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The development of primary and secondary pre-service teachers' beliefs about constructivist and transmission-oriented teaching

Philippe Wanlin & Holli Schaubert, *University of Geneva*

Introduction

Recent literature contrasts constructivist and transmissive teaching approaches. Current teacher education programs consider constructivist teaching as the best way to enhance students learning.

Objective

This paper examines whether pre-service teachers do the same: contrast constructivist and transmissive teaching approaches and rate constructivism as superior for learning gains.

Method

We drew on several assessment tools from the English- and German language educational literature. From these, we extracted items which we translated into French and submitted to 228 pre-service teachers. They had to provide their degree of agreement on a 6 point Likert scale.

Results

Factor analysis show a good model fit. Results reveal that pre-service teachers' beliefs are less split than what the educational literature suggests and that support for constructivism depends on the teacher education program.

Conclusion

As constructivist and transmissive orientations coexist in pre-service teachers' minds, implications for research and teacher education are discussed.

Key Words : Constructivism; Transmissive teaching; Beliefs profiles; Measurement scale;

Development

Le développement des conceptions d'enseignants en formation pour le primaire et le secondaire sur l'enseignement constructiviste et transmissif

Philippe Wanlin & Holli Schauber, *University of Geneva*

Introduction

La littérature récente oppose les approches constructivistes et transmissives de l'enseignement. Les programmes de formation des enseignants contemporains considèrent que l'enseignement constructiviste est la meilleure voie à suivre pour favoriser l'apprentissage des élèves.

Objectif

Cet article examine si les enseignants en formation se positionnent à l'identique par rapport à ces aspects : opposer les approches d'enseignement constructivistes et transmissives et considérer que les approches constructivistes sont supérieures en termes de gains d'apprentissage.

Méthode

Nous nous référons à plusieurs instruments de mesure issus de la littérature en sciences de l'éducation Anglophone et germanophone. Nous en extrayons des items que nous avons traduits en français et que nous avons soumis à 228 enseignants en formation. Ils devaient donner leur degré d'adhésion à ces affirmations sur une échelle Likert à 6 modalités de réponse.

Resultats

Les analyses factorielles aboutissent à un modèle présentant de bonnes qualités psychométriques. Les résultats montrent que les enseignants en formation détiennent des conceptions nettement moins binaires que ce que suggère la littérature et que l'adhésion au constructivisme dépend du programme ou de la filière de formation à l'enseignement suivi(e).

Conclusion

Vu que les conceptions constructiviste et transmissive coexistent dans les cognitions des enseignants en formation, nous discutons d'implications pour la recherche et la formation des enseignants.

Mots clés : Constructivisme; Enseignement transmissif; Profiles de conceptions; Echelle de mesure; Développement

The development of primary and secondary pre-service teachers' beliefs about constructivist and transmission-oriented teaching

Philippe Wanlin & Holli Schaubert, *University of Geneva*

1. Introduction

Recent research reveals some contradictory evidence about the effectiveness of constructivist teaching approaches. On the one hand, the research indicates that constructivist teachers provide enhanced learning environments (e.g. Staub & Stern, 2002) and generate better student learning than traditional teaching strategies (e.g. Voss, Kleickmann, Kunter, & Hachfeld, 2011). The opposing view is that constructivist teaching is only effective if it is undertaken with behaviorist teaching principles (e.g. Alfieri, Brooks, Aldrich, & Tenenbaum, 2011). This view also suggests that teachers holding constructivist beliefs don't implement different practices than their transmission-oriented colleagues (e.g. Leuchter, Reusser, Pauli, & Klieme, 2008).

Most current teacher training programs provide a strong emphasis on constructivist teaching approaches; as is the case in Geneva, Switzerland. Drawing on this premise, our main objective is to analyze pre-service teachers' opinions on constructivist and transmission-oriented teaching approaches. We aim to analyze the development of the beliefs they hold about the best teaching principles and practices throughout the duration of the training program. Our purpose is also to analyze if there are differences in these developments related to the school level and the content area for which they are being prepared.

In order to pursue this research objective, we first reviewed the literature to develop a questionnaire with general, non-content-oriented statements about constructivist and

transmission-oriented teaching approaches. Then, we validated this instrument with a sample of 228 pre-service teachers being trained for elementary or secondary education to permit a robust description of their beliefs and of the possible differences one can observe between the years of the training program or the levels for which the pre-service teachers are being prepared. This led us to interesting findings which we discuss in terms of possible sources of developmental differences and in terms of implications for research and teacher education.

