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Alternative Research Approaches: Development Strategies in Educational Technology

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Summary:
Given the state of affairs it is not advisable to discuss on Instructional design (ID) problems without having clarified previously the paradigm issue. After a reconstruction of the "objectivist" and the "constructivist" point of view the author gives his reasons for preferring a realistic position. On that basis the theoretical status of ID statements is elaborated as being either theoretical or technological. Both types are shown to be the results of different research strategies, logically as well as pragmatically. The question is raised whether there are reasons to follow preferably one of them. But it turns out that it is not possible to make a rational choice on that issue. Rather, for the growth of knowledge in the field of ID it seems best if both strategies are followed under the condition that they keep connected to each other systematically.

Introduction

During the first decades of its existence, not much consideration was to be found in Instructional Design (ID) on its philosophical and systematic foundation. Roughly speaking, one could state that up to the early 1990ies a rather unscrupulous eclecticism was the prevailing characteristic of the scene (c.f. Bednar et al. 1992; Dinter 1998, 267; Molenda 1997, 44-45). It was not least the upcoming reception of constructivism stimulated especially by Jonassen (1990) to change the picture and to provoke a debate on fundamental notions and concepts of ID. Many authors were now open to the 'new' ideas and tried to incorporate them into their approaches. In relation to the degree to which they assimilated constructivism they were classified as more or less moderate up to radical constructivists. But at least in its radical version constructivism seemed to be incompatible with ID: If it is true that the learner is fully autonomous concerning objectives as well as processes (Winn 1992, 179) then learning can't be planned by a third person and therefore ID would be dispensable, if not senseless (cf. Dick 1992, 97; Hoops 1998, 237).

Faced with the far-reaching consequences of radical constructivism many instructional designers started to enter a discussion on the presuppositions and structures of ID. Within the last decade different points of view were developed and shaped step by step. The scene became more and more intricate, including explicit or implicit

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constructivist or objectivist positions mixed up or combined with behavioristic or cognitivistic approaches (Tennyson/Breuer 1997, 113-114), not to forget the still active eclecticism.

It is not the purpose of this paper to re-analyze or re-construct all the different opinions nor to add another one to the many facets in discussion. Rather, it raises a programmatic question: How can ID researchers deal with the situation just outlined in a rational way? “Muddling through” does not seem to be a rational choice. On the other hand, it makes a big difference whether “instruction” is understood as a notion dealing with the implementation of objective knowledge into a student’s memory or as a notion pointing at the process of helping to enable a student to construct his or her unique personal knowledge base. These are two alternatives with nothing in between (see below). In order to manage ID as a rational business it seems to be necessary to take up a clear position in terms of philosophy of science and to (re-)identify the entity which is to be designed in ID. Only within a clear frame of reference it seems to be possible to discuss different strategies which might be followed by ID research in a rational manner.

The following chapters try to develop that argument in making a decision for a non-constructivist position and introducing a differentiation between a theory-driven and a technology driven strategy in ID research. Surprisingly, in discussing the “pros” and “cons” of both strategies it will turn out that looking at internal criteria of research as well as at external criteria of practice a choice between the two strategies cannot be made systematically. At a first glance, this seems to be an unpleasant situation. But it will be shown that, on the contrary, that situation is almost a prerequisite for prosperous progress in ID research.

Constructivism and Realism

Of course, it is not possible to analyze in detail the two opponent positions within this paper. But, as far as I can see, besides a lot of misunderstandings there are some clear distinctions that can help to identify the most important arguments in discussion.

(i) Under an *ontological* aspect we can discriminate between two main points of view, the realistic and the idealistic. The realistic point of view claims that there is a physical world outside of our consciousness existing independently of us (cf. e.g. Popper 1982, 60-76). The idealistic or, to put it more pointedly, the anti-realistic point of view, on the opposite, denies the existence of a real world emphasizing that the only ontological quality we can rely on is the content of consciousness (c.f. e.g. Husserl 1922, 36). On both sides variations are to be found which state the central thesis more or less radically. But between them there is nothing left, not any middling position which could allow us (as e.g. Molenda, 1997, 48-50, believes) to conceive a radical version of realism and a radical version of idealism as the two extreme points of a continuous scale. A transition from realism to idealism can only be accomplished by "jumping from platform to platform". As long as someone is "standing" on the realistic platform (at least some) contents of consciousness have to be conceived as representations of something out there. From the viewpoint of idealism consciousness contains nothing of that representational character at all. The difference between both is not to be overpassed by continuous quantitative movement but only by a qualitative "jump", i.e. a paradigm shift. So, realism and idealism are two positions totally separated from each other. It will turn out below that it is important to stress that point.

