

Psychological theory on entrepreneurship tested at gifted children's language learning in LEGO-simulation-game

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Abstract

The aim of this paper is to present results of learning processes for gifted children, using the Action Regulation Theory on entrepreneurship in learning a basic vocabulary of the 6 major languages of the world. Why the focus on giftedness? The idea to develop a specific learning method for children that are gifted, evolved from the notion that the learning demands of these gifted children are not (enough) met.

Children are gifted when their ability is significantly above the norm for their age. The major requirement for the learning processes of these gifted children, is challenge. The presented challenge for them is to communicate in the six major languages of the world: Chinese, Russian, Arabic, Hindi, Spanish and English. We earlier published that it is possible to combine language learning with entrepreneurial learning (edupreneurial method) that allows the participants to learn the basic vocabulary of a totally unknown language. A specially developed entrepreneurship LEGO-game (the simulation game LA-Game) provides an authentic entrepreneurial setting. The learning method has been tested in several experiments using languages such as Chinese, Korean and Hindi. We now present the results of learning experiments with gifted children: measuring their basic vocabulary Russian before and after LA-Game.

In our view Frese's Action Regulation Theory is a general theory of learning entrepreneurship, that can be applied universally in any (action) learning process. All elements of this Action Regulation Theory are present in LA-Game as we published earlier. We will show that all of them:

- *the facets of active performance,*
- *the differentiated steps in sequence of action regulation,*
- *the hierarchical structure in 4 levels of action regulation,*
- *the foci of action regulation and the action oriented mental model,*

fit also in the learning needs of gifted children. This theory is specifically relevant because it focuses on the regulation of learning actions.

The identified specific 'market need' in learning and teaching processes for gifted children, explains 'innovative entrepreneurship' applied in our learning programs, so the "why, who, what, when, where, how and for whom".

Keywords: Action Regulation Theory, psychology of learning entrepreneurship, edupreneurial method, LA-Game, giftedness, entrepreneurship LEGO-game

Introduction

The psychological theory on learning entrepreneurship (Action Regulation Theory, ART) can be applied for other learning processes using an entrepreneurial teaching method, that applies to a receptive mindset of gifted children who specifically want to learn in such a way. For this group, it is:

- relatively easy to organize experiments with new learning methods (there are specific school groups of gifted children, school organizations are open for experiments on teaching)
- acquire observations of entrepreneurial learning. This due to what ART mentions as '*the cognitive ability and qualifications that are needed to be able to regulate on this meta-level*'. Gifted children have these abilities.

In this paper we present the why (need), the who (gifted children), the what (basic vocabulary of a totally unknown language, Russian, so an easy to identify learning process), the when (sequence of ART), where (LA-Game), how (levels of regulation of ART) and for whom (gifted children with the need). The learning results by

Kahoot surveys: before LA-Game, after LA-Game and 1 week after LA-Game, are presented. The process or the sequence of ART is demonstrated with short YouTube-movies of the experiment (links in are in a non-public mode, privacy!) which gives an indication of the validity of several elements of Action Regulation Theory for entrepreneurial learning.

Giftedness and their need for entrepreneurial learning processes

Gifted children have abilities significantly above the norm for their age, generally these children learn more quickly, deeply, and broadly than their peers. Gifted behavior occurs when there is an interaction among three basic clusters of human traits: above-average general and/or specific abilities, high levels of task commitment (motivation), and high levels of creativity. Gifted and talented children are those who possess or are capable of developing this composite of traits and applying them to any potentially valuable area of human performance. As noted in the Schoolwide Enrichment Model, gifted behaviors can be found "in certain people (not all people), at certain times (not all the time), and under certain circumstances (not all circumstances)." (Renzulli, 1978). Characteristics are: high reasoning ability, creativity, curiosity, a large vocabulary, an excellent memory, able to master concepts with few repetitions, be perfectionist, often question authority, have trouble relating to or communicating with their peers.