2. Theoretical background

2.1. Assessing teachers' beliefs about constructivist and transmission-oriented teaching approaches

There are many texts on teachers' beliefs about constructivist and transmission-oriented teaching approaches but most of them rely on the same instrument developed by Fennema, Carpenter, and Loef (1990; see also Fennema & Carpenter, 1990). This instrument is designed to measure mathematics teachers' beliefs on the best way to teach mathematics. It contrasts constructivist student-centered approaches with a teacher-centered direct transmissive instructional approach. It was first used by Peterson, Fennema, Carpenter, and Loef (1989) but the most commonly cited paper using this instrument is that of Staub and Stern (2002). Both of these papers conclude that teachers with constructivist beliefs obtain higher student performance than those with transmission-oriented beliefs.¹ They also conclude that constructivist teachers provide better and richer learning environments than their behaviorist colleagues. There are plenty of studies that have used this instrument (Capraro, 2001; Dubberke, Kunter, McElvany, Brunner, & Baumert, 2008; Hess, 2002; OECD, 2009; Rakoczy, Buff, & Lipowsky, 2005; Voss, Kunter, & Baumert, 2011). For example, Voss et al. (2011) showed a positive association between constructivist teacher beliefs and students' math performance and

¹ Note that both papers also concluded that students' prior achievement is a better predictor of students' learning gains than teachers' beliefs orientations.

a negative link between transmission-oriented teacher beliefs and student's achievement in secondary math. Kunter et al. (2013) also provide an interesting study about the effects of teacher Pedagogical Content Knowledge (PCK), including among others, teachers' orientations towards constructivism, assessed with a part of the instrument developed by Fennema et al. (1990), on students' performance and motivation. They show that constructivist beliefs, when taken independently, are positively associated with students' motivation and achievement. This univariate effect was not found in the analysis taking into account all other teacher characteristics measured in their study. They conclude that "*all other teacher attributes being equal, teachers who endorse constructivist beliefs showed no advantage in cognitive activation or student support, and even scored lower on classroom management*" (Kunter et al., 2013, p. 816). Note that, Leuchter, Reusser, Pauli, and Klieme (2008) could not demonstrate that constructivist or transmission-oriented teachers differ in their teaching practices.

It is important to underline that our reading of all papers using this instrument led us to the following finding: little evidence was available on the reliability and the psychometric quality of this instrument before the work of Mareike Kunter and Jürgen Baumert (e.g. Kunter et al., 2011). The German research team provides two interesting insights. Firstly, teachers can hold both kinds of beliefs – with a preferred orientation – so that constructivist and transmission-oriented beliefs are not seen as two extremes of the same continuum but rather as a bi-dimensional interrelated system (Voss et al., 2011). Even if some researchers highlight that elementary school teachers prefer transmissive teaching (Demant & Yates, 2003) or that teachers can adopt one orientation and not the other (Tsai, 2002), research shows that secondary physics teachers hold both kinds of beliefs in an interrelated system consisting of content-oriented and student-oriented beliefs and that teachers agree with the importance of both teacher-regulated and student-regulated learning (Belo, van Driel, van Veen, & Verloop, 2014).

Schuh (2004) discusses results adopting the same interrelated beliefs system as her elementary school teacher used principles of learner-centered teaching embedded within a traditional teacher-centered environment. Secondly, they provide an indication about the high quality of their 44 item instrument (4 point likert scale): $\chi^2_{(13)} = 21.62$ $p < 0,05$, CFI = .988, RMSEA = .045 with factor loadings ranging between .46 and .91 and Cronbach's alphas ranging from .67 to .88. Unfortunately, most of these papers do not provide the entirety of the instruments' items – with the exception of Hess (2002) and Capraro (2001) – and all of the items are dedicated to mathematics instruction so that it is not designed to assess the beliefs of generalist teachers working for example in elementary schools or the beliefs of secondary school practitioners teaching different subjects.

Two other instruments used to assess teachers beliefs about constructivist and transmission- oriented teaching approaches exist. Both are similarly designed to assess constructivist and transmission-oriented beliefs from a non-subject specific perspective. The first one was developed by Woolley, Benjamin, and Williams-Woolley (2004) and stems from their findings resulting from teacher interviews. Their instrument, a 34 item (short version 21) 6 point likert scale, leads to a three-factor solution for their validation study using a sample of 856 pre-service teachers: traditional management ($\alpha = .52$), traditional teaching ($\alpha = .78$), and constructivist teaching ($\alpha = .73$). The psychometric qualities of this instrument are relatively low ($\chi^2_{(186)} = 753.79$ $p < 0.00$, CFI = .81 NFI = .76 NNFI = .78 GFI = .91 AGFI = .88 RMSEA = .066). Unfortunately, these researchers do not provide the factor loadings of the 21 items in their respective factors using a confirmatory factor analysis. The second instrument was developed in an identical way by Hermans, Van Braak, and Van Keer (2008). Its short version contains 18 items leading to a two-factor solution. It was first tested on a sample of 377 teachers using a 5 point likert scale which leads to the following results: constructivist-developmental

($\alpha=.71$) and transmissive ($\alpha=.75$) beliefs ($\chi^2_{(132)}=272.0$ $p<0,00$ CFI=.87 GFI=.92 AGFI=.90 RMSEA=.053 (90 % CI = 0.044 - 0.062) and factor loadings ranging from .33 to .66). Then it was tested on a sample of 380 other teachers leading to quite similar psychometric qualities: constructivist-developmental ($\alpha=.69$) and transmissive ($\alpha=.71$) beliefs ($\chi^2_{(132)}=322.0$ $p<0,00$ CFI=.80 GFI=.90 AGFI=.88 RMSEA=.063). Unfortunately, the psychometric properties of these two non-subject specific instruments fail to meet the standards associated with high quality measurement scales (Brown, 2006; Furr, 2011; Muthén & Muthén, 2002). Other instruments were used by Belo et al. (2014) and Könings, Seidel, Brand-Gruwel, and van Merriënboer (2014) that we didn't use as they were not published yet when we constructed our pool of items. But by checking our items afterwards with those available in the item sample provided by the authors of these texts, one can say that they are relatively close.