(ii) Next, under an *epistemological* aspect the question is whether we are able to attain knowledge of what exists. For the ontological realism that question is open to be answered in different ways. Immanuel Kant, for example, has been an ontological realist but an epistemological skepticist (Albert 1978, 13-16), i.e. he believed in a real existing world "out there" though he was sure that we are incapable of experiencing it as it "really" is. On the other hand, the position of rationalism, esp. "Critical Rationalism" (Popper), holds that we can have experience of the real world existing outside and independently of us. Again, the idealistic view is totally different. Above all, in principle there is no epistemological problem for idealists at all because for them there is nothing to be perceived. Nevertheless, also idealists make use of notions like "perception" and "cognition", non-logical "truth" and "falseness". But they attach a strictly different meaning to them which focuses on experiences of consciousness not of a world outside the self. Listening to an idealistic argument sometimes stimulates the impression that it is epistemologically of the same character as a realistic argument because it is speaking about the problem of identification of true and pure contents of consciousness just as a realistic argument is dealing with truth and validity of perceptions. But both cases are radically different in that the idealistic quasi-epistemological problem doesn't transcend the threshold of non-consciousness, i.e. in that it remains within the internal milieu of mental entities and processes.

Once more, there are different variations within the scope of the two positions, e.g. a naïve realism, called positivism, on the one side, and a hyper-critical realism on the other side of the scale (cf. Lakoff 1987). In the realm of idealism we find also several variations reaching from a weak phenomenalism to pure solipsism. But as stated above, there is no "bridging" position whatsoever between the two that would allow to speak of a continuum connecting rationalism with idealism.

Now, looking at the ongoing discussion in educational research and esp. in ID science we can state that the notion of "objectivism" is used to denote (variants of) ontological realism, usually (and mostly implicit) combined with a more or less pronounced epistemological optimism (Dinter 1998, 258), well-known and best elaborated as Critical Rationalism. On the other side "constructivism" turns out to be a subtype of idealism, a position skeptic about the existence of a world outside consciousness (ontological skepticism) and, consequently, also skeptic about the possibility of having knowledge of a real world which can be proved by experience (epistemological skepticism). The claim of being not a radical but "only" a moderate constructivist is not enlightening at all because that notion usually entails many different and often incompatible ontological and epistemological assumptions (Molenda 1997, 51). But if the term "constructivist" has to be taken seriously in statements of that type even a moderate specimen of constructivism remains to be a version of ontological and epistemological skepticism. My impression with regard to a common way of speaking about constructivism is that many authors sympathizing with a moderate position are indeed – at least intuitively - critical realists. On the other hand, there are radical constructivists, as e.g. von Glasersfeld (1998, 510), who seem to be "moderate" ontologists in saying that they feel uncertain whether there is a world outside of us existing or not. However, a closer look at that position reveals that its "moderate" ontological view is totally overruled by a radical epistemological skepticism and that, consequently, for the construction of that type of constructivism ontological hypotheses loose their relevance. If we can't have any experience of a world "out there" speculations on its ontological structure are senseless. On the other hand, a person who concedes that something from "out there" may "perturbate" (von Glasersfeld) our consciousness that person has taken a realistic platform. To claim both, that our consciousness may be affected by the real world and, at the same time, that we can't have experience of non-mental reality is an epistemological contradiction in itself. Furthermore, to claim that it is totally unsure and, in any case, not possible to be tested whether there exists a real world outside of our consciousness but that it "perturbates" our minds is an ontological contradiction in itself. To claim, at last, that there is (or might be) a real world outside but to deny the possibility of having experience of it is logically permissible but undermines the position of empirical research.

It has to be stated at this point of deliberation that there is no possibility at all to make a decision between the two main positions based on logic, experience, research or something else which eventually could function as an objective and independent arbitrator of its own rights. Rather, both positions are founded on a basis called "metaphysic hypotheses", i.e. on beliefs in basic statements distinguished by deep plausibility for those who trust in them. Nevertheless, a decision between them is not necessarily an irrational matter. Besides assessing them by plausibility they can be evaluated in the light of their consequences, too.

To cut it short, in my view there are two types of arguments that give reason to favor realism (especially its critical version). The *first* type is related to plausibility pointing to the experience of being influenced from "outside", e.g. of feeling an impact on my finger originated by something that appears to me to be a hammer. Or, as a friend of the phenomenalist bishop Berkley has put it in the 18th century (Stegmüller 1974, 286-287) after having listened to his sermon when he kicked away a stone and said: "I refute him thus!" The *second* type of argument refers to the consequences of taking the position of critical realism in connection with Critical Rationalism. Looking not only at natural sciences and technology but also at social sciences and social techniques (e.g. marketing, electoral forecasts, psychotherapy) which work within that paradigm, it seems to me that they have been rather successful in solving practical problems we are faced with as human beings. They have done so in trying to describe and to model an external world more and more precisely though being convinced that there is no Archimedian point of definite certainty and that therefore we never can be sure that we have reached empirical truth.

