The concept of a learning oriented Subjective Action Space

Prof. Dr. Albert Ziegler &

Prof. Dr. Heidrun Stoeger

Frequent encounters with the components of the Actiotope in our early work

Gender studies with gifted girls in STEM

- Action repertoire
- Environment
- Goals

Action repertoire

- Lower participation rates, particularly among the top performers
- Lower achievements, particularly among the top performers
- STEM activities

Environment

2 Examples

Photo from an older school book

Photos from recent school books

Goals

- Lower aspirations in STEM
- Externally set goals
- Dysfunctional goals

Two sources of dissatisfaction:

- Single variable approach
- Regulation of the components

Single variable approach: Attributions

Why did you fail / pass the math test?

		Locus	
		internal	**external**
Stability	**stable**	**Talent, intelligence**	**Task difficulty**
	variable	**Effort**	**Luck/bad luck**

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		internal	**external**
Stability	**stable**	Action repertoire	Environment
	variable	**Goals**	Luck/bad luck

Single variable approach:
From self-concept to self-efficacy

- Self-concept: Just a description of me
- Self-efficacy: An estimation if I can master the task

→ action repertoire and environment combined in a new variable

Some problems with self-efficacy

- But what if I do not want to do this task?
- Do girls overestimate the task or underestimate themselves (or both)?

What is needed?

- An individual needs the ability to reason what action (from his/her action repertoire) is best suited in this environment to attain a goal.

→ Subjective Action Space

Regulation of the components in the SAS: Some examples

What is the most effective educational method?