As the quality of the mathematics-oriented measurement scale is better than the general-oriented instruments, it might be interesting to convert the items of the instrument developed by Fennema et al. (1990) into global non content-oriented statements. In addition, it is important to keep some of the items of the more generalist-oriented instrument scales, those with the better factor loadings.

2.2. Effectiveness of constructivist teaching: some insights

As noted before, evidence of an effect of constructivist beliefs on student performance and motivation has led to opposite findings. One body of research provides evidence of a direct effect, while evidence from competing studies suggest that constructivist beliefs are a part of teachers PCK and do not influence the positive effect of high quality PCK on student development. Studies also show that constructivist teachers provide better learning environments but also that there is no difference in the teaching process of teachers holding

constructivist beliefs versus teachers holding transmission-oriented beliefs. These contrasting results led us to the following question: what empirically-based evidence exists on the efficacy of constructivist strategies?

Within the last decade, many concerns have emerged about the effectiveness of constructivist teaching approaches (Kirschner, Sweller, & Clark, 2006; Mayer, 2004; Sweller, Kirschner, & Clark, 2007; Tobias & Duffy, 2009). For example, Alfieri, Brooks, Aldrich, and Tenenbaum (2011) provide two interesting meta-analyses of 164 studies about the effectiveness of constructivist teaching approaches – i.e. unassisted and enhanced discovery learning – contrasted with transmission-oriented teaching or other teaching methods. Their results are unambiguous: explicit teaching outperforms unassisted constructivist teaching and enhanced discovery teaching has a more positive but small effect on students' learning than do other types of instructional methods. Their overall conclusion is that unassisted discovery learning does not benefit learners. They write that the most important contributions to students' learning are feedback, worked examples, scaffolding, and elicited explanations. They also found that domain and subjects' age are significant moderators of these overall results. Verbal and social learning tasks favor explicit instruction and enhanced discovery learning followed next by problem solving, science, and math. Children and adolescents were found to benefit significantly more from explicit instruction than did adults who also do not benefit from unassisted discovery. In the case of enhanced discovery, adults benefit more from this method than children do. That is, adolescents tend to benefit least and adults tend to benefit most from both unassisted and enhanced discovery tasks.

Examining the effectiveness of a variety of teaching strategies in the area of science teaching, Schroeder, Scott, Tolson, Huang, and Lee (2007) obtained similar results. Their meta-

analysis of 61 studies indicates the following effectiveness results for eight strategies (effect sizes in parentheses): enhanced context strategies where the teacher refers to students' prior knowledge and beliefs (1.48); collaborative learning strategies where the teacher arranges students in flexible groups (0.95); questioning strategies where the teacher varies timing, positioning, or cognitive levels for questions (0.74), inquiry strategies where the teacher uses student-centered instruction that is less step-by-step and teacher-oriented than traditional instruction (0.65); manipulation strategies where the teacher provides the students with opportunities to work or practice with physical objects (0.57); assessment strategies where the teacher changes the frequency, purpose, or cognitive levels of testing and evaluation (0.51); instructional technology strategies (0.48); and enhanced material strategies i.e. teacher's modification and transformation of existing instructional material (0.29). Schwerdt and Wuppermann (2010) as well as Castonguay and Gauthier (2012) also suggest that transmission-oriented teaching is associated with significant higher student achievement. Furtak, Seidel, Iverson, and Briggs (2012) show that studies of inquiry-based science teaching involving teacher-led activities combining procedural, epistemic and social goals had mean effect sizes about .40 larger than those with student-led conditions.

Additional support for teacher led teaching strategies is found in Hattie's well known work (Hattie, 2009, 2012) that suggests i.e., that providing "dollops of feedback" is one of the most important contributions to student learning (Hattie & Gan, 2011; Hattie & Timperley, 2007). Hattie's conclusions are interesting in two ways. First, he shows that almost all teaching strategies contribute to students' learning outcomes but that their effectiveness is not equally strong; the strongest are globally teacher led. Secondly, he suggests that variation in teaching strategies might be a strong influence on students' learning gains. Such a view is close to the position of the aptitude-treatment interaction paradigm (Cronbach & Snow, 1977). According

to this paradigm, students with different characteristics benefit from different teaching procedures. Mayer (2004) has a similar opinion. His results show that guided discovery appears to offer the best method for promoting constructivist learning. He suggests therefore that what counts in promoting students' learning gains by guided discovery is to know how much and what kind of guidance to provide. Helmke and Schrader (1987) showed that the teachers who do best in adapting the amount and kind of guidance are those with the best diagnostic competences of their students' needs. Thus, Brunner, Anders, Hachfeld, and Krauss (2011) showed that the quality of diagnostic competences has a positive effect on students' achievement in secondary math.