One consequence of this short sketch of the state of affairs is that it is meaningless to speak of "weak", "moderate", "strong" or "radical" constructivism as long as these attributes are thought of as markers on a scale running continuously from objectivism to constructivism (e.g. Law/Wong 1996, 121-124). May be, that within idealism it makes sense to distinguish different types of constructivism. But even so, the "weakest" one of them still claims at least that we can't have any reliable experience of a world outside of our mind (epistemological skepticism) and hence denies any relevance of "reality" for the quality and dignity of thinking. Speaking logically, there is no possibility to take the position of "a-little-bit-Constructivism" because there is no position of that type which could be conceived without inner contradictions as it is absurd to state that one is existing only a bit or is being pregnant only a bit. Bednar et al. (1992, 30) have put it similarly: "Viewed from contrasting epistemologies, the findings of constructivism replace rather than add to our current understanding of learning."

Theoretical Status of ID

It would be carrying coals to Newcastle if one tried to offer here a definition of ID. But at least as a means of communication it may help to give a short outline of facts and interrelations to be observed under this concept and to offer an overview on the basics which guide the following reflections. In general, ID deals with the question how to arrange the world in a way that – if the arrangement is perceived by a certain person, say a student – learning of an intentional kind will be evoked (Tennyson/Schott 1997, 1). To put it in causal terms, ID deals with the problem which causes have to be brought in effect to produce a certain learning outcome. To be sure, the objective of ID is not limited to conquer one singular problem of learning at one singular space-time-point. ID rather seeks to discover rules as general as possible which provide information on how to manage problems of making someone learn under certain circumstances including learning environments and learners, as well. Independently of what is meant by "learning" (whether in a behavioristic or in a cognitivistic sense; cf. Ross/Morrison 1997; Tennyson/Elmore 1997) the basic question of ID is directed to the relation between any environment (brought about or designed by someone who intends to make another person learn) and its impact on the learner (his or her pattern of reaction on stimuli or his or her internal structures and procedures of processing information). Though it is of practical use to distinguish between theories of instruction and theories of learning a systematic difference between them seems not to exist. Both state a connection of environmental conditions and learning outcomes. In that sense, Tennyson and Elmore (1997, 57, 62) though discriminating the two concepts claim that instructional (design) theory "needs to explain theoretically how a particular instructional procedure works" and that it "should be cognitive" (ibid., 63). That means (see Fig. 1) that theories of instruction have to say something about an empirical connection between occurrences outside the learner ("**e**nvironment" as cause) and their consequences inside ("**l**earning" as effect) in short: **e** → **l** ("**If** a given realization of **e** occurs, **then**, as an outcome, a given realization of **l** results."). Given that the notion of instructional (design) theory is narrower in its meaning than "learning theory" because its focus is restricted to learning which is intended by a teacher.

What is the role of ID within this context? To put it in terms of language analysis ID comprises statements on the attributes of an environment which is intended to provoke learning effects. Again, *nota bene*, ID statements of that meaning are not restricted to singular, i.e. space-time-specific environmental attributes. Rather, they usually contain at least one – more or less – generalized element (mostly they are unrestricted with respect to time and, to a certain extent, also to learners). Formally speaking, they include usually at least one variable. So, ID statements make use of generalizations to characterize selected features of learning environments – features which may vary or can be varied systematically where the variation is followed by well-known or, at least, hypothesized learning effects (Collins 1992). ID statements do not necessarily speak *explicitly* about learning outcomes though they may include also remarks on that. But mainly they focus on the *if*-component of instructional theories (**e**). That does not mean that ID statements don't "care" about the effects of treatments they describe (or suggest). But their peculiarity is richness of variation of the *if*-component mostly focusing on non-teacher-related elements of treatments. ID statements are usually connected to an educational objective (or to a group of educational objectives) which is being held constant. ID research, then, studies the relations between varying conditions and characteristics of **e** and the "fixed" **l** (i.e. "**L**") taking that as a task of optimization. As a contrast to that, in instructional theories both, the *if*-and the *the*n-component consist of universals whereas in ID statements the content of the *then*-component is specialized focusing a single (group of) educational objective(s).