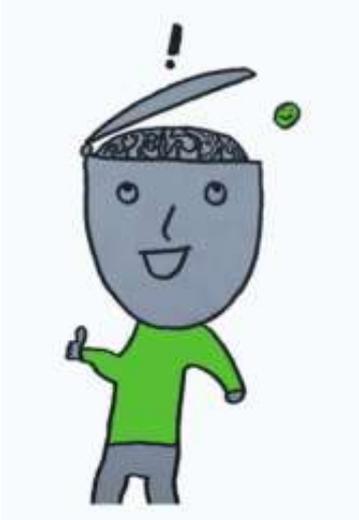
The perception of his "school-teaching " by a gifted child (Bart)	The perception of learning processes by a gifted child (Bart)
 <p data-bbox="188 1373 304 1402">"negative"</p>	 <p data-bbox="810 1373 911 1402">"positive"</p>

Figure 1 different perceptions

According to specialists on education of gifted children like Linsen and Goethals (2003) teaching to gifted children need to: avoid routine jobs; steps in learning should be large; a reasonable level of abstraction should be present; divergent thinking should be needed and creativity ; internalization should be as independent as possible. Bronkhorst (2001) has similarly requirements for teaching gifted children: appeal their creativity; open assignments; high level of abstraction; high complexity; generate added value in relation to the regular learning content; activate an investigative attitude; evoke an attitude of reflection on operating; appeal to their meta-cognitive skills; provoke interaction; appeal to the self-dependence.

One of the key principles of gifted children is the holistic approach in thinking: the so called "top-down thinking". Instead of the question: "why?", it focuses on the question "how?". The meaning of the knowledge is essential for gifted children to store it as useful. The approach in school-education is generally bottom-up: stepwise built up with at the last step the goal and meaning. So the usefulness of knowledge in practice, the answer to the why-question is not essential.

Formulating learning goals is the main element of top-down learning: generating the perspective of the final goal. A gifted child than understands that his hard work will lead to a goal which he or she has not yet accomplished at the start of his or hers learning process. Top down learning implicates learning from the

explicit level (generic, declarative level) to the implicit level (specific, procedural knowledge) and is analytic in nature (Sun, Merrill & Peterson, 2001)

Because gifted children request new learning methods, the teaching methods should change too and made applicable to the mind-sets of these gifted children. Teaching might otherwise lead to mislearning. For example, “instant payoff”. Illeris (2009): *‘in education, at workplaces and many other situations, very often people do not learn what they could learn or what they are supposed to learn. Mislearning due to misunderstandings, lack of concentration, mental resistance, etc. Because young people are highly engaged in a process of personal identity development’*. Illeris (2009) means *‘that young people fundamentally meet all learning initiatives with questions such as: What does it mean to me? Or: What can I use this for?’* - implying that it is only worth paying attention to if it is subjectively accepted as a usable contribution to the present demands of the identity process.

In an earlier publication (Roelofs, 2012) we showed that it is possible to combine language learning with entrepreneurship learning to create such a new learning process. The process of conscious and unconscious learning referred to as “Reference Creation”; an “edu-preneurial” method of teaching that allows the participants to learn the basic vocabulary of a totally unknown language using an entrepreneurial network set up. The learning method has been tested in several experiments using languages such as Chinese, Korean and Hindi and a local dialect (Drents). In this paper, the focus is on Russian and gifted children.

Language is a complex skill, where the learning process is similar to learning entrepreneurship. A well-known definition of Entrepreneurship is “the pursuit of opportunity without regard to resources currently controlled.” Hence, learning a language could be similar, that is, the pursuit of communication opportunities. A basic vocabulary is necessary to be able to communicate actively. Similar to entrepreneurship, acquiring a new language vocabulary does not necessarily require conscious study of theory, such as the study of grammatical rules. Learning a new language happens naturally (and automatically) when you get lots of interesting and meaningful input, which can be provided by an authentic learning environment. As soon as a person has learned a reasonable amount of vocabulary, it is a lot easier to set the next step in the process of learning a language.

LA-Game explained

The simulation role game, LA-Game, is an entrepreneurial context using LEGO to teach and learn in a playful manner. In the simulation, several markets are created, where LEGO products are traded. Participants buy and sell commodities, produce and /or trade LEGO towers or LEGO parts. The use of LEGO makes LA-Game also quite sustainable.