2.3. Research questions

According to the literature, effective teaching combines both transmission-oriented teaching strategies and constructivist teaching methods. Pure discovery methods are ineffective on their own. In contrast, enhanced discovery learning including feedback, demonstration, worked examples, explanations, etc. are the most effective means to ensure students' learning gains. In other words, constructivist teaching strategies have to be provided through behaviorist teaching principles in order to have positive effects on students' achievement. Yet, most of today's curricula favor constructivist teaching strategies. The purpose of this article is to investigate how constructivist teaching approaches are imparted in pre-service teacher education programs. We want to analyze the effects of the initial teacher training program at the Institute of Teacher Education of the University of Geneva on the development of these beliefs. Our hypothesis is that pre-service teachers should demonstrate equally strong beliefs on constructivist and transmission-oriented beliefs. This profile might be linked to their adaptation competence to their students' heterogeneous learning profiles and levels. So it might

be that adopting strong beliefs on both teaching orientations would be favorable to teaching effectiveness.

To analyze this objective, we need a reliable scale, but as mentioned above, an instrument measuring constructivist and transmission-oriented teacher beliefs from a non-subject specific perspective containing high psychometric properties does not exist. The second purpose of this article is therefore to provide such an instrument combining statements from older measurement scales.

3. Method

3.1. Sample

A sample was taken of 228 pre-service teachers from the Institute for Teacher Training at the University of Geneva in Switzerland. Most of them are preparing for elementary school certification (n=138) while the remaining 90 are training to become secondary school teachers. Elementary school pre-service teachers are from the three last years of training. As the first year of elementary teacher training is a general track for individuals who want to become a teacher and those who want to become social scientists, psychologists and speech pathologists; first year students were excluded from this study. Teaching experience of the elementary school pre-service teachers is limited at the beginning of the second year of training and increases in importance in the third and fourth years of the program when a practicum is included in the training. This subsample of elementary pre-service school teachers includes 84 second year students (ET2), 38 third year students (ET3), and 16 fourth year students (ET4). The secondary school training program takes two years. Our sample focuses on 21 first year students (ST1) and 69 second year teachers (ST2). An important feature of the secondary teacher training program is that first year students have no practicum and therefore limited access to teaching

experience; second year students divide their time equally between a teaching post and courses in the teacher training program. These teachers who enter the program with a Master's degree come from varying content areas: social sciences (n=26), sciences (n=28), languages (n=13), sports (n=14), and 9 missing data. Most of the participants are female (n=158) and are registered in the primary school training program (n=110).

3.2. Instrument

Appendix 1 provides the instrument we used to assess teacher's beliefs about constructivist and transmission-oriented teaching approaches. We took all of the questions from Fennema and Carpenter's (1990) questionnaire and adapted them in two ways: first, as Geneva is part of the French speaking community of Switzerland, all items were translated into French. Secondly, all of the references to mathematics were eliminated. That led to the observation that the questionnaire was redundant so we retained only 20 of the 48 items of Fennema and Carpenter's (1990) instrument. As the balance between constructivist and transmission-oriented items was not optimal (respectively, 8 items vs. 12 items), we completed our pool of items with 10 items from the scale developed by (Hermans et al., 2008) because it provides better psychometric qualities than the scale provided by Woolley et al. (2004). We chose the 10 remaining items according to the following selection criteria: they had to explicitly involve teaching strategies². This led to a pool of 30 items, 14 are supposed to be linked to a constructivist orientation of teaching and 16 to a more transmission-oriented approach. Pre-service teachers had to rate their degree of agreement with all statements on a 6 point likert scale from “strongly agree” to “strongly disagree”.

² It is for that same reason that we didn't refer to the questionnaire developed by Chan and Elliott (2004). We didn't include items of Chen, Brown, Hattie, and Millward (2012) because our research team thought it could be problematic for the Swiss teachers in terms of social desirability.

4. Results

4.1. Instrument validation

Pre-service teachers' responses on the 30 items were analyzed first using an exploratory factor analysis [EFA] within MPlus 7.1 (Muthén & Muthén, 2002). Data were analyzed using the weighted least-squares within mean and variance (WLSMV) estimation procedure with an oblique CF-Equamax rotation. The WLSMV procedure was chosen because it is the best way to analyze categorical ordinal data and is robust for non-normal data distributions (Brown, 2006; Muthén & Muthén, 2002). The CF-Equamax rotation was used because it combines the Quartimax and Varimax criteria and simplifies both variable and factor complexity by spreading the variances more equally across the factors (Brown, 2006). Although the percent of missing data was minimal (< 1.5%), all missing data were treated using the FIML estimation procedure by default in MPlus. The same estimators were used for the confirmatory factor analysis [CFA].