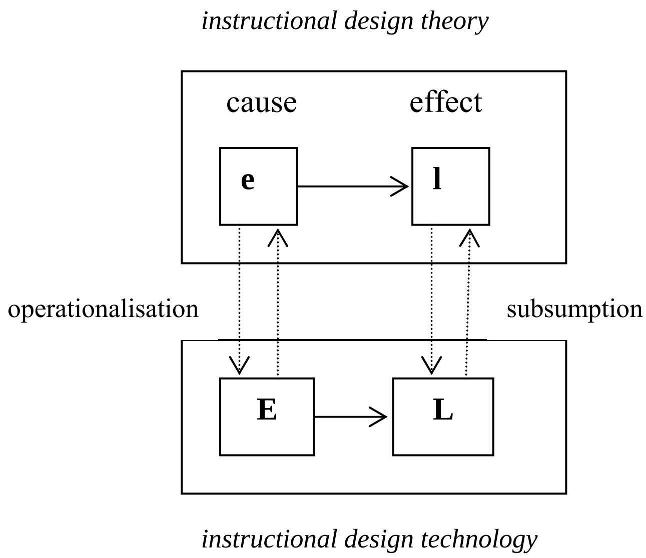

Fig. 1: The Systematic Locus of ID

If one agrees with that reconstruction (which is, of course, more intuitive than exact) there is no obstacle to be seen in making use of descriptive and prescriptive ID statements. As long as ID sentences don't claim to be theories in a strong sense (in which case they were always descriptive; cf. Seel 1997, 356) they are not limited to one of the two modes. But their very sense seems to be prescriptive in that they aim at giving suggestions what to do if **L** is the educational objective to be reached by a given student (Schott/Driscoll 1997, 143). Again, using the terminology of language analysis, we can put it more precisely: ID statements of the prescriptive type appear as conditional norms where **L** is the condition and **E** is the description of a certain state of learning environment one is requested to bring about, in short: "$!(\mathbf{L}|\mathbf{E}_o)$" (cf. Merril 1999, 3). In that case ID research has discovered that $\mathbf{E}_o$ is (or seems to be) the best (**o**ptimal) singular configuration of learning conditions, i.e. the optimal variant out of a set $\mathbf{e}_L$, given **L** as the educational objective to be reached. Usually we call statements like those also *technological statements*. And it is in that sense if ID is called a technology. Nevertheless, there is a systematic link between instructional theories ($\mathbf{e} \rightarrow \mathbf{l}$) and ID technologies $!(\mathbf{L}|\mathbf{E})$: **E** and **L** are concretizations of **e** and **l**, respectively.

Two research strategies

Now, there are two main strategies for doing research in this field. The ***first*** strives for the improvement of instructional theories, the second aims at optimizations of learning environments given certain objectives and addressees of education (Reeves 1999, 5). In following the first strategy it is necessary to do large scale research in order to test general hypotheses on the relation between **e** and **l**. Progress in that case is made (i) if hypotheses resist more and more attempts of falsification and (ii) if they become more and more informative. The latter is the case if **e** and/or **l** are enriched in content, i.e. if the number of classes of entities added to **e** by adjunction, to **l** by conjunction is growing: Examples for growth of information of **e** are inclusion of content, media, teacher characteristics, social relations between students, learner characteristics as prerequisites and other more specific conditions like noise, light, day time, ergonomics etc. Examples for growth of **l** are the addition of extent of learning progress, of the amount of knowledge, stability of learning gain, interconnectedness of knowledge, and, again, learner characteristics as far as they have been changed by the learning process.

How does theoretical progress matter for technology? There are two main contributions to be received from that progress. One consists of information on the *relevance* of elements of **e** for a given **L.** From the **e** → **l**-theory containing information on the co-variance of (combinations of) elements of **e** and **l** it can be learned which (combination of) factor(s) will be of impact on a fixed **L** (let's say, a given educational objective for a given group of learners entering the learning process with this pre-knowledge, that intellectual capacity, this interest in the object, that achievement motivation etc.). Technology research takes advantage of that knowledge on relevance insofar that it can concentrate its activities of optimization on the experimental variation of elements and attributes of environments which are of known (and possibly high) influence on the objective(s) to be reached. And, furthermore, ID technology can get information from an elaborated learning theory on the relative weights of the relevant factors. That helps to divide up investment of research efforts and, eventually, to estimate the practical use of research outcomes.

The ***second*** strategy, i.e. the technology development approach, starts off from a given **L** and sometimes also from an initial $\mathbf{E}_i$ trying to optimize **E** by more or less extensive changes. Sometimes ID technology will create a (nearly) totally new **E** (e.g. traditional classroom teaching compared to computer-based self-organized learning given **L** as additional knowledge in the "heads" of students). In both cases ID technology gets the criteria for optimization from **L**. Without a decision on any **L** ID technology had no goal and therefore would not know what to optimize. Even in the case of a very modest technology research program, e.g. if the only destination to be arrived at were learners feeling well in a learning situation, that aim is to be understood as a – relatively loose – determination of **L**. Therefore, technology research can't be pursued as a pure technique of developing certain arrangements. Possibly, the criteria of optimization of technology work are sometimes only implicit and vague. But that doesn't alter anything in its logical character.

