry. *Contemp. Educ. Psychol. 39, 262-274 (2014)*; McGinnis D: Epistemological orientations and evidence evaluation in undergraduates. *Think. Skills Creativ. 19, 279-289 (2016)*; Faria C *et al*: Epistemological development and attachment in European college students. *J. Coll. Stud. Devl.56, 845-860 (2015)*. Qualitative research is needed to understand cogntive development at a deeper level. See Greene JA & Yu SB: Modeling and measuring epistemic cognition: A qualitative re-investigation. *Contemp. Educ. Psychol. 39, 12-25 (2014)* and Barzilai S & Weinstock M: Measuring epistemic thinking within and across topics: A scenario-based approach. *Contemp. Educ. Psychol. 42, 141-158 (2015)*.

Luckily, more research has concerned itself with the relations between characteristics of the teaching-learning environment and the learning of students. Frequently used dimensions are the depth of learning (deep learning *vs.* reproductive learning) and the regulation of the learning process (self-regulated *vs.* externally regulated). When I try to relate these dimensions to the conceptions of learning, which are mentioned above, I see the following connections. A dualistic student is mainly interested in finding a correct answer and depends on the teacher to guide him/her in fnding this answer. A relativistic student is more interested in which theories can be used and in the rules and procedures, which need to be used to reach a suitable explanation. Simply said, learning of a dualistic student will be reproductive and externally regulated. A relativistic student, on the other hand, can self-regulate his/her own 'deep' learning[27].

	Dualism (Perry 2)	**Early multiplicity (Perry 3)**	**Multiplicity (Perry 4)**	**Relativism (Perry 5)**
Conception of knowledge	Truth exists. All knowledge is known	Truth exists, but is incomplete	Some uncertainty exists. **Authorities must supply guidance and context**	Complex and contextual. Rules apply for 'adeqaute arguments'
Role of the student	Work hard, receive information	Learn how to learn. Express oneself well	Confront and challenge. **Learn "how they want us to think"**	Exercise and apply the rules. Use different perspectives
Role of the teacher	Authority; source of knowledge	Models the process for finding truth	Sets the context. **Models the way of thinking**	Guide and consultant; source of expertise
Way of learning	Distinguish right from wrong; provide explanations.	Multiple perspectives. Distinguish content from process.	Play 'intellectual game' **Use supporting evidence, learn to think abstractly**	See relationships and complexity. Acknowledge different contexts.

	Reproduction-directed learning	**Meaning-directed learning**
Processing strategy	Stepwise processing	Deep processing
Regulation strategy	External regulation	Self-regulation

In order to see if students make a transition, longitudinal research is necessary. In the last ten years I have used Jan Vermunt's ILS-questionnaire to find out whether students in our Pharmacy curriculum do develop over time. I have used 'deep learning' and 'self regulation' as a proxy for the desired cognitive development, and I can show you that in the Pharmacy

[27] Direct relations between relativistic epistemic conceptions and deep learning and between dualistic conceptions and reproductive learning in higher education have been demonstrated by Lee SW *et al:* Do sophisticated epistemic beliefs predict meaningful learning? Findings from a structural equation model of undergraduate biology learning. *Int. J. Sc. Educ. 38, 2327-2345 (2016)*.

curriculum develop as desired. Using the ILS-questionnaire 'deep' and 'reproductive' learning, as well as 'self regulation' and 'external regulation' can be measured.

When we do these measurements in students in year-1 or year-2, and make a comparison with the same measurement in the same students in year-4 or year-5, we can see that these students have made a transition towards more 'deep learning' and more 'self regulation'. This could be related to a transition from dualistic thinking towards relativistic thinking, although this cannot be formally concluded from this research. No or only very little change is seen in 'reproductive learning' and 'external regulation' of learning.

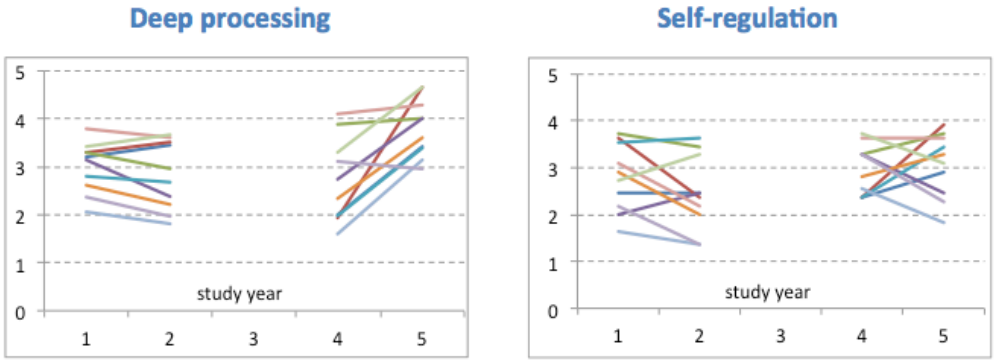
Deep processing

yr 1-2	effect size	yr 4-5
2.79 ± 0.11	↑↑ 1.24	3.57 ± 0.12

Self-regulation

yr 1-2	effect size	yr 4-5
2.55 ± 0.12	↑ 0.69	3.03 ± 0.13

Data represents means ± s.e.m., measured on a 1 to 5 scale (90 Pharmacy students)



Scores for individual students, measured on a 1 to 5 scale

Also in our case the variability between students is extensive: differences between students in the same year often are more extensive than the change in the means, which occurs within a group of students in three years. This can also be illustrated by looking in detail at the data of a number of students, where we have the data from year-1, -2, -4 and -5: inter-individual differences are more extensive than the individual changes over a number of years.

If we cannot make it easier ..... can we make it more fun?

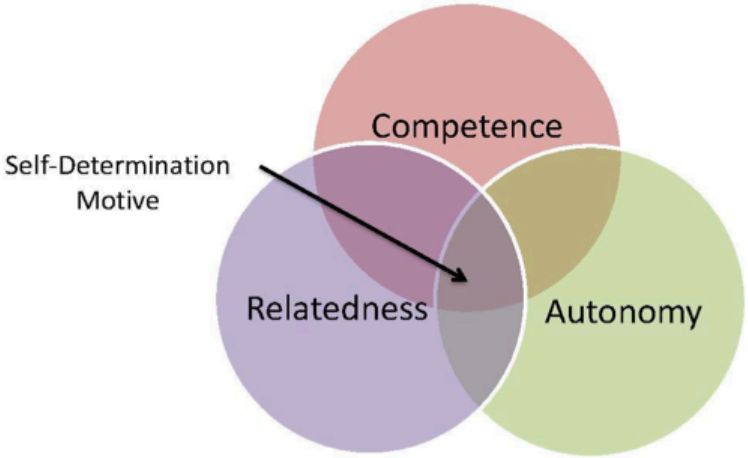
It will be clear that evaluating the quality of education is not 'easy'. Many methods and tools exist to investigate several aspects of the curriculum, but they are mostly oriented towards student satisfaction with teachers or facilities.

When designing or updating a curriculum, we would like to know whether the curriculum actually attains the goals it strives for. In my opinion, for the organisation it would be 'nice' if it were possible to demonstrate that students are actually developing form dualistic thinkers to contextual relativists. Moreover, it would be nice to know whether they don't lose their motivation.

‘There is nothing more practical than a good theory’

The self-determination theory (SDT)

I have mentioned the Self Determination Theory a few times, when speaking about learning of students and when speaking about learning of teachers. In both cases this theory can be used as a guide and to test whether the design of a learning trajectory respects the three basic psychological needs of competence, autonomy and relatedness. Only when all three needs are satisfied sufficiently, autonomous motivation results. The SDT, and related questionnaires, is a suitable theory to monitor – under widely divergent circumstances – how students, teachers, patients, family members or partners can be motivated or dé-motivated in the circumstances, where they are working or living together[28].