The statistics employed to evaluate model fit for EFA and CFA were the following:

- Tucker-Lewis Index [TLI] and Comparative Fit Index [CFI] with values less than .90 for a suspect model that has to be rejected, between .90 and .95 for a model with an acceptable fit, and from .95 and greater for a model with excellent fit (Brown, 2006).
- Root Mean Square Residual [RMSEA] with values higher than .10 for a model with poor fit, between .10 and .08 for a model with acceptable fit, and from .06, or better less than .05, for models with excellent fit (Brown, 2006).
- Two other indicators were used. The first one is the Standardized Root Mean Square Residual [SRMR] which is computed for the EFA and that has to reach values equal

or less than .08 or .07. This statistic is not provided for the CFA. For CFA, the Weighted Root Mean Square Residual [WRMR] is computed. Models with values of approximately 1 would be a good model fit (Brown, 2006; Muthén & Muthén, 2002; Wang & Wang, 2012).

Note that less emphasis was placed on the χ^2 statistic compared to the above mentioned statistics because it varies as a function of the sample size. This is in line with the suggestions provided in Brown (2006) and Furr (2011). There is also no clear agreement about the cut-off of the WRMR (Muthén & Muthén, 2002 vs. Wang & Wang, 2012) so that we would be less strict with this statistic.

Appendix 1 shows the factor loadings of the two EFA we applied to our data. The first EFA was performed including all 30 statements of our pool of items. It led to satisfying psychometric qualities with the extraction of two factors according to our theoretical model ($\chi^2_{(435)} = 2868.909$, $p < 0.001$; CFI = 0.853; TLI = 0.830; RMSEA = 0.065 (90 % CI = 0.050 - 0.071); SRMR = 0.070). In order to shorten our instrument's size and to improve the psychometric qualities of our instrument, we used the following rules: removing items (1) loading on the incorrect factor, (2) possessing a higher cross-loading on another factor (factor loading $>.30$), and (3) having a small estimated factor loading on the theorized factor ($<.40$). We then removed the items which had the lowest factor loading on their theorized factor to get an equilibrated balance between the number of constructivist and transmission-oriented items. We get an excellent model fit by using this procedure ($\chi^2_{(66)} = 1506.783$, $p < 0.001$; CFI = 0.950; TLI = 0.923; RMSEA = 0.086 (90 % CI = 0.067 - 0.105); SRMR = 0.050).

We kept a 12 item short version including 6 items to assess constructivist beliefs and 6 items to assess the transmission-oriented beliefs. CFA showed an excellent model fit for this solution ($\chi^2_{(66)} = 1506.783$, $p < 0.001$; CFI = 0.965; TLI = 0.957; RMSEA = 0.064 (90 % CI = 0.046 - 0.083); WRMR = 0.831). MPlus suggested a correlation between the residuals of two pairs of items to improve model fit: a22c with a13c, and a16c with a06c. These correlations are theoretically significant as both items a22c and a13c deal with cooperation between students, and items a06c and a16c deal with individualized problem solving. This model, shown in figure 1, gets excellent model fit indices ($\chi^2_{(66)} = 1506.783$, $p < 0.001$; CFI = 0.989; TLI = 0.986; RMSEA = 0.036 (90 % CI = 0.000 - 0.059); WRMR = 0.631) that appear to be statistically better than the solution without correlations between residuals (DIFFTEST: $\chi^2_{(2)} = 37,022$; $p < .001$). Factor loadings range from .458 to .799 for the constructivist sub-scale and from .533 to .819 for the transmission-oriented sub-scale. These values are good and close to those obtained by other researchers (Voss, Kleickmann, et al., 2011). We used this last model to generate the factor scores we would use later in this paper. There is a small but significant negative correlation between the constructivist and the transmission-oriented beliefs. This suggests that these two approaches are somehow a bit opposite but that they can't be seen as extremes of a same continuum. This observation is supported by MPlus analysis fixing the correlation between both belief orientations at 1 or force a 1 dimensional solution. In both cases the fit indices decrease (e.g. RMSEA = .284 and CFI = .337 for the fixed correlation model).

Internal consistency is acceptable to strong. Cronbach's alpha for the constructivist sub-scale is .75 and it is .83 for the transmission-oriented sub-scale. Furr (2011) and Brown (2006), wrote that Cronbach's coefficient alpha is a misestimation of the scale reliability of a multicomponent measuring instrument like for example multi-item questionnaires. We used the estimated reliability formula provided by Furr (2011, p. 105): $(\sum \lambda_i)^2 / ((\sum \lambda_i)^2 + \sum \theta_{ii} + 2\sum \theta_{ij})$.

The estimated reliability for both sub-scales ranges from good to strong (Constr.: .70; Transm.: .83). These values are close to the reliability values obtained by other researchers in the domain of mathematics (Dubberke et al., 2008).