Opposed to the theory development approach, this second type of ID research is more experimental, a "small scale" type of research, so to speak. Its strength and power seems to lie in the field of material, "technical" arrangements. But that impression drawn from ID history and from the fact that computers are usually at stake in ID is misleading. If there is a certain restriction at all one might tend to say that technological research mainly deals with the exactly repeatable elements of a learning situation, i.e. with all stuff apart from teachers. But again, there is no systematic reason that restricts that second variant of ID research, i.e. the technology development approach, in the indicated direction. The field of research in this second case is and stays to be the unrestricted realm of **e** (Dijkstra 19997, 20).

Compared to the theory oriented approach results of technological research are restricted in two dimensions. Firstly, **L** is a beforehand fixed learning outcome to be achieved by means of a certain treatment. That restriction opens the possibility to link technological research systematically to curricula because **L** always consists of or, at least, includes an educational objective. Secondly, **E** is consisting of a description of an environment to be put into practice if **L** is the aim. Though it is not totally clear on which level of generalization that description should be formulated many ID researchers seem to agree that the level is neither strictly singular pointing to a single space-time-point nor is it strictly general in making exclusive use of universals (the latter being logically excluded: as long as **L** denotes a somehow fixed effect the causes of **L** have to be fixed to a certain extent, as well; it is logically not possible to express a (partly) singular state as effected by unrestricted varying causes).

With a current expression one could say that **E** is of "middle range". What that means has to be elaborated with respect to the different dimensions of **E**. For instance, if some computer software is part of (the realization of) **E** a technological ID statement would be based on all intended states that special software can get into (but it is restricted to that software). Or, if some working material to be used by learners is an element of (the realization of) **E** the technological ID statement includes all states and relations (to learners as well as to other elements of **E)** that material should get into during the learning process (but it is restricted to that material). Or, if eventually a certain book is part of (the realization of) **E** a technological ID statement includes all types of use of that book suggested to learners (but it is restricted to that book). All these states may be lower or higher in number but in principle they are always enumerable and thus beyond generality.

To summarize, technological ID research within that approach means studying certain variations of elements of an arrangement **E** with respect to their impact on **L**, striving for statements of the type !(**L**|**E**) where **E** includes/excludes explicitly certain states of that environmental elements which increase/decrease the probability of achieving the educational objective. It is a genuine characteristic of that research type that it can be reduced to the analysis of some comparatively few constellations of **E** which – based on the experience and intuition of the researcher – seem to be promising. This implies that it is rational to stop ID research of the technological type if an $\mathbf{E_0}$ has been discovered that allows to reach **L** with an acceptable amount of expenditure.

Developmental logic of the two strategies

As described above the strategy of (1) theory development and that of (2) technology development show significant differences in research practice and aim at different purposes (s. Tab. below). Whereas e.g. the technology development strategy compared to the theory development strategy is – roughly speaking – more accidental in character and its outcomes are of relatively low or, at least, of uncertain dependability the theory development strategy is very slow, time and cost consuming and its outcomes are highly abstract. On the opposite, the latter strategy provides reliable information for an unlimited number of situations whereas the former offers only concrete solutions for – more or less – special cases. Furthermore, technological arrangements are comparatively inflexible with regard to transfer and adaptation to other environmental conditions because the interesting inherent causal relations are not fully known and therefore it is not clear which features of a treatment (and which not) may vary from one situation to another without consequences to the outcomes. On the other hand, technological arrangements should and could be of relatively high curricular and ecological validity.

Looking at these circumstances the question arises which of the two strategies shall be chosen. Obviously, both of them offer some advantages but are also connected with disadvantages. It depends on how the importance of each of the criteria in Tab. 1 is valued whether strategy no. 1 or no. 2 has to be preferred. If, for instance, within a company a special solution is needed for the qualification of staff to make use of, say, a new computer program one would prefer the technology development strategy which can offer an instructional design after a comparatively short time of constructional and research activities. If, on the other hand, there is an educational task stable in profile as e.g. teaching writing and reading, presumably one might prefer to have a theoretically grounded reliable treatment which covers nearly the full range of variation of causes and effects and so enables the user to adapt to (nearly) all real constellations of attributes.

Moreover, given an educational objective to be reached by students who are very different in their initial competencies one would tend to favor a theory based arrangement which allows to vary systematically some features of the treatment with respect to the varying needs of the learners. But if the educational task is mainly including the shaping of behavior one might incline to apply a technologically based design.

Of course, these are only examples and probably not everybody agrees to their pragmatic interpretation. More systematically speaking, every **E** as part of an (**L**|**E**)-argument is in principle a special case of an (**e** → **l**)-theory. In other words: Every realization of any **E** as a means of reaching **L** falls under a theory (**e** → **l**), whether (**e** → **l**) is already invented or still to be found. Therefore, there is no logical or theoretical contradiction between the two strategies (at least as long there is no difference in their underlying paradigms as e.g. realistic or constructivistic). On the contrary, they are parallel in that **E** and **L** are (potential) operationalizations of **e** and **l**. Therefore, they are like the two sides of a medal or, to put it under the aspect of philosophy of science, they are expressed by statements of a strictly theoretical or a (semi-)observational language, respectively. And exactly this is the reason for the fact that we have a strategic choice between them:

Tab. 1: Comparison of theory and technology driven ID*

Criterion	**Strategy** **1** **theory driven**	 **2** **technology driven**
1. *Pragmatic* Ecological validity	low	*high*
Curricular validity	low	*high*
Scope of validity	*broad*	narrow
Applicability	difficult	*easy*
Adaptability	*flexible*	inflexible
Progress	slow	*fast*
Dependability	*high*	low to medium
Reliability of treatment construction	low	*high*
Cost of development	high	*low to medium*
Cost of application	depending	depending
Outcome of application	*high predictability*	low predictability
2. Systematic Truth	*relatively high*	uncertain
Universality	*high*	low
Abstractness	high	*low*
Type of propositions	universals	individuals
Development strategy	*systematic*	accidental, trail and error
Predictive validity	*high*	low
Reliability of outcomes	*high*	low
Causal relations	*known*	unknown/ assumed

*"Pros" *written in italics*

It makes a difference in logic as well as in practice whether it is tried to falsify a general theory by observation of its applications or whether it is tried to reach a certain state of learners by variation of treatment characteristics. Systematically, both "coincide" at last or, more strictly, the growing number of (descriptions of) technologies (which is in principle infinite) approaches more and more the whole set of (descriptions of) realizations of (**e** → **l**) to which they are to be assigned by subsumption. (Admittedly, to speak of coincidence is somewhat inaccurate. Maybe, a comparison with the two rails of a railway track offers a better image of the relation to be described.)

Logically, neither (**e** → **l**) can be deduced from (**L**|**E**) nor (**L**|**E**) can be deduced from (**e** → **l**). Rather, the relation between them, as mentioned above, is to be described as operationalization or as subsumption, respectively. Both, operationalization and subsumption presuppose the existence of a theory (**e** → **l**). Any development of new technological approaches of the type (**L**|**E**) is for the moment without theory. Only after having a well developed and relevant theory (**e** → **l**) at hand it can be decided whether (**L**|**E**) is a case falling under (**e** → **l**). That decision is not a matter of empirical research but a matter of "power of judgment" (Kant). Yet, on the other hand, it is not at all arbitrary: Theory development proceeds in a close connection to intended applications, the latter being genuine operationalizations. It is a matter of "architecture" of concepts used within a theory to delimit their empirical meaning, i.e. their realm of operationalization. So, given a new technological development (**L**|**E**), it is a question still to be examined whether or not it can be conceived as an operationalization of a theory (**e** → **l**). In principle, the result of such an examination may be negative. But if (**L**|**E**) is a (description of a) very successful treatment it is also likely to be an operationalization of a theory. Thus, it makes sense to compare the relation between the two strategies, i.e. the theory and the technology driven ID, with the two rails of a railway track. In the worse case they may run to different directions. But that always puts in charge the technological variants as they are not controlled for "truth".

The problem of choice

As shown above the two strategies are different in their logical and pragmatic character. It is a matter of research policy and practice which rail is to be followed. The question is whether there are good reasons to do *either* the one *or* the other. Of course, researchers are free in their decisions. And interestingly enough, there are many of them pursuing the "theoretical rail" and, at the same time, there is also a large group pursuing the "technological rail", as well. This is an indicator for the fact that there are no clear and unambiguous arguments for following one of the two rails. Yet, practice, even scientific practice, does not always walk on the path of rationality. What are the criteria to be taken into account in making a decision between the two strategies? The list given in Tab. 1 seems not to move the weight on one of the two sides though there are nine *pros* for the theory driven and seven *pros* for the technology driven strategy. As was said above, it depends on how the single criterion is valued by a decision maker. Now, what are the arguments for that valuation, then? As far as I can see it might be a question of pedagogical risk and its ethical valuation which of the two possibilities should be chosen. Generally speaking, the risk of theory development strategy is that during a considerable amount of time possibly high effective treatments will not be construed and implemented at the expense of students who have to learn under traditional circumstances. For all subgroups ranging at the lower limits of competencies needed for passing an examination or an entrance test this might mean a loss of chances they could capture, a loss of possibilities to develop academically and vocationally. Of course, we do not know at all anything about the quantitative extent of that possible qualitative deprivation in motivation and knowledge as we don't for other types of not offering the best education to any student. In other words: The retention of an improvement of educational treatments by technological innovations will add an unknown rate to the unknown amount of reduction of individual chances for personal development with unknown but in any case negative consequences.