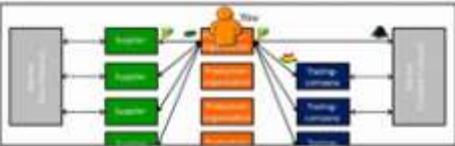
The essence of the simulation game LA-Game lies in the conflict of interests among the different market players. In LA-Game, participants are exposed to real uncertain market situations and have to communicate with the markets in a foreign language. In LA-Game the objective is learning, but there is also a competitive element on making profit. The rules of LA-Game are:

- o Everybody is entrepreneur in his/her role. In the simulation, several markets are created, where LEGO products are traded. Participants buy and sell commodities, produce and /or trade LEGO towers or LEGO parts;
- o There are three variations in the roles: Traders, Producers (see figure 2) and Suppliers. The added value is created by the entrepreneurs by trading the raw materials, which can be bought (using Russian language!) at the Market Raw Materials and the finished products which can be sold (using Russian language!) at the Market Finished products;
- o The market consists of two types of products: mono-coloured towers (sold by Producers & Traders) and multi-coloured towers (sold only by Traders);
- o All participants are limited in their resources, have a (small) competitive advantage in their stock and have the same starting capital: € 2500 in cash and in kind.

LE Network
Role: Production Organization 2a (LE-Game 1.0)

Tower 3 series	Tower 5 series	Tower 5 series	Tower 1-series	Tower 7 series
				

Production Organization 2a conducts the production of specific types of Towers. You have a license to produce. You, as an entrepreneur have to create an income by realizing a Gross margin in production.



Trade organizations approach you to deliver and produce simple mono color Towers 301, 302, ... or the fixed multi color Towers 501, 502, ... or customer specific colored Towers 702, 703, 709. Trade organization have their own distributor channels and are able to deliver all kinds of Towers to the World Market.

You also look out at the World market for attractive orders: but only the simple mono color Towers 301, 302. You are allowed to deliver only the specific colored Towers to the World market, so you are restricted to orders with only mono colored towers. Of course this takes time and energy which you also can use to earn money with producing.

You earn your money by producing, adding value to the purchased raw materials. In general your gross margin is more 20%.

You have to negotiate with the Trading organizations about the price you are prepared to deliver the requested Towers.

You have to negotiate with suppliers about the price they are prepared to deliver, so the price you are willing to pay for the raw materials. Both, reductions of the price or higher prices, are possible.

You will experience **competition** because there are competitors who have to get their income in a similar way by producing towers. You do not have an export license so the only way to purchase raw materials is through suppliers. Your available resources limit your opportunities: you cannot buy a lot of raw materials.

LE Network

Your balance sheet:

Debit:		Credit:	
Cash	€ 282,-	Capital/Own Funds	€ 2.500,-
Inventory of raw materials	€ 2.218,-		
total	€ 2.500,-	total	€ 2.500,-

Figure 2 An example of a role in LA-Game

Participants experience market competition in combination with scarcity of resources: pressures of scarcity of money, time and competitors. So, being continuously exposed to the market transactions and the risk during the game. The dynamics caused by these pressures of scarcity create both linear and non-linear learning processes. The context is Russia, each participant is triggered by senses and emotions (Damasio,1994). Positive emotions in experiencing successful transactions support the learning by doing process.

Methodology

Our methodology in publications is based on systematic generation of theory from data that contains both inductive and deductive thinking, like the grounded theory method, a systematic methodology in the social sciences involving the construction of theory through the analysis of data. Here one does not begin with a theory ... one begins with an area of study and what is relevant to that area is allowed to emerge [Glaser & Strauss, 1967 and Strauss & Corbin, 1990]. We did and do not aim for the "truth", but we conceptualize what is going on by empirical research, especially by observing what is going on in our simulations. We formulate hypotheses based on conceptual ideas on learning (and teaching) processes in these simulations and test and re-test them in experiments with these simulations. So a kind of 'simulation grounded theory' that is shown in previous publications.

We apply the experimental method as a research method, because LA-Game can be played again and again, so our hypothesis can be validated or falsified whenever the experiments are repeated. This is exactly what we do. Here we use the testing environment of LA-Game, which offers participants the opportunity to experience the learning of a totally unknown language in a safe and simulated environment. LA-Game using LEGO is literally playful, as the word LEGO is Danish for "toy".

We assume that our hypotheses on the learning and teaching process are valid; we have tested them with the help of the experimental method during simulations, by testing participants "before" and "after" attending an LA-Game session. The effectiveness of the learning process is measured by the retention rate of the learned words. The elements of Action Regulation Theory are shown by videos of the participants.

Language learning as action learning of “tacit knowledge”

The idea that learning a language is consequently the creation of images which can be related to the dispositional representation in the personal, so subjective mind-set is supported by Damasio (1994). It is basically what is called constructivist learning, where it is assumed that the learner him-or herself actively builds up or construes his/her learning as mental structures, mental schemes in the brain. Damasio sees the brain as a “safe harbour” where the signals of the senses arrive in specific sectors, which are the basis for topographically organized representations, the source of mental images.

Damasio states that we share our mental image-based concept of the world with other humans and that there is a remarkable consistency in the constructions different individuals make of essential aspects of the environment (textures, sounds, shapes, colours, space), where these images can be perceptual or recalled. Damasio suggests that mental images are momentary constructions.

For language communication, Damasio adds: “*Most of the words we use in our inner speech, before speaking or writing a sentence, exist as auditory or visual images in our consciousness*”. Damasio refers to Roger Shepard (1980) and Stephen Kosslyn (1982) when he argues that the value accorded to images is a recent development, part of the cognitive revolution that followed the long night of stimulus – response behaviourism. Also Damasio quotes Albert Einstein: “*The words or language, as they are written or spoken, do not seem to play any role in my mechanism of thought. The psychical entities which seem to serve as elements in thought are certain signs and more or less clear images which can be ‘voluntarily’ reproduced and combined...*” Damasio speaks of **dispositional representations** with which one is able to reconstitute a picture, dispositional representations are in his view ‘*dormant firing potentiality which comes to life when neurons fire.*’ For learning processes it is relevant how these images can be recalled to be able to communicate in a foreign language.

Because you need to recall the words in your ‘inner speech’ to be able to use words functional for communication, these dispositional representations in our view are related to the effectiveness of a learning (and teaching) process.

The psychological approach to this ‘inner speech’ is similar to Vygotsky’s (1978) concept of “internalization” that evoked from Action Theory . Similarly “internalization” can be interpreted as the internal reconstruction of an external operation.

Language can be regarded as a kind of tacit knowledge (Nonaka, 1994), the kind of knowledge which is highly personal and hard to formalize. The internalization of the knowledge where explicit knowledge is transformed to tacit knowledge is the key of learning processes.

LA-Game is an educational method based on experiencing successes, and learning from failures (Popper, 2006). It is “action learning” (Argyris C. , Schön D.A., 1978), learning by doing, so the effectiveness of the learning process is better than other learning systems such as lectures (Sousa, 2006). A learning environment based on pull learning, since the development of communication skills is far more demand driven than supply driven. LA-Game is also a “neutral-Kolb environment”(Roelofs, 2013) , where each participant can apply their individual specific Kolb-learning style. The role game simulation has the dynamics that makes it possible to learn from making mistakes and from experiencing successes in a safe learning environment. The difference between this kind of learning environment and a professional environment is that it is allowed to make mistakes, sometimes even encouraged to make mistakes. Making mistakes is regarded positive learning (Popper 2006). Playing makes people free: they dare to make mistakes.

Action Regulation Theory (ART) in LA-Game

The Action Regulation Theory (Hacker, 1986) originally focused on modelling working conditions. Frese cs. (2018) have applied it to entrepreneurship and we pointed out that Action Regulation Theory is a theory of learning entrepreneurship. (Roelofs, 2018). This Action Regulation Theory (ART) focuses on the regulation of the activity process which is applied to the gap between the visible activity and the non-visible cognitive processes by using a hierarchical-sequential structured model of the stepwise actions..

In general the ART distinguishes three levels of regulation of activities:

- the intellectual regulation-level, the highest level of the mental action-plans, the goal setting and selection of goals. These goals are realized through concrete actions. So the hierarchical highest level of thinking about what to achieve and which action steps to take to do so.