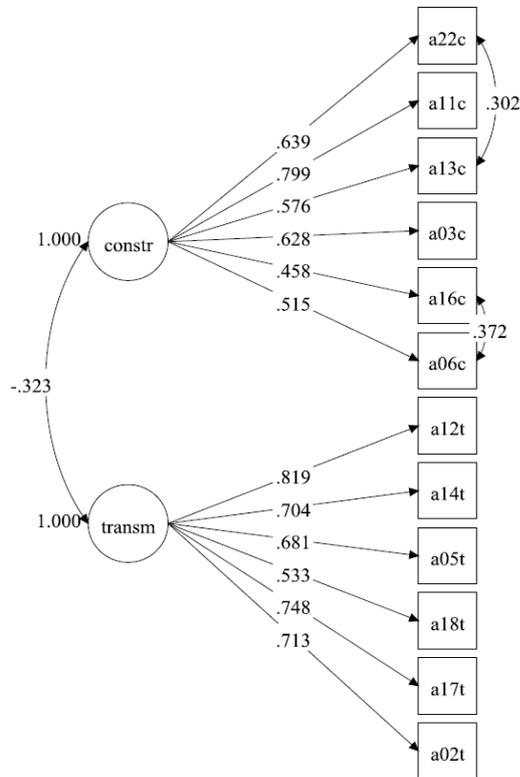
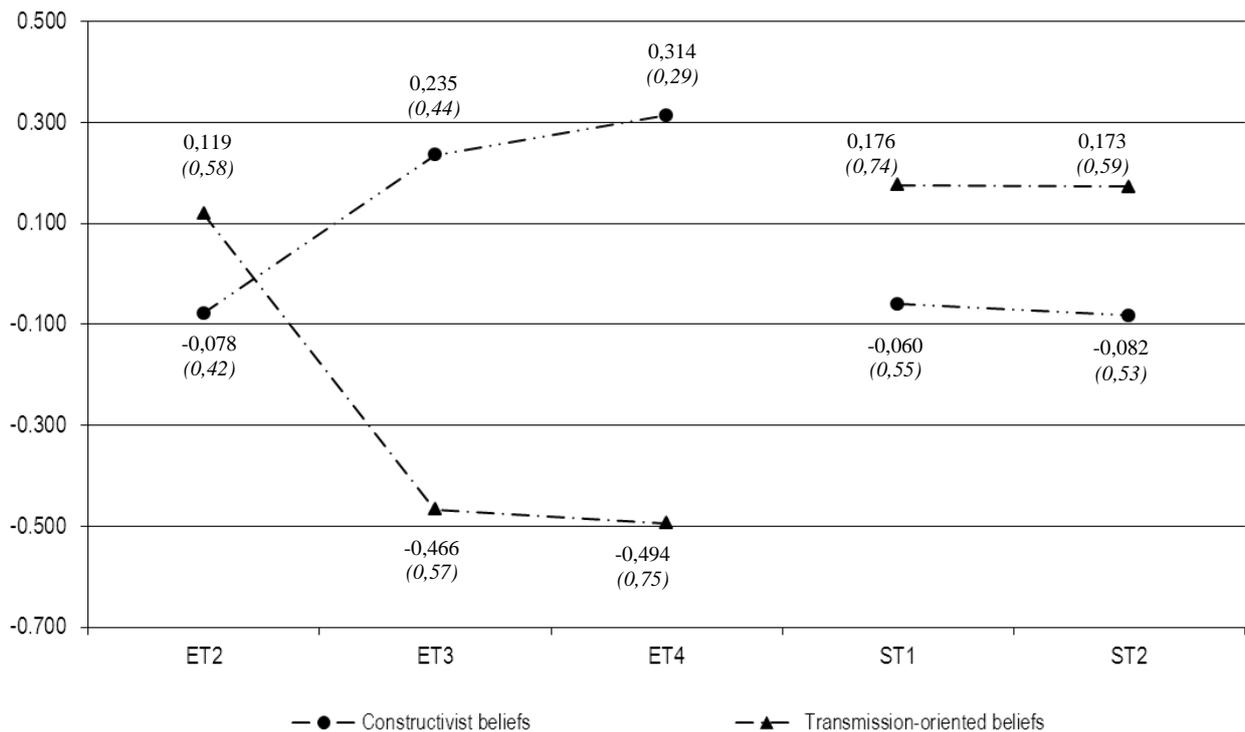


Figure 1
Structural model for pre-service teachers' beliefs about teaching approaches - standardized values

4.2. Development of constructivist and transmission-oriented beliefs: a cross-sectional analysis

As shown in figure 2, the development of pre-service teachers' beliefs about constructivist and transmission-oriented teaching approaches are different according to the school level for which they are being trained to teach. Second year elementary school pre-service teachers (ET2) prefer transmission-oriented beliefs and do not subscribe to constructivist beliefs. This balance reverses during the third year of the teacher training program (ET3) and tends to be reinforced during the fourth year (ET4). From the third year on, they strongly favor constructivist beliefs and strongly reject transmission-oriented beliefs. Colleagues graduating for secondary school teaching (ST1 and ST2) present no difference on

belief profiles according to the year of the training program: they value transmission-oriented beliefs and reject constructivist teaching beliefs. There is no influence of pre-service teachers gender on these developmental paths (Constr.: $F_{1/226} = 0.99$, $p = 0.32$; Transm.: $F_{1/226} = 3.37$, $p = 0.07$). There is also no difference according secondary school graduating pre-service teachers' subject matter (Constr.: $F_{3/77} = 0.274$, $p = 0.84$; Transm.: $F_{3/77} = 0.32$, $p = 0.81$).