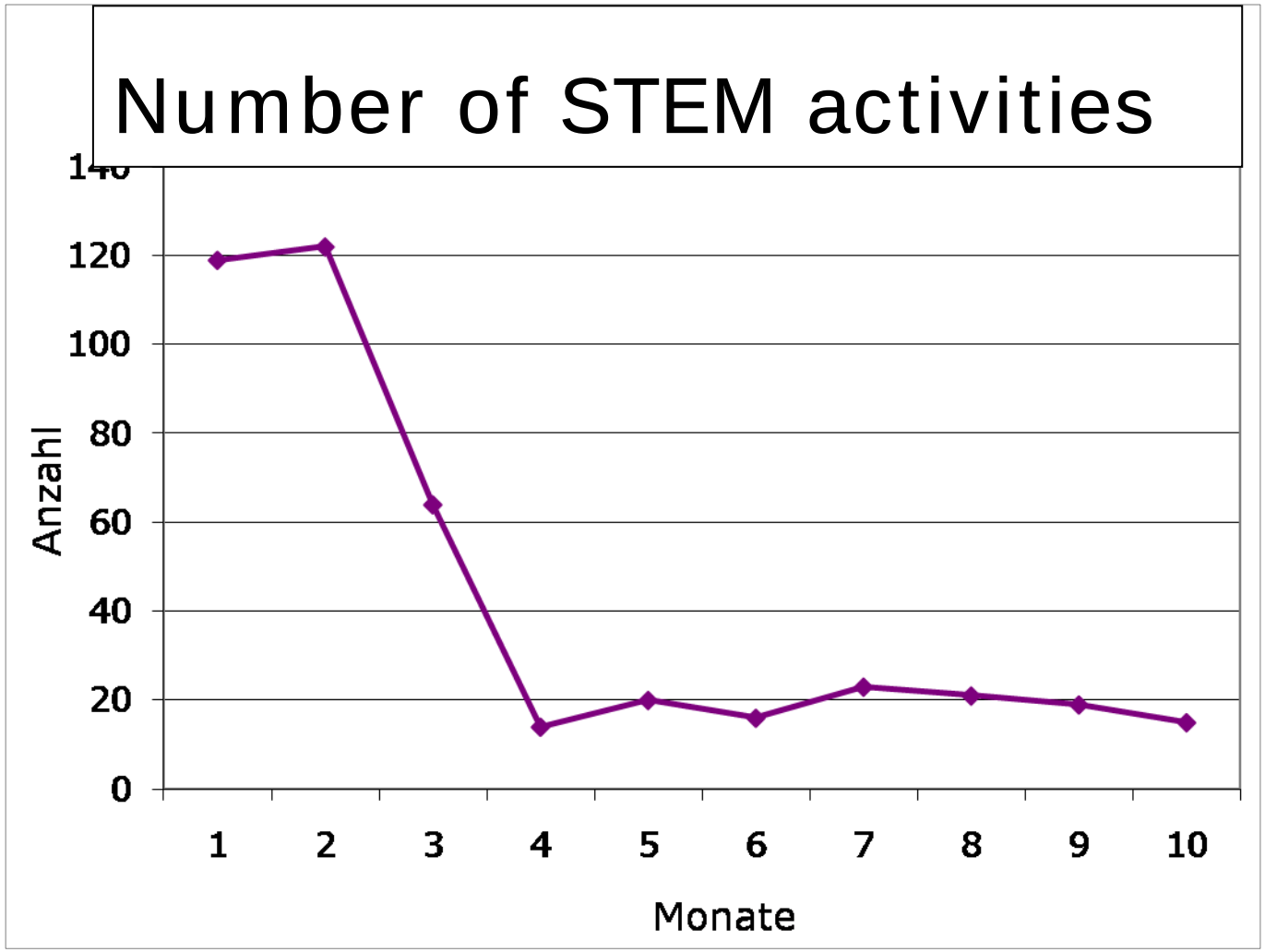
Mentoring

Gold standard of educational methods

CyberMentor-Team

Ulm

Regensburg


Number of STEM activities
140
120
100
80
60
40
20
0
Anzahl
1
2
3
4
5
6
7
8
9
10
Monate

Participants in CyberMentor

Girls

- with high interest in STEM
- high achievements

… and in the program with a wonderful environment

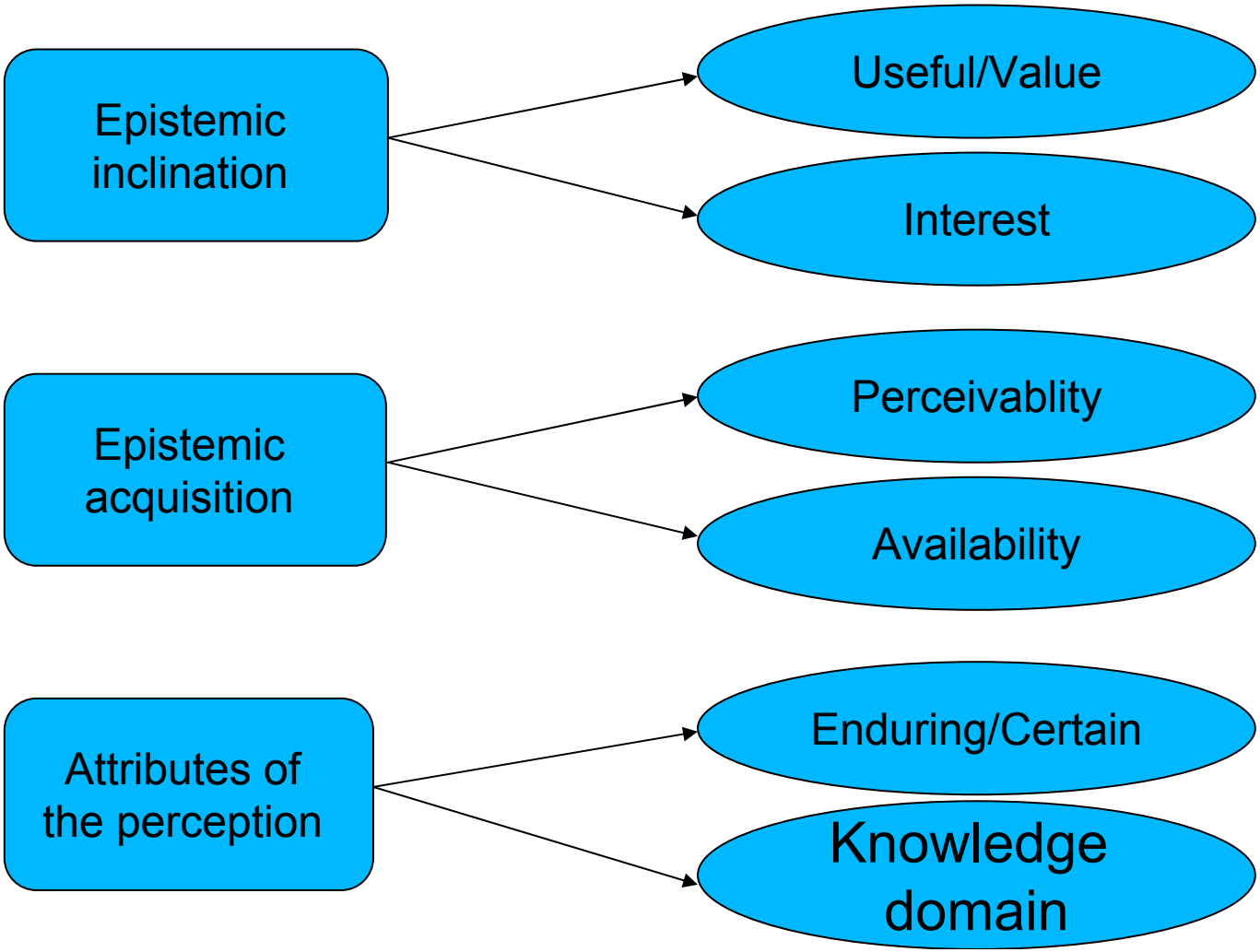
A Learning Oriented Subjective Action Space (SAS)