The counterpart of the risk of restraining is the risk of "miseducation". Newly developed arrangements are normally not fully seen through with respect to all of their short-, middle-, and long-term main and side effects (Merril 1999, 1). Again, we do not know these effects for many "traditional" treatments, too. But the introduction of a new treatment entails, of course, additional educational risks which might in sum be higher than that of a "traditional" learning arrangement. Negative effects of this type are (i) missing intended educational objectives (which could mean: producing unwanted outcomes) or (ii) failing completely in reaching educational objectives or (iii) achieving the educational objectives desired but, at the same time, ending with outcomes explicitly undesired (e.g. computer literacy in combination with computer play addiction).

The question is now whether we are ethically allowed to dare the implementation of newly developed arrangements as outcomes of the technology development strategy taking the (comparative) risks sketched out above or, to state it reversely, whether we are allowed to postpone changes in pedagogical treatments in favor of the theory development strategy which focuses on the task to integrate first new technologies in a well-formulated conditional body of knowledge and then make practical and justifiable use of it in terms of application. This version of the problem seems to be rather "academic" and in my eyes it is so, indeed. Faced with a pedagogical reality in which still a high percentage of actions is based on naïve subjective theories the alternative to be decided on is not a theory driven versus a technology driven practice. Rather, it is the choice of perpetuation of a mainly intuitive practice versus a change towards more rationality and sophistication whether grounded on sound theory or on elaborated technology.

What follows from that evaluation of the state of affairs of pedagogical practice for ID research practice? The situation here is not totally analogous in that research practice – in principle – is not a matter of intuition and thus has not to be improved by making it more rational. From the perspective of pedagogical practice it seems to make no difference whether help for improvement comes from a theory or a technology development approach. So, from the point of view of educational practice no argument can be drawn in favor of one of the two strategies. This stays to be true even if the dimension of time is taken into account: It is true that theory development is a slow process. But at the present state of affairs, i.e. widespread theoretical abstinence of educational practice, the already existing stock of theoretical knowledge which could be used for an immediate improvement of instruction seems to me to be considerable.

Besides, there are, of course, additional aspects and reasons for likes and dislikes of researchers with respect to the two strategies (personal preferences for research content and methodology, opportunities to get funding, deliberations on career planning etc.). That might be the true background and, at the same time, the legitimate reason for the fact that up to now there are colleagues working in the field of theory development as well as colleagues working in the field of technology development. For the growth of the body of knowledge on teaching and learning as a whole this seems to be the very best constellation as long as one condition is fulfilled, i.e. the incessant caring for systematic links between **e** and **E**. Promoting **E** without connection to **e** would result in blind practicism. I think we already have a sufficient amount of examples of and experiences with such developments in the fields of teach-ware and on-the-job-training (video-based skill drills etc.). Promoting **e** without creative inventions of well-adapted applications of **E**, on the other hand, would mean ignoring the needs and legitimate claims of society alimenting research. Therefore, as a result, reason demands that an intensified co-operation between theory and technology oriented researchers sharing a realistic point of view should take place. That makes sense because from a systematic point of view, theory driven and technology driven ID research are not alternative, rather, they are compensative. However, researchers as single persons cannot avoid the decision between the two strategies because each of them needs special research competence and exhausts the full working capacity of an individual or a specialized group. Yet, it is improbable that during a “normal” researcher’s biography that decision has to be made definitely. Rather, circumstances, opportunities, and interests push or escort her or him on one of the two tracks. But even if one had to decide explicitly no reasons are to be seen immanent to ID research forcing someone to follow the one or the other strategy – at least, as long as none of both is at risk to perish. Only in that latter case it were a dictate of reason to strengthen the track in danger to fizzle out.

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Literature

Albert, H. (1978): Traktat über rationale Praxis. Tübingen: Mohr

Bednar, A.K. et al. (1992): Theory into practice: How to we ling? In: Duffy, T.M./Jonassen, D.H. (eds.): Constructivism and the technology of instruction. A conversation. Hillsdale: Erlbaum, pp. 17-34

Collins, A. (1992): Toward a design science of Education. In: Scaulon, E./O'Shea, T. (eds.): New directions in educational technology. Berlin: Springer, pp. 15-22

Dick, W. (1992): An instructional designer's view of constructivism. In: Duffy, T.M./Honasson, D.H. (eds.): Constructivism and the technology of instruction. A conversation. Hillsdale: Erlbaum, pp. 91-98