ANOVA comparisons using SPSS 21 : Mean (standard-deviation)

Constructivist beliefs : $F_{4/223} = 5,65$, $p < .000$; Scheffé : $(ST1=ST2=ET2) < (ET4)$; $ET4=ET3 \geq (ST1=ST2=ET2)$

Transmission-oriented beliefs : $F_{2/135} = 10,779$, $p < .000$; Scheffé : $(ET2=ST1=ST2) > (ET3=ET4)$

Figure 2

Pre-service teachers' beliefs about teaching approaches as a function of teacher education program and year of training: mean scores (and standard deviations) and ANOVA comparisons with post hoc tests

5. Discussion

As seen earlier in this paper, the literature raises much concern about the efficiency of constructivist beliefs and about the implementation of constructivist teaching strategies in the classroom. Some research shows that teachers holding constructivist beliefs offer better learning opportunities for their students and obtain better results in terms of student achievement (e.g. Staub & Stern, 2002; Voss et al., 2011). Kunter et al. (2013) showed that the

link between constructivist beliefs and students' motivation and performance is more complex. Their results show that what determines learning gains and motivation is the broader concept of PCK and especially teacher enthusiasm. Even if, in their study, teachers with the highest PCK hold especially strong constructivist beliefs, all other teacher attributes being equal, the latter do not influence student outcomes and motivation in math.

Research on the efficacy of teaching strategies showed significant importance for keeping some kind of behaviorist strategies such as feedback, practice, etc. to ensure some positive impact on students' learning when teachers use constructivist teaching approaches.³ Effectively, results show that providing problem solving tasks to students that have to resolve them individually or in collaboration with peers without providing guidance is counterproductive (e.g. Alfieri et al., 2011). Research also supports the idea that the teacher should identify students' needs and adapt the nature and amount of guidance they provide to their students according to their diagnosis (e.g. Helmke & Schrader, 1987), and that this adaptation should depend on students' characteristics (e.g. Cronbach & Snow, 1977).

These observations led us to the hypothesis that an optimal teacher should teach using both kinds of belief orientations. In accordance with that hypothesis, an optimal teacher training program should prepare its students to value both kinds of beliefs. So our purpose was to describe how pre-service teachers in the teacher training program at the University of Geneva develop their beliefs about constructivist or transmission-oriented teaching approaches. Drawing on that perspective, we developed an instrument to assess these beliefs without reference to a specific content or domain. Our measurement scale possesses robust

³ Some will counter this assertion by saying that certain types of feedback are wholly constructivist acts (Hmelo-Silver, Duncan, & Chinn, 2007). This position has been criticized by Sweller, Kirschner and Clark (2007). See these texts for a detailed review.

psychometric qualities. Comparisons show that developmental paths are different for elementary school pre-service teachers than for secondary school pre-service teachers. Secondary school pre-service teachers favor transmission-oriented beliefs and reject the constructivist beliefs and maintain this belief profile throughout the teacher training program. Elementary school pre-service teachers enter the training program with the same profile as their colleagues graduating in the secondary school program. But from the third year on, they highly value constructivist beliefs and are strongly opposed to transmission-oriented beliefs.

5.1. Implications for teacher training

Three issues grow out of these findings. The first issue is linked to the impact of the teacher training programs in Geneva on the beliefs of pre-service teachers. Secondary school pre-service teachers keep their beliefs orientation stable throughout the training. Thus, the influence of this program on teacher beliefs is not visible in our data or it is not strong enough to impact their beliefs significantly. It might be that this stability is because these pre-service teachers all hold at least a Master's degree in a discipline such as math or English. They are content-oriented and maybe this influences their teaching beliefs in such a way that they want to transmit their knowledge and expertise of a specific content. Another explanation could be their year-long transmissive lecture experiences during their training at the university. Maybe this influences their view about how to best teach their content (Lortie, 1975). A third reason could be due to their employment in the field. For most of them, it is their early encounter with adolescents and with the realm of teaching and managing a class. It is well known that the first induction phase is a difficult period for beginning teachers as they struggle with self-oriented concerns while developing their teacher identity (e.g. Fuller & Bown, 1975; Fuller, 1969; Ryan, 1986). This phase includes concerns about how to discipline a group of students, one of the tasks pre-service teachers struggle with the most (e.g. Lasley & Applegate, 1985). During this

induction phase it might be possible that they experience that classroom management and constructivist teaching represent mutually exclusive paradigms of instruction (Brophy, 1999). Maybe they experience that it is important to monitor or direct students' behavior with principles like, for example, those developed by Kounin (1970). It might also be that in doing so pre-service teachers experience some incompatibility between these principles and student self-directed learning common to the constructivist approaches (cf. Tobias & Duffy, 2009). It might also be that they need to guide students learning to achieve better content mastery according to research findings showing that enhanced learning is more effective than non-guided discovery (Alfieri et al., 2011; Kirschner et al., 2006; Mayer, 2004; Sweller et al., 2007).