- the perceptual-conceptual regulatory-level, the control process of the continuously monitoring of the actions using a feedback-loop to ensure achieving the planned goal or make adjustments otherwise. This is the level about the monitoring and making adjustments.
- the sensory-motor regulatory level, the automated, “internalized” routine actions. The not-having-to-think level. Often in language learning focuses on this automated level: learning words without any structure to increase the “automated” level.

Frese distinguishes four levels and more “building blocks” in ART, each of them fits in the characteristics of giftedness!

1. the facets of active performance,

Frese and Fay (2001) distinguish three facets of being active: self-starting, long-term proactivity and persistence/overcome barriers. All three facets of active performance are present in LA-Game: Each role in LA-Game implies **self-starting**, that is activated by the pull aspects of the simulation context. There is no superior present who tells the participant what to do or not to do. In LA-Game, self-starting of information collection is based on active search, active exploration of the environment and the information available. (<https://youtu.be/36jKJNeMk4>)

Each role in LA-Game implies **proactivity** of not to wait until a demand is explicitly made to which one must respond. We observed that even during the coffee breaks the actions continue.

Each role in LA-Game implies **persistence** because there are always bottlenecks and limitations due to changing prices, scarcity of LEGO materials of specific colours, etc. Each participant has to overcome adversity (“no one wants my yellow LEGO bricks..”) and of course to communicate in Russian requires persistence.

2. the differentiated steps in sequence of action regulation

Before the sequence of action regulation can start, Frese adds a pre-phase of the regulation: ‘the consciousness of regulation’. (<https://youtu.be/Hvb17mS4KII>) As we experienced, this is an important phase: as an individual you have to know that entrepreneurial behaviour is required. An “entrepreneurial mode”, so a context that entrepreneurial operating is needed. In LA-Game we bring participants in such a mode (colored jackets, specific badges, <https://youtu.be/9ZT4pHwgYc0>)

- First step: goal development and selection,

‘Goals’, according to Frese, *‘are proactive, when future opportunities are transformed into goals, ...* Frese refers Austin & Vancouver (1996) that goals are *‘internal representations of desired states in the future’* and Hacker (1985), that an *‘action is the smallest unit of behavior that is linked to a goal’*. (<https://youtu.be/gUOjOkJl6vg>)

Second step: orientation or mapping the environment,

According to Frese, *“individuals regulate their action based on information or signals they receive from the environment, and they also change their environment through action”*. The ‘change of the environment’ is literally observable in LA-Game.

Regarding information collection and prognosis, Frese states that: *“Proactive information collection appears if owners systematically search and scan for potential future opportunities or problems. Overcoming barriers in information collection implies that one continues on when it is difficult.”*

This information collection can be observed constantly during LA-Game. The systematic search for opportunities is literally observable, because the participants are cruising through the games location, moving from one participant to another. (<https://youtu.be/rRSK63hIF1U>)

- Third step: planning (plan development and plan selection),

Frese: *“This phase involves the creation of and selection among different plans that are instrumental in attaining a goal. .as bridges between thought and action..”* In LA-Game this planning process is executed within seconds or minutes. The mental simulations illustrate the learning process of Action Regulation Theory. (<https://youtu.be/wgGrdJ5d6Q>)



Figure 3 : Impression of LA-Game

- Fourth step: monitoring of execution,

Frese: *“People need to monitor their actions. This involves a comparison between the goal and the associated plan and the actual execution of behavior. During execution,can respond more or less flexibly to unexpected situations, adapt their goals and plans, ..(Frese & Zapf, 1994)”*.

This monitoring and adapting goals and plans are manifest in the dynamics of LA-Game. ‘Adapting’ means implicit that in Action Regulation Theory there is a learning process.

- Fifth step: feedback processing

Especially in this fifth step of the action sequence, the learning aspect is highlighted. Frese: *“Feedback provides people with information from the environment about their current performance or progress toward attaining the goal. Moreover, feedback enables learning which types of plans can be most successfully used in the future.. They then regulate their behavior to reduce any discrepancies and to achieve the goal”*. (<https://youtu.be/Ry9NpYGcXgk>)

In LA-Game the feedback is a constant process on the actions of the participants which in communicating in Russian are stimulated to help each other with Russian words.

