The analyses from Appendix C and the summarized results from Table 1 present the type of quantitative studies that were performed. Starting from the concept of teacher collaboration and collegiality, professional community started to be investigated as a predictor of student achievement, especially after 1995 in the United States, when more studies focused on evaluating the effects of different reform movements found professional community as a facilitator or predictor of student achievement.

From the seven studies focused on secondary education, five of them were performed in the USA, one in the Netherlands (Visscher & Witziers, 2003) and one in England (Bolam et al., 2005). Moreover, two studies had a different way of measuring the concept of professional community as team-based learning (Supovitz, 2002 and Lee & Smith 1995) and one study considered professional community as a subject department trait (Visscher & Witziers, 2003). In this way, four studies performed in secondary education are left that used the same conceptualization and operationalization of professional community (Newmann & Wehlage, 1995; Marks & Louis, 1997; Louis & Marks, 1998 and Bolam et al., 2005). All these four studies used a similar concept of professional community (Marks & Louis, 1997; Louis & Marks, 1998), schoolwide professional community (Newmann & Wehlage, 1995) or professional learning community (Bolam et al., 2005) but a very similar operationalization of the concept. In addition, these studies had as dependent variable an explicit measurement of student achievement, as authentic achievement[27] in mathematics, sciences and social sciences (Newmann & Wehlage, 1995; Marks & Louis, 1997; Louis & Marks, 1998) and students' academic progress (Bolam et al., 2005) and they all used teacher data as source and questionnaires as type of test employed. Moreover, all four studies used a mixed methodology design, questionnaires being accompanied by case studies, interviews and classrooms or meetings' observations.

The different type of statistical technique used to perform the quantitative data analysis determines the difference between these four studies. One study focused on associations

[27] Multidisciplinary standards measuring: construction of knowledge, disciplined inquiry and value beyond school) (Appendix C, 1 – dependent variable)

between professional community and student achievement in different domains, finding a significant relation between high student authentic achievement and high school professional community (Newmann, & Wehlage, 1995). Two of these three studies used correlation analysis to investigate this relation (Marks & Louis, 1997; Bolam et al., 2005), both studies reporting correlation indices and levels of significance. Both studies found a significant positive relation between student achievement or progress and professional community. Only one study (Louis & Marks, 1998) used a multilevel analytical technique to investigate the effect of professional community on student achievement, indicating the standardized coefficient of school professional community in the model and the percentage of variance explained at school level. This study found that professional community related strongly with the social support for achievement and authentic pedagogy[28] (p.549), but had no direct effect on student achievement (p.550).

When referring to the effects of professional community on student achievement, Table 1 indicates that five of the seven studies found a level of significant effects. It is important to know the size of the effects found in each study and to compare them. In order to compare the effect sizes found, it is necessary to look at the same type of results. In this case, the comparison will be made between coefficients of correlations on student level, transformed into Cohen's *d* coefficients that indicate the size of the effects. When results are reported on school level or as total explained variance, necessary recalculations will be performed (Appendix B) in order to express all results as coefficients of relationships at student level and corresponding effect size coefficients.

Going back to the differences between these seven studies, it is known that Suppovitz, (2002) Lee and Smith, (1995) and Visscher and Witziers, (2003) used a different conceptualization of professional community. However, when Suppovitz (2002) operationalized professional community team-based schooling, he found very small and inconsistent effects on student achievement, presented as "les than .10 *SD* between the performance of students in the team-based and non-team-based schools" (p.1612). Only 3

[28] "Authentic pedagogy, as embodied in instruction and assessment, reflects the hallmarks of authentic human achievement referred to: construction of meaning, disciplined inquiry, and value beyond the classroom" (p.538), Appendix C.

of the 25 regression results were statistical significant in favor of students in team-based schools, as .09 (.03) ($p<.01$) coefficient for mathematics in grade 7, .06 (.02) ($p<.01$) coefficient for science in grade 7 and .08 (.03) ($p<.01$) coefficient for citizenship in grade 8. These results indicate a Cohen's *d* coefficient of approximately less than .10, which in his terminology (Cohen, 1989) is a small effect size. However, considering "the large sample size and consequent likelihood of statistical difference" (p.1612), even the author points out that "the magnitude of the differences is strikingly small" (p.1612).