The profile of elementary school pre-service teachers differs from their secondary colleagues perhaps because they come directly from secondary school when entering teacher education. Their belief profiles change radically so that they reject transmission and value constructivism. Elementary teacher education has a strong influence on the development of pre-service teachers' beliefs about the constructivist and transmission-oriented practices. Unfortunately, our study could not find reasons explaining this strong influence. Among the possible factors one could probably consider is that (1) these pre-service teachers come directly from secondary schools without experiencing many transmissive lectures at universities, (2) they are not oriented towards the transmission of specific content knowledge, (3) the elementary teacher education curriculum is built in such a way that it favors a strong beliefs transformation in line with constructivist principles, and (4) their teaching experiences are divided into periods of a few weeks spread over the duration of their training program through internships. They experience many reflective seminars and are not as challenged by the urgencies of every day practice as those pre-service teachers who prepare for secondary education. This may provide them with the opportunity to experience the idea that active participation of students in

constructivist approaches and classroom management can be successfully combined despite the challenges this poses (e.g. Evertson & Harris, 1999; Weinstein, 1999).

The second issue is more linked to the kind of desired teacher profile. According to research results underlining the importance of embedding behaviorist principles into constructivist teaching strategies (cf. Alfieri et al., 2011), is it desirable for teachers to reject one kind of belief system (e.g. constructivist beliefs) and value another set of beliefs (e.g. transmission-oriented beliefs) ? More explicitly, is the development observed for the elementary school pre-service teachers an appropriate one when the goal is to favor student learning and motivation or to ensure an optimal classroom environment? Unfortunately, our research design does not permit any speculation on this crucial issue. But according to the findings of previous research, it might be that the most effective teachers hold both kinds of belief orientations with equal strength and that they rely on one or the other kind of belief in response to contextual demands and student characteristics, etc. (e.g. Cronbach & Snow, 1977; Karst, 2012). This has an important implication for teacher education. Teacher training programs should probably provide pre-service teachers with opportunities to learn different kinds of teaching strategies that are not only associated with a constructivist orientation but also with behaviorist principles (e.g. Schauber, 2012). Schauber (2012) argues that teacher education presents a natural instructional and mentoring opportunity for the consideration of pluripedagogical values wherein multiple pedagogical orientations (culled from exposure to diverse global educational perspectives) serve as instructional resources that are mobilized in response to local contextual demands. Moreover, the selection of a constructivist or transmission-oriented approach may well depend on the student's orientations and not on the teacher's. She claims that denying pre- and in-service practitioners with access to a

pluripedagogical orientation may limit the kinds of instructional decisions they can ultimately make and therefore the kinds and range of learning opportunities their students can experience.

The third issue is linked to students' transition between elementary and secondary school. Our results show two contrasting ways to conceptualize teaching depending on the school level for which pre-service teachers are being professionally prepared. Elementary school pre-service teachers are convinced constructivists, while, secondary school pre-service teachers are convinced transmitters. This absence of harmony between the two school levels is surprising and might generate some student difficulties during the transition between elementary and secondary school. It might be interesting to develop programs to help students grapple with both kinds of profiles when they move from primary to secondary school.

5.2. Implications for Future Research

The implications for follow up research are numerous and diverse. We only mention four in this paper as we do not have enough space to treat more. Firstly, an analysis of different belief profiles would be interesting as we saw that beliefs about constructivist and transmission-oriented teaching approaches are not extremes of the same continuum. It seems possible that beliefs about teaching approaches spread out in a bi-dimensional space. It might be that teachers can be categorized into this bi-dimensional space. This categorization should lead to a hypothetical four profile system of non-constructivist-transmissive, non-constructivist-non-transmissive, constructivist non-transmissive, and constructivist-transmissive beliefs. Research should also foster interest in analyzing which belief profiles generate the best student achievement and motivation and in which circumstances. Another interesting research orientation would be to analyze if teachers adopt different belief profiles according to student or task characteristics. Finally, other research should analyze whether the belief profiles we

found remain stable over time, especially when pre-service teachers are employed in a school and experience the reality of a class during their first induction phase.

5.3. Limitations of the Research

Beyond the fact that our sample size is reasonable but contains an unequal number of subjects by years and levels of teacher education, one important limitation of our research is its cross-sectional design. This may limit the impact of our analysis of pre-service teachers' conceptual change towards their training program. Some longitudinal research is needed to broadly analyze the development of pre-service teachers' personal epistemologies and the evolution of their beliefs about the best teaching approaches to favor students' learning.

A further limitation of the research is that our instrument was not created to reveal the factors influencing pre-service teachers' development through constructivist and transmission-oriented teaching. That means that our discussion about the impact of early education, teacher training program or field experience is hypothetical. Similarly, our suggestion about the context-, task- or student- oriented choices of teaching approaches should be tested for example with a vignette study design.

We hope our paper provides some stimulation for further research.

6. References

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