Richard Ryan

Edward Deci

In a teaching-learning environment aiming for personal autonomous development of competences a very useful tool for receiving feedback on the curriculum is the mapping of controlled and autonomous motivation of students. As an example I can show you the results of a recent investigation, in which Sharon Tjin A Tsoi showed that the autonomous motivation of pharmacists participating in continuous professional development, decreased between 2013 and 2014 and that frustration of basic psychological needs resulted in an increase in controlled motivation, decreased vitality and a decreased lifelong learning adaptability[29]. In the recently updated pharmacy curriculum, an SDT-derived questionnaire is

[28] The Self Determination Theory is applicable in many areas of personal development, motivation and psychological well-being. This theory is not only useful for understanding developmental processes in families and education, but also has wide implications for health care, sport and work environment. See for an overview Ryan RM & Deci EL: Self-determination theory. Basic psychological needs in motivation, development and wellness. *The Guildford Press, New York, London, 2017, xii + 756 pags*.

[29] See Tjin A Tsoi SLNM *et al*: A longitudinal approach to changes in the motivation of Dutch pharmacists and current continuing education system. *Am. J. Pharm. Educ. 82, article 6199 (2018)* and Tjin A Tsoi SLNM *et*

used to monitor whether the students experience the characteristics of an autonomy-stimulating teaching learning environment. This MUSIC model measures eMpowerment, Usefulness, Success, (situational and personal) Interest and (academic and personal) Caring)[30].

Universiteitsweg 99, 1 month ago

In about 40 years the world has changed considerably. When I started to work in the Faculty of Pharmacy no mobile phones, personal computers, internet or social media existed[31]. The closed door with a doorbell, which for insiders was no barrier, has changed into a revolving door that is open to everybody[32]. In 1979 the material for a pharmacology course existed of a textbook (Bowman en Rand), a reference book (Goodman en Gilman), a course manual and a few overhead sheet, and videos to demonstrate the unpleasant animal experiments. All very controlled and of 'uncontested' quality. In 2018 the material exists of multiple books, online material from many universities, libraries, databases, professional organizations, and many well-intending but not always scientifically educated individuals. The (scientific) reliability of all these facts, alternative facts, interpretations and translations to new contexts is often very disputable and varies much in quality. As a consequence an important task – if not THE most important task – of a university teacher has become to learn everybody (students and

al: How basic psychological needs and motivation affect vitality and lifelong learning of pharmacists: a structural equation model. *Adv. Health Sc. Educ. 2018, doi: 10.1007/s10459-018-9812-7* [published online]

[30] The MUSIC model is practice-oriented course evaluation tool, based on the Self Determination Theory. The model has a good theoretical basis and is validated in learning environments, which are diverse with respect to content and educational format. See Jones BD: Motivating Students to Engage in Learning: The MUSIC Model of Academic Motivation, *Int. J. Teach. Learn. High. Educ. 21, 272-285 (2009)* and Jones BD & Wilkins JLM: Testing the MUSIC model of academic motivation through confirmatory factor analysis, *Educ. Psychol. 33, 482–503 (2013)*.

[31] When we wanted to analyze a multiple-choice test by computer, we had to find budget first and make an appointment with the Academic Computer Centrum (ACCU), where punch card were used to enter the students' tests and the answering keys. The analysis was programmed in FORTRAN and it took a few days before results were delivered in the form of a computer print-out. The first three IBM desk-top computers were obtained in 1985 by the Department of Pharmacology obtained three IBM-desktops at the expense of 50.000 guilders (around € 23.000)!

[32] Selective admission is more subtle now, with electronic gates and access cards, within the building.

colleagues) how to investigate and assess the reliability and trustworthiness of all this available information. My personal opinion is that educating students must primarily be concerned with facilitating the change form dualistic thinking to contextual relativistic thinking. An emphasis on critical and reflective thinking, methodical reasoning and methodological techniques has become of critical importance[33].