Lee and Smith, (1995) represents a second study that used a different conceptualization of professional community (Appendix C), operationalized using five specific characteristics of restructuring schools. Using multivariate analysis (HLM), the authors found a mean of the effects of restructuring-practices on student achievement of .40 (p.256), which in Cohen's terminology is a small to medium effect.

Moreover, Visscher and Witziers, (2003) measured professional community as a mathematics related community, investigating only its effect on students' mathematics achievement and based on a different operationalization than the one defined. Specifically in this case, the authors found that only 6% of the variance was explained by the mathematics professional community variables, out of the 20% of the variance that was localized at the school level. The variance explained at school level of 6% represents 1.2% of the total explained variance between students (Appendix B (2) for recalculations). After performing more necessary recalculations (Appendix B (3)), the correlation coefficient found between the mathematic professional community and student achievement was of .11, which indicates a Cohen's *d* of approximately .20 (Appendix B(1)). The Cohen's *d* of .20 indicates a small effect size.

Going back to the four studies that operationalized professional community based on the five characteristics known, the size of the effects found will be compared. Newmann and Wehlage, (1995) summarized the results of more studies on restructuring schools, based on comparing students' achievement from schools with low to high professional communities. Based compared means, the authors concluded that "an average student in the low community school would score at the 36^{th} percentile and in the high community school at the 67^{th} percentile" (p.63), with a difference in "gain of 31 percentile points"

(p.30). By transforming these percentiles into *Z* scores of -36 and .44 (Field, 2005, p.751), and with 2 *SD* to consider (Newmann & Wehlage, 1995, p.63, end note 24), the effect size obtained is approximately of .40, which in Cohen's terminology indicates a small to medium effect size.

To continue, two of the four studies used correlation analysis on school level to investigate the same relationship. More specific, Marks and Louis, (1997) found a significant school level correlation of .36 ($p<.05$) (p.263), which can be translated student level correlation of .07 of student achievement with professional community, which indicates a Cohen's *d* coefficient of approximately .20 (Cohen, 1989), which is a small effect size.

In addition, Bolam et al., (2005) found also a correlation of .21 ($p<.01$) (p.49) of the aspects of professional learning community with schools' value added performance. Following the same recalculations (Appendix B), a correlation coefficient of .04 on student level can be found, which can be translated into Cohen's *d* coefficient of approximately .10 (Cohen, 1989), which is a small effect size.

The study of Louis and Marks, (1998) is the only study that used multilevel data analysis to investigate the effect if professional community on student achievement. A model with no classroom-level predictors, adjusting for grade level and student background variables, and with professional community as main predictor, accounts for 85% of the variation of student authentic achievement (.26, $p<.001$, the standardized coefficient of school professional community) (p.549). However, no effect of professional community on student achievement was found when other variables, like authentic pedagogy predictor, were introduced in the model.

A summary of the effect sizes found in the seven studies is presented in Table 2.

Table 2. Cohen's *d* approximately coefficients and effect sizes

Study Author	Cohen's *d* coefficient	Effect size
Known definition and operationalization of professional community (see page 7)		
Newmann & Wehlage, 1995	.40	Small to medium
Marks & Louis, 1997	.20	Small
Louis & Marks, 1998	No effects found	No effects found
Bolam et al., 2005	.10	Small
Different definition and operationalization of professional community (Appendix C)		
Lee & Smith, 1995	.40	Small to medium
Supovitz, 2002	No effects found	No effects found
Visscher & Witziers, 2003	.20	Small

Table 2 indicates that diverse effects of professional community were obtained by the studies performed, from no effects to small and small to medium effects.

4. Discussion

Summary of results

Is the empirical evidence available by now supporting the positive impact of professional community on student achievement in secondary schools? In order to answer this research question, a selection and an analysis of the quantitative empirical evidence was presented. The search found seven articles that respected the selection criteria established from 1980 until now and the results show that effect sizes are small and in some cases, small to medium. It is important to mention that the measures used in the studies are far from perfectly reliable and thus may lead to an underestimation of the association (Witziers, Bosker, & Kruger, 2003). Moreover, when the effect of one individual – the teacher in this case – on many others – the students - is investigated, a small effect may still be very relevant (Witziers, Bosker, and Kruger, 2003). Looking specifically at the

four studies that used a similar way of defining and operationalizing professional community (Newmann & Wehlage, 1995; