A SOCIAL EXTENSION OF A PSYCHOLOGICAL INTEREST THEORY

Angelika Bikner-Ahsbahs

Flensburg University, Germany

Based on an individual interest theory as a sensitising theory, empirical data are used to gain social interest concepts, as there are situated collective interest and interest-dense situation. These concepts serve as a basis for a social extension of a psychological interest theory. Its construction combines social interactions, the dynamic of epistemic processes and mathematical valency of situations in maths lessons. However, this paper is restricted to the presentation of results concerning social interactions. The construction process of theoretical interaction types is outlined and leads to a typology of interactions which provides the theoretical background for interaction analyses of interest-dense situations and their genesis processes.

INTRODUCTION

Researchers agree that interest is an outcome of social processes. But there is a lack of empirical studies investigating social situations, especially social interactions in maths classes in order to find out interest supporting conditions (Bikner-Ahsbahs 2001, 2002). The main reason for this seems to be that it is difficult to link an individual to a social perspective within one empirical study. In my study the psychological interest theory and its implications were used in a sensitising way (Brandt/ Krummheuer 2001, p. 11) to gain the concept of *interest-dense situations* which describes situations in maths classes with a high potential for the support of interest development. The investigation of these situations led to the construction of a contextual theory (Brandt/Krummheuer 2001, p. 199) about the genesis of *situated collective interest* and its impact on the development of interest.[1]

MATHEMATICAL IDENTITY AND INTEREST IN MATHS

A concept of personal interest is a concept of intrinsic motivation. Nevertheless, it cannot be restricted to it. Interest research is always connected with research dealing with self determination theory and personal development (Deci 1992, 1998) which includes research of the development of mathematical identity. Mathematical learning practice always produces relationships between mathematics and the students through the discursive processes and the production processes of mathematical ideas, no matter the participants are actively participating or not. The way students advocate mathematics in discursive processes forms the quality of mathematical identity (Klein 2002, Boaler 2002). Whether mathematical identity includes interest in maths or not, is due to the experience of competence and autonomy within the production processes of mathematical ideas, the amount to which students engage themselves within these

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[1] The theoretical background of interest research concerned with the individual view of interest development was presented at PME25 (Bikner-Ahsbahs 2001).

processes and the experience of valuable and sense-making mathematical contents connected with positive emotions (Krapp 2002, Bikner-Ahsbahs 2001, Deci 1992, 1998).

Now I am going to propose a concept of mathematical identity which assumes the necessity of interaction. This concept explains the emergence of interest within the construction process of mathematical identity.

AN INTERACTIONIST VIEW ON IDENTITY AND INTEREST

Krappmann proposes a concept of identity which is balanced between an individual and a social view of identity based on the necessity of social interaction (Krappmann 1968). He assumes that interaction only continues, if the participants of the discursive processes take up the interlocutors' contributions and if they simultaneously work out and express their individual views. This means that a person with a balanced identity shares views of others in a discourse, while simultaneously he or she develops and expresses his or her individual view on and preferences for special aspects and methods. Mathematical (learner) identity can be understood as a balanced concept of identity within mathematical learning practices, as it is constantly (re-)constructed by adopting, refusing or (re-)constructing mathematical ideas, mathematical methods, and other ways of interacting or not-interacting with mathematical tools and material in discursive processes. Hence, mathematical identity can be regarded as a construct which describes the relationship of a person with mathematics. This relationship becomes evident through one person's behaviour that is basically dependent on - and stimulated by - experienced mathematical learning practice. In a similar way interest development can be regarded as a constantly balanced process between individual and social relatedness to mathematical learning practices, in which a person (re-)constructs an epistemic relationship with experienced mathematical contents, expressing his or her valuing and emotional relationship to it.

Usually interest is an individual concept which requires an appropriate approach that is psychologically focusing on individuals. Analyses intended to investigate social and epistemic conditions in classes require different approaches concerning social interaction patterns, social practices and epistemic actions. A theoretical approach intended to describe social conditions which foster or hinder interest development in maths lessons has to include views of individual interest. This is the idea for the construction of the basic concept of "interest-dense situations".