3. the hierarchical structure in 4 levels of action regulation

Frese identifies a **hierarchical structure** in the regulation of actions. Action sequences on lower levels (less conscious and more routine behavior) are regulated by higher levels that require more conscious operating, more cognitive effort and feedback. So a higher level of action regulation requires more learning (and teaching) effort. Four hierarchical levels are distinguished:

- a) The sensorimotor level which does not require conscious attention.
- b) The level of flexible action patterns. In LA-Game these flexible actions patterns can literally be observed. Participants moving more or less random trough the room of the playing session.
- c) Intellectual or Conscious Level. This ‘consciously regulate’ is the challenge for each participant when playing LA-Game. This intellectual level sees Frese related to the mental simulation: *“This level is concerned with conscious regulation of goal oriented behavior.* (<https://youtu.be/f1DrZRf-DLM>)
- d) Level of Meta-Cognitive Heuristics. According to Frese this is a complex level of regulation, because it embraces both conscious as well as non-conscious forms of regulation. At this highest level of action regulation, meta-cognitive templates, strategies, and abstract heuristics are used, to guide goal and plan development, and feedback processing as well as understanding the environment (Frese & Zapf, 1994). *“These meta-cognitions allow individuals to approach similar problems in an effective way “* illustrates the relevance of learning for future acting. The learning aspect of Action Regulation Theory is implicitly presented by Frese as *“freeing up higher levels of regulation”*.

4. the foci of action regulation and the action oriented mental model

Because all actions are done within a certain situation or context, Frese differentiates three foci of performance:

- a) Task focus. A strong task focus is generally associated with high efficiency and effectiveness of action regulation, because it links goals with relevant plans, behaviour and feedback. In LA-Game we see this task focus in delivering the order in Russian, or buying LEGO bricks in Russian.
- b) Social focus. Actions are performed within a social context. Interactions with other people influence the action sequence. In LA-Game a social focus can be observed: personal networks clustering together, also in helping with Russian. (<https://youtu.be/Ry9NpYGCXgk>)
- c) Self-focus. The self as a focus of regulation, implies that the impact of the individuals' actions on their self -emotions and self-beliefs- are in the foreground. Frese: "*The self-system is regulated on the meta-level*". It implies that a cognitive ability and qualifications are needed to be able to regulate on this meta-level. Gifted children are supposed to have these abilities.

The action oriented mental model is the need to communicate in Russian with the markets.

(<https://youtu.be/FRZms8I3Gbw>)

Basic vocabulary needed to "survive"

The major pull learning is caused by the need to "survive", therefore basic communication is needed: the basic vocabulary! As Damasio states: "*An organism is designed with automatic survival mechanisms, and to which education and acculturation add a set of socially permissible and desirable decision strategies that, in turn, enhance survival,...*". The simulation activates the power for associations, which result in the capabilities of participants to adapt to this realistic context which need communication in a completely new language to be able to "survive". Associations (word images) are activating dispositional representation through reasoning strategy. Damasio: "*emotion is needed for mastering the know-how*" (Introduction, p.xxv).

In the LA-Game simulation each participant is set back into an "unknown" context, basically "back to zero" and confronted with a totally new language. To be able to have success, communication is necessary. By confronting each participant with the language handicap, each participant is placed in a kind of "survival mode", where communication is demanded. This requires active and collaborative learning processes, not "pushed" but "pulled", any participant will apply and remember the words which are needed in communicating to 'survive'. (<https://youtu.be/wob5qVcHdq>)

Theory like Damasio's, made clear that for learning a language, to communicate in a foreign language we had to create learning elements which activate or stimulate this making of 'mental images', these dispositional representations. To be able to communicate in such a new language you have to create your personal 'mental images'. This aspect of subjectivity emphasizes the subjective element of learning processes. An element that is also highlighted for teaching gifted children.

For each language the basic vocabulary consists of circa 50-100 words, which can be compared with the first level of learning a language: "the Common European Framework A 1"

The results of the test on Russian

We tested a number of words of a basic vocabulary Russian. So colors, simple numbers, greetings etc. We tested by using Kahoot survey, before and after the LA-Game course. The results showed an increase of 52% in a few hours. Due to the chance element in testing (just gambling generates 25% good answers), the increase was even larger when corrected for this aspect. We repeated the same survey a week later: the results were even better: an increase of 61% good

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