Someone with a learning oriented SAS

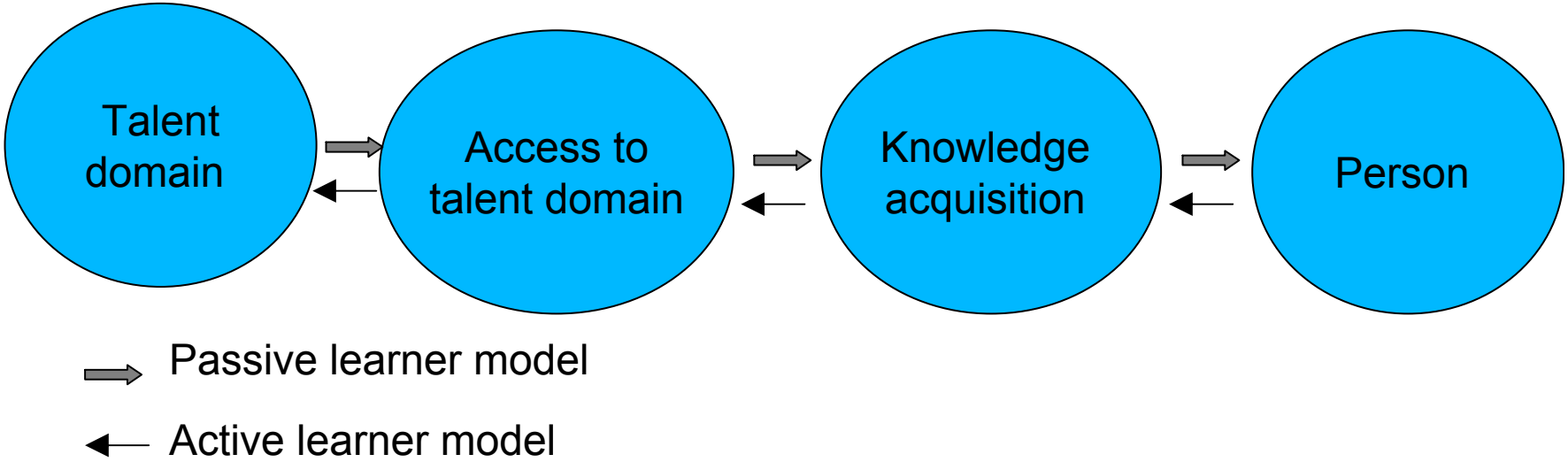
- prefers learning actions
- prefers learning goals
- prefers environments in which you can learn

Development of the Questionnaire

Learning is part of epistemology and usually described as an epistemic act



Results of an interview based pre-study: two naïve learner models



In the passive learner model (1) the talent domain is seen as a person independent, objective structure of reality, to which (2) diverse types of access exist. For example, through books or teachers. Attempts are made (3) in a knowledge acquisition process (4) by persons to assimilate this knowledge.

Rationale of our Questionnaire

- We systematically combined the four areas of the naïve learning model with the three aspects of the epistemic act.

- A questionnaire was constructed, in which each of 48 items addressed one of the four phases of the naïve learning model and one of the six sub-aspects of the epistemic act in the field of physics, each combination was represented twice in the survey.

- For example, the combination of knowledge and the sub-aspect *interest* of epistemic inclination was tapped by two items in the domain of physics, e.g., „Physics is a field which is interesting“.

Participants (physics):

- 171 boys and 160 girls attending grades eight through eleven of two German Gymnasiums
- Mean age of the boys: 16.0 years (SD=1.3)
  Mean age of the girls: 16.0 years (SD=1.4)

Participants of the Study 1 (physics):

On the KFT developed by Heller and Perleth (2000)

34 pupils scored on the verbal IQ≥130 and 31 pupils scored on the quantitative IQ≥130. These pupils will be referred to as either verbally or quantitatively gifted.

Respectively 122 pupils scored 85≤ IQ≤115 on either the verbal or quantitative test. These pupils will be referred to as average gifted.

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Gifted???

IQ is an indicator of the quality of the academic action repertoire

Differences between verbally gifted and averagely gifted studens

	Mean values gifted	Mean values average gifted	t-test with 154 df
Inclination	3.57 (.89)	3.48 (.94)	.53
Acquisition	3.73 (.91)	3.56 (.92)	.98
Learnability	3.62 (.63)	3.69 (.68)	-.54
Uniqueness	3.44 (.63)	3.48 (.82)	-.27

Differences between quantitatively gifted and averagely gifted studens

	Mean values gifted	Mean values average gifted	t-test with 151 df
Inclination	3.91 (.99)	3.38 (.92)	2.82**
Acquisition	4.07 (1.15)	3.39 (.91)	3.55**
Learnability	3.94 (.72)	3.59 (.62)	2.71*
Uniqueness	3.74 (.78)	3.53 (.84)	1.22

Results of regression analyses

	Achievement	Choice behavior	Learning goal	Approach goal	Avoidance goal
1 IQ					
2 Inclination		β =.46 R^2 =.47	β =.70 R^2 =.49	β =.29 R^2 =.14	
3 Acquisition	β =.52 R^2 =.25	β =.38 R^2 =.50			
4 Learn-ability		β =-.19 R^2 =.52			
5 Unique-ness	β =.16 R^2 =.27				β =.22 R^2 =.07
(1) x (2)		β =.12 R^2 =.54		β =.20 R^2 =.17	
(2) x (3)					β =.19 R^2 =.10

Summary of main results

- No differences in the learning oriented SAS could be isolated between pupils averagely gifted in verbal skills and students deemed gifted in verbal skills. Opposite results for quantitative IQ.

- Good prognostic quality of learning oriented SAS, which proved to be a better predictor of scholastic achievement, choice behavior and motivation than quantitative intelligence.

Subjective Action Space and IQ: Results of 3 studies

Study 1

Study 1 was conducted in the scholastic subject of mathematics.

Participants:

332 pupils attending Gymnasiums in the German public school system, age M=16.1 (SD=1.3)

Measures:

- Cognitive Abilities: KFT-4-12+R (Heller & Perleth, 2000)
- Learning oriented SAS: 48 Items, 4 subscales (epistemic inclination, epistemic accessibility, epistemic learnability, domain uniqueness), Cronbach $\alpha > .92$.
- Scholastic achievement

Hypothesis 1: Since the IQ measures only a part of the academic action repertoire, we expect to find rather weak correlations between IQ and a learning oriented SAS.

Hypothesis 1 could be confirmed, the correlation was $r = .29$.

Hypotheses 2 and 3 refer to the relationships between IQ and scholastic performance; and a learning oriented SAS and scholastic performance.

In **Hypothesis 2** we expected that among the pupils exhibiting top performances in school, both pupils with high IQ as well as pupils with a high learning oriented SAS will be overrepresented.

Among 332 pupils, 41 obtained the highest grade possible, in other words they approximate the top achieving 3 % in their cohort.

	Top students	Average students
IQ	**124.3**	**114.2**
Learning oriented SAS	**4.12**	**3.65**

Hypothesis 3 is the longitudinal counterpart to Hypothesis 2: IQ and a learning oriented SAS should both predict top performances, whereby we assume that the latter is the better predictor.

- The dependent variable was the dichotomized scholastic grade (pupils with top grades vs. other pupils) obtained 6 months later.

- A binary regression was calculated. Predictor variables were IQ, learning oriented SAS and the interaction term of these two variables.

- Significant predictors were:
  learning oriented SAS (*Wald* = 17.3, *p* = 0.000)
  learning oriented SAS x IQ (*Wald* = 17.3, *p* = 0.000)

  Nagelkerke R^2 = 15.3.

Study 2

- Study 1 was conducted in the scholastic subject of mathematics. It represents a replication of Study 1 in the subject of biology, thus we examined the same hypotheses.

Participants: 226 pupils attending Gymnasiums in the German public school system, age M=16.3 (SD=1.4)

- In **Hypothesis 1** the assumption was made that an learning oriented SAS would correlate, at best, moderately with intelligence.

- This assumption could be confirmed once again, although the correlation coefficient was not statistically significant this time (r = -.05, p > 0.10).

- According to **Hypothesis 2**, high achieving pupils should demonstrate a higher IQ as well as a more pronounced learning oriented SAS.

- We once again compared the pupils with the highest marks on class exams (*n* = 43) with their classmates.

	Top students	Average students
IQ	**118.3**	**116,5**
Learning oriented SAS	**4.12**	**3.52***

- **Hypothesis 3** infers that IQ as well as the learning oriented SAS should be able to predict high scholastic achievement six months later.

A binary regression equation was calculated where, once again, IQ, a learning oriented SAS and the interaction term of both variables served as predictors.

The dependent variable was the dichotomized academic grade (43 pupils with the highest marks vs. the remaining pupils).

Significant predictors were:
Learning orientated SAS (*Wald* = 13.35 *p* = 0.000)
IQ (*Wald* = 5.60, *p* < 0.01).

Nagelkerke R^2 = 18.6
(SAS 14.0%, IQ added an increment of 4.6%)

Study 3

In Study 3, we wanted to find out whether a learning oriented SAS is beneficial for coming to terms with failure.

Rationale:

- A learning oriented SAS should better equip an individual to come to terms with setbacks during the learning process (as, for example, an high IQ).

- To consider setbacks is important because the development of excellence is a process by which the levels defining individual achievement are permanently being set higher. This implies that, inevitably, failures will arise.
- Thus, individuals constantly have to cope with failure.

The study was carried out in the scholastic subject of physics.

Participants:

289 pupils attending German Gymnasiums, age M=15.9 (SD=1.5)

Measures:

- Cognitive abilities, learning oriented SAS, scholastic achievement (as in Studies 1 and 2)
- Aspiration level, confidence in own abilities, control beliefs, academic elective intentions