THE CONCEPT OF INTEREST-DENSE SITUATIONS

Using the psychological interest theory (Krapp 2002, Bikner-Ahsbahs 2001) as it is developed so far as a sensitising theory (Brandt/Krummheuer 2001) and the concept of balanced interest development as a sensitising concept, I constructed the concept of *interest-dense situations* based on the collected data on the one hand and the empirical results of interest research on the other hand. In brief, an *interest-dense situation* is a *situation during a maths lesson which initiates interest activities*, that is the emergence of *situated collective interest.*

What does *situated collective interest* mean?

In a maths camp young people come together because they are collectively interested in maths. In classes this is usually not the case. But sometimes a kind of *situated collective interest* emerges. That is a construct which *describes a relationship between the active participants in the class and the mathematical content. This relationship can be observed through interaction processes showing high amount of student involvement in the activity, student constructions of further-going meanings, and mathematical valency of the situation* (Bikner-Ahsbahs 2002). That means that the students all together construct further-going meanings turn by turn, one after another is getting involved in the activity and the value status of the situation is tied up with its mathematics. Situations in which situated collective interest emerges are called *interest-dense,* and *interest density* is used as a synonym for situated collective interest.

During an interest-dense situation the active participants do not have to be individually interested in the topic area, in the sense that they are aware of their interest. Since they act as if they were interested, they at least begin to build up a kind of situated interest as a balanced, epistemic, positively valued relationship to the mathematical content. Therefore, active participation in interest-dense situations is likely to foster the development of individual or situational interest as components of mathematical identity.

The concept of interest density now leads to the basic research question for the data analyses: How do social interactions, the dynamics of the epistemic processes, and the constructions of mathematical valencies have an effect on the genesis and stabilisation of interest-dense situations? Although the theory is already worked out, I will restrict my presentation to social interactions and the construction of theoretical types of interaction structures, which can help teachers in fostering the development of interest and help them to avoid enhancing the development of disinterest.

METHODOLOGICAL FRAMEWORK

The design of data collection was already presented at PME25 (Bikner-Ahsbahs 2001, 2002). In this paper I will focus on data analysis concerning social interaction practices. The analysis was done by using video recordings of all lessons of one class from half a school year, except the lessons which were involved with test taking.

The data show two different kinds of interest-dense situations, as there are *ad-hoc-interest-dense situations* and *generative-interest-dense situations*. Ad-hoc-interest-dense-situations are initiated by the students asking deep questions or contributing far going ideas. Generative-interest-dense situations are initiated by the teacher based on mathematical tasks, problems or questions the teacher begins with and the way these situations are organised. In ad-hoc-interest-dense situations situated collective interest emerges spontaneously. However, through generative-interest-dense situations the hole genesis process of interest density is observable, hence reconstructable.

My analysis of interest-dense situations uses an interpretive approach reconstructing structures of meanings by interpreting the interactions at three levels: the level of information (locutional), the level of generating meaning through acting (illocutional), and the level of intention and effect (perlocutional) (Beck/ Maier 1994). The method of analysis follows a recursive structure enhancing the theoretical content cycle by cycle. Every cycle of analysis comprises the comparison of an ad-hoc-interest-dense scene with a scene which begins in a similar way but in which interest density ceases. Through analysing these contrasting scenes in a comparative way it was possible to construct two theoretical types (Kluge 1999) of social interaction structures which foster or hinder the emergence or stabilisation of interest density. Based on these types I gained a marking space made of two dimensions, the teacher and the student behaviour, with two features each. A crossing table gives an overview about possible theoretical types of interactions (fig.1). These theoretical types are seen as theoretical descriptions being helpful to describe, analyse and diagnose real situations.

An analysis of the data which did not show situated collective interest led to a more precise description of all possible fields in the crossing table which creates a typology (Kluge 1999) of interactions. This typology was the theoretical background for the analysis of the genesis processes of generative-interest-dense situations from the perspective of social interactions. Applications of this typology to real situations have to include, that a typology is not a classification of reality. It describes real situations more or less and transitions between the types cannot always clearly be fixed in reality.

A TYPOLOGY OF INTERACTIONS

student behaviour teacher behaviour	**expectation dependent**	**expectation independent** ((re-)constructing own r which is)	
	(anticipating the teacher's expectations)	part of the e pectation space	not part of the exp. S space pace
expectation controlled (expecting concrete students' answers)	expectation-dominant interaction structure	F lowing	confligating
situation controlled (re-)constructing the students' meanings	misunderstanding	expectation-recessive interaction structure	

Figure 1: A typology of interactions (expectations are meant as the teacher's content specific expectations)

Each of the two dimensions in the crossing table show two features: expectation-controlled and situation-controlled teacher behaviour; expectation-dependent and expectation-independent student behaviour. This leads to four different situations. However, the reconstruction of different kinds of interactions through the data distinguishes five different situations:

- two situations which are balanced by interaction structures;
- two situations with inherent conflicts showing incompatible teacher and student behaviour (misunderstanding and conflicting interactions) and

- one situation which shows a flow of interactions in which the students' utterances seem to be part of the expectation space of the teacher. The students act concerning their own constructions whereas the teacher handles the utterances like a reconstruction of his own expectations.

If the teacher and the students focus on the teacher's content specific expectations, a stable balance of social interactions emerges: the *expectation-dominant interaction structure*. The function of this interaction structure is to reproduce teacher expectations. If the teacher and the students focus on the students constructions of meaning, another but labile balance of social interactions may emerge: the *expectation-recessive interaction structure*. The function of this interaction structure is to enable students to (re-)produce mathematical meanings.

The comparison of generative-interest-dense situations with ad-hoc-interest-dense situations shows that ad-hoc-interest-dense situations immediately begin with an expectation-recessive interaction structure and maintain interest density until this pattern ceases or the task is finished. Unlike ad-hoc-interest-dense situations, the process of genesis of generative-interest-dense situations begins with an expectation-controlled teacher behaviour. In this case situated collective interest is generating more slowly so that the starting point of situated collective interest usually cannot precisely be fixed. Based on the crossing table we find a wide range of different generating processes which all have in common, that as soon as interest density emerges, we find an expectation-recessive interaction structure. Therefore, an expectation-recessive interaction structure is necessary for the genesis of an interest-dense situation, but not sufficient.

I will now present a short summary of the analysis of a scene, in order to give you an impression of the way how these interaction structures are constructed.

CONSTRUCTION OF THE EXPECTATION-RECESSIVE INTERACTION STRUCTURE

The presented scene shows a prototype of an interaction structure that fosters the emergence and stabilisation of interest density in ad-hoc-interest-dense situations. Anji refers to a group activity in which a group of three boys had to divide four pieces of liquorice into three parts while each length of the four pieces was not divisible by three. The group made a long piece out of all pieces by putting one after the other. The whole length was divisible by three then. Since they had to find more then one way of dividing their sweets into three equal parts they invented a way of dividing the pieces lengthwise by dividing the round cross-section into three. As the class had not measured angles before this group had to find out how to divide a circle into three equal parts.

1 Anji: I've a question. they've divided it from the top downwards sure but how do they know then what 120 DEGREES means.

2 T: I see' you now want to go back to the set square once again. won't you'

3 /Anji: no (.) yeah but if they ,that's such a small piece and how do they know that because ,they can't do that with the set square

4 /S: yeah that's round of course.

5 /Ernst: but that's round of course

6 S: that is round of course

7 T: Tom yes. that's such a practical problem isn't it' how do I do it if that's such a very small one and not such a BIG circle.

8 Tom: you must put zero in the centre and then it will work anyway I think (.) then you must only keep the lines in mind going from 120 until you can draw them.

9 T: well I see ,there must be additional ,we're going to practice that sometime

10 /S: yes but how'

11 /Rahel: Mr Kramer I have another silly question ,how do we get the centre OUT ,how have they got it OUT because that is so small

12 S: that's of course

13 T: that's a problem too ,exactly. that's a practical problem (...) well ,how do you get the centre of such a small circle anyhow (.) ,exactly. these are questions'

14 Anji: with a small compass'

15 T: yeah you can get it out with a compass ,only if you draw a circle first' then you'll have the centre but if you already have got a circle'

16 Rahel: yes

17 T: that's exactly what Geometry deals with

18 Andy: I KNOW that

19 T: there are possibilities to get that out a-n-d you may puzzle on it at home probably somebody might find a possibility'

20 /Rahel: yes I know-

21 T: well at home after all ,we'll just use that as a part of the homework' you draw a circle ,but you'll erase (.) the centre and when you have got the circle. you'll try how can you find the centre

22 /S: but you do put that thing in there

23 /S: you stick it in

24 T: you stick it in

25 /S: wha'

26 S: um

27 T: yeah but you can act as if you didn't have it. how can you find it then. probably there is a possibility probably you'll find something and then you try try once again to divide into three (..) well at first drawing a circle' then doing like you didn't have the centre' you can't find it anymore and how can you find it again when you have it how can you divide it into three then

TRANSCRIPTION KEY

S(s), T	student(s), teacher
EXECT	emphasized or with a loud voice
e-x-a-c-t	prolonged
exact.	dropping the voice
exact´	raising the voice
,exact	with a new onset
(.),(..)...	1, 2 ... sec pause

The teacher tries to understand what the students mean. He does not force the students to answer in a special way and he does not show his own content specific expectations. We can assume that he has some, but they do not seem to be important. Instead, he tries to reconstruct the students' goals and he tries to reflect and understand the way the students act. His behaviour is focused on the children's contributions and not on his own ideas. He is (re-)constructing the students meanings, acts in a *situation-controlled* and not in an *expectation-controlled* way concerning his own content specific expectations.

On the other hand the children ask their own questions in a self assured way. They even refuse the teacher's information about the topic of Geometry in general. The students are involved in the problem which they want to get solved. They construct their own sense-making mathematical meanings and they are not concerned with reproducing teacher expectations. They act in an *expectation-independent* way. Teacher behaviour matches with student behaviour. That stabilises the interaction and supports the production of mathematical ideas by the students.

This scene shows that an *expectation-recessive interaction structure* gives the students access to the construction of their own sense-making mathematical meanings and to experience themselves as competent and autonomous participators within the discursive practices. The teacher himself is not passive. He focuses on the students' constructions, shows interest in their constructed meanings and tries to understand their behaviour.

Further analyses show that content specific expectations of the teacher which dominate the teacher's behaviour, hinders a successful emergence of interest density, on the other hand if the teacher abstains from his content specific expectations, he will be able to focus on the constructions of the students' meanings. Then the teacher will be able to support the emergence of interest actions and interest density. However, the support of interest only works, if the students act in a adequate way: They have to concentrate on their own thinking. This is not usual, because often the students try to reconstruct the teacher's expectations, even though the teacher does not really show any. The students may interpret the teacher's behaviour as a hint for being on the wrong track.

CONCLUSIONS

The constructed types are theoretical types which provide basic concepts for the constructed theory. Theoretical types cannot be observed empirically, but data give access to prototypes corresponding as far as possible but not in all perspectives to them. The interrelations of the theoretical types are used to generate the theory as a contextual theory (Brandt/Krummheuer 2001, p. 199) with a limited scope and with deep insight in the processes concerning the genesis of interest-dense situations in maths classes during the learning of fractions at the age of about 11 in a German gymnasium. Using such local theories it will probably be easier to change teacher-student-relations towards the support of interest development in every day maths classes. However, innovative practice cannot mean implementing theoretical types. Practice has to deal with unexpected situations. These theoretical types can serve as an orientation which may help teachers diagnosing real situations, making decisions and developing and implementing suitable prototypes depending on the contextual environment, on their view of mathematics and the mathematical learning process and on the behaviour of the students. However, this theory does not include the impact on interest development of individuals yet, because the analyses of the individual data are not finished. But there is growing evidence in the data that active participation in interest-dense situations do support the development of interest.[2]

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