Dijkstra, S. (1997): Theoretical Foundations of instructional design: Introduction and overview. In: Tennyson, R.D./Schott, F./Seel, N.M./Dijkstra, S. (eds.): Instructional Design: International Perspectives. Vol. 1: Theory, Research, and Models. Mahwah, N.J./London: Lawrence Erlbaum, pp. 19-24

Dinter, F. (1998): Zur Diskussion des Konstruktivismus im Instruktionsdesign (Constructivism and instructional design). Unterrichtswissenschaft, 3, 254-287

Hoops, W. (1998): Konstruktivismus: Ein neues Paradigma für Didaktisches Design. Unterrichtswissenschaft, 26, 229-253

Husserl, E. (1922): Ideen zu einer Phänomenologie und phänomenologischen Philosophie. Erstes Buch, Allgemeine Einführung in die reine Phänomenologie. Halle: Niemeyer

Jonassen, D.H. (1990): Thinking technology, toward a constructivist view of instructional design. Educational Technology, issue Sept. pp. 32-34

Lakoff, G. (1987): Woman, fire, and dangerous things: What categories reveal about the mind. Chicago: Univ. of. Chicago Pr.

Law, L.-C./Wong, K.-M. P. (1996): Expertise und Instructional Design. In: Gruber, H./Ziegler, A. (Hrsg.): Expertiseforschung. Opladen: Westdt. Verlag, 115-147

Merril, M.D. (1999): Components of instruction. Toward a theoretical toll for instructional design. Paper pres. at the Johannes Gutenberg-University Mainz, Germany, May 10, 1999

Molenda, M. (1997): Historical and philosophical foundations of instructional design: A north American view. In: In: Tennyson, R.D./Schott, F./Seel, N.M./Dijkstra, S. (eds.): Instructional Design: International Perspectives. Vol. 1: Theory, Research, and Models. Mahwah, N.J./London: Lawrence Erlbaum, pp.41-53

Popper, K.R. ([7]1982): Logik der Forschung. Tübingen: Mohr

Reeves, Th. C. (1999): A research agenda for interactive learning in the New Millennium. Paper presented at ED-MEDIA '99

Ross, S.M./Morrison, G.R. (1997): Measurement and evaluation approaches in instructional design: Historical roots and current perspectives. In: Tennyson, R.D./Schott, F./Seel, N.M./Dijkstra, S. (eds.): Instructional Design: International Perspectives. Vol. 1: Theory, Research, and Models. Mahwah, N.J./London: Lawrence Erlbaum, pp. 327-351

Schott, F./Driscoll, M.P. (1997): On the architectonics of instructional theory. In: Tennyson, R.D./Schott, F./Seel, N.M./Dijkstra, S. (eds.): Instructional Design: International Perspectives. Vol. 1: Theory, Research, and Models. Mahwah, N.J./London: Lawrence Erlbaum, pp. 135-173

Seel, N.M. (1997): Models of instructional design: Introduction an overview. In: Tennyson, R.D./Schott, F./Seel, N.M./Dijkstra, S. (eds.): Instructional Design: International Perspectives. Vol. 1: Theory, Research, and Models. Mahwah, N.J./London: Lawrence Erlbaum, pp. 355-359

Stegmüller, W. (1974): Probleme und Resultate der Wissenschaftstheorie und Analytischen Philosophie. Band I. Wissenschaftliche Erklärung und Begründung. Berlin: Springer

Tennyson, R.D./Breuer, K. (1997): Psychological Foundations for Instructional Design Theory. In: Tennyson, R.D./Schott, F./Seel, N.M./Dijkstra, S. (eds.): Instructional Design: International Perspectives. Vol. 1: Theory, Research, and Models. Mahwah, N.J./London: Lawrence Erlbaum, pp. 113-134

Tennyson, R.D./Elmore, R.L. (1997): Learning theory foundations for instructional design. In: Tennyson, R.D./Schott, F./Seel, N.M./Dijkstra, S. (eds.): Instructional Design: International Perspectives. Vol. 1: Theory, Research, and Models. Mahwah, N.J./London: Lawrence Erlbaum, pp. 55-78

Tennyson, R.D./Schott, F. (1997) Instructional design theory, research, and models. In: Tennyson, R.D./Schott, F./Seel, N.M./Dijkstra, S. (eds.): Instructional Design: International Perspectives. Vol. 1: Theory, Research, and Models. Mahwah, N.J./London: Lawrence Erlbaum, pp. 1-16

von Glasersfeld, E. (1998): Die Radikal-Konstruktivistische Wissenschaftstheorie. Ethik und Sozialwissenschaften, 9, 503-511

Winn, W. (1992): The assumptions of constructivism and instructional design. In: Duffy, T.M./Jonasson, D:H. (eds.): Constructivism and the technology of instruction: A conversation. Hillsdale, N.J.: Erlbaum, pp. 117-182

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