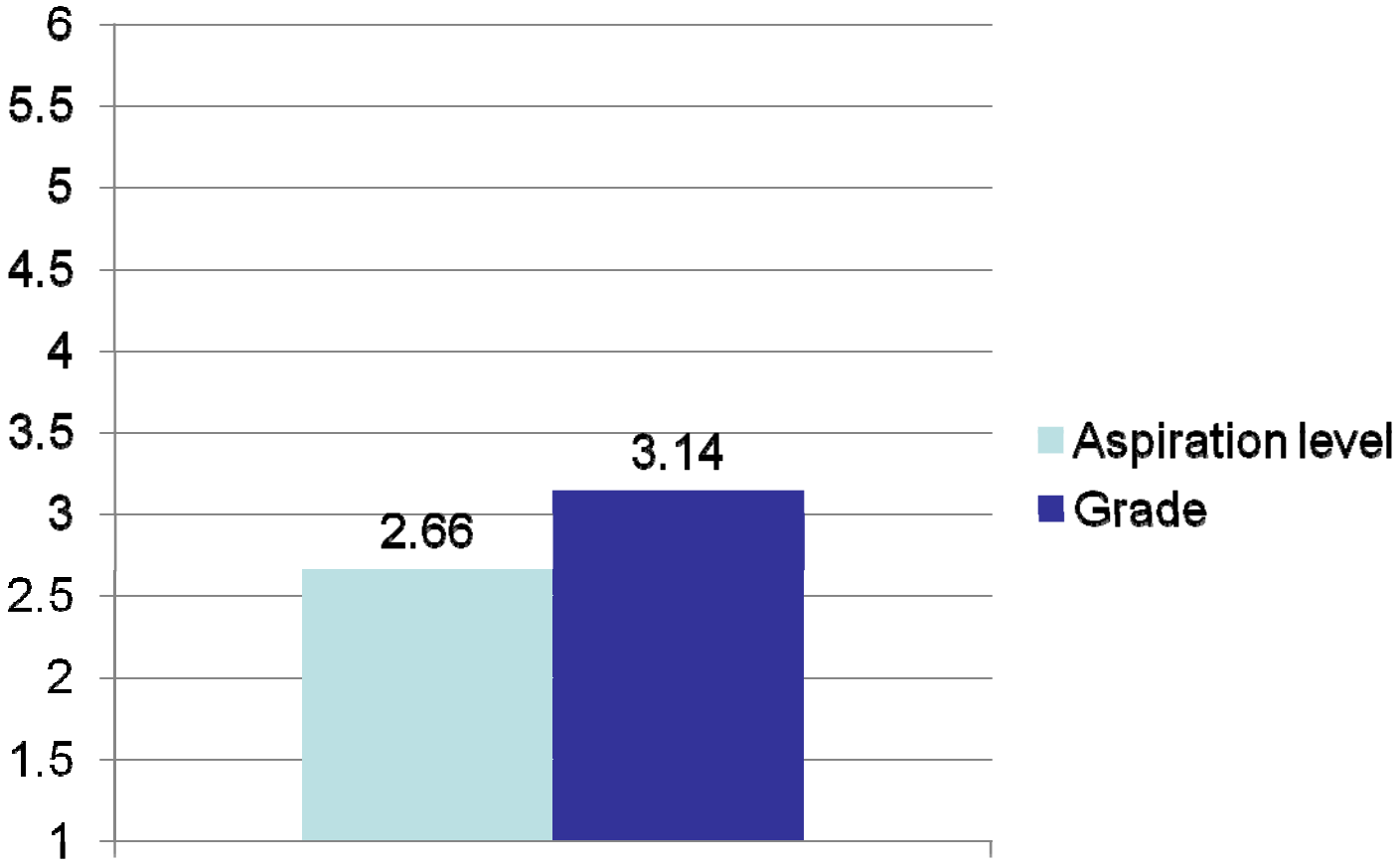
Design:

Two measuring points:

- First measurement two weeks prior to a class test in physics
- Second measurement point immediately following the announcement of the exam results.

Thus we could include experiences of proximal successes and failures as a moderator into the statistical analyses.

Subjective success and failure on the class test was measured by comparing aspiration level and the grade obtained on the class test.



A total of 96 pupils were awarded grades lower than the lowest grade they would have been satisfied with.

	IQ x Failure	*SAS x Failure*	R^2
Aspiration Level	-	X	14.8
Academic elective intention	-	X	30.2
Self-confidence	-	X	43.3
Control beliefs	-	X	19.5

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