Thank you …

In all the years that I worked in this University, it often was not easy, but I tried to make it more fun for myself. I consider myself lucky to have worked in an environment that made that possible, or at least tolerated that. There have been always possibilities to develop competences by visiting conferences or laboratories, there was a lot of autonomy and a few times there was also strong relatedness. The programme of the Center for Teaching Excellence (CEUT) has been very important for me: I experienced all 'thinking colours', mainly the Blue and the Green. I never felt very comfortable with Yellow thinking and maybe we spent not enough attention to Red thinking. In the end White thinking has always been comforting[34]. When in secondary school I completed the Strong (professional) Interest Inventory it turned out that I should become an architect or a music conductor. Both have become true.

Finally I like to thank the people, who have made it all possible:

First the students and teachers, who – often unknowingly – have been the subject of try-outs, experiments or research to enhance the quality of education. Thank you for your understanding, loyalty and tolerance in class settings, committees and governing bodies.

Then the five 'families' I have been part of:

In the first place the 'nice pharmacology family' (FFF in Dutch), where I still encounter part of my own past. They have always been my home base, although content wise our relationship became less and less when I was doing something else for the University,

[33] Radical changes in the position of scientific research in society as a consequence of the increasing influence of social media and political interference has led to redefining present-day science as 'post-normal science' by philosophers of science. Attention and care for the quality of scientific research and science education is considered of the utmost importance. See Ravetz JR & Funtowicz SO: New forms of science. *Int. Encyclop. Soc. Behav. Sc. (2nd ed.) vol. 21, 248-254 (2015)*; Koenig N *et al*: The ethos of post-normal science. *Futures 91, 12-24 (2017)*; J. Ravetz: Keep standards high. *Nature 481, 25 (2012)*. A compact summary by J.R. Ravetz can be found on Youtube: Introduction to the Conversations", workshop *New currents in science: The challenges of quality, Ispra, 3-4 March 2016* (www.youtube.com/watch?v=LVyY23T8LR4).

[34] Léon de Caluwe and Hans Vermaak described different ways of understanding change processes and used color codes as shortcuts for characterization: Yellow (politics and power), Blue (planning and controlling), Red (motivation and human-oriented), Green (development and learning) and White (natural and organic). The nature and phase of a change trajectory, or the role of persons involved, can be described using these color codes. See de Caluwé L & Vermaak H: *Learning to change. A guide for organizational change agents. Sage publications, 2003, 344 pags*.

University College (Utrecht), the Roosevelt Academy (Middelburg) or the European Association of Faculties of Pharmacy (EAFP). It is always nice to come 'home'.

Secondly my new 'research family' at the VU medical centre, which during the last five years became a home base for research into the quality enhancement of working environment and education. I keep learning new things every time from you.

My third 'family' consists of all the friends I encountered through Stichting De Kringen. All friends I met there demonstrate that competence, autonomy and relatedness are extremely important for well being, emancipation and self-realization.

My own family from Friesland and Gelderland. Our contact has not been very frequent, but in a literal sense familiar. It is also a regular confrontation with your own past and the environment in which I have grown up and developed as a child.

Finally my family-in-law. No stronger contrast than with my own family, in numbers, interaction and travel interest. It took me years to learn all the names and family relations, both in the Netherlands and Indonesia.

If you have to maintain so many family relationships, there is always insufficient time. Maybe that will improve after my retirement.

I would like to thank all individuals, which are present here, for something, but that is obviously sheer impossible. There are a few exceptions:

The 'lords and masters' who made it happen: Willem-Hendrik Gispen, Bert van der Zwaan, Auke Bult, Daan Crommelin, Ton de Boer, Wim Hennink, Frans Nijkamp and Johan Garssen.

The 'masters' who were important inspirational sources: Albert Pilot, Stephan Ramaekers and the other IVLOS colleagues, Hans Adriaansens, Jan Vermunt, Sari Lindblom-Ylänne and Christel Lutz.

The 'soul mates' with a shared passion for doing research, be it biomedical or educational: Aletta Kraneveld, Frank Redegeld, Rashmi Kusurkar, Sharon Tjin A Tsoi, Anneke van Houwelingen en Irma Meijerman.

And finally my friend and partner, Paul Dirk, who always shows me that improving the world not only exists of changing institutions and organizations, but also of supporting people who have been less lucky in their personal lives than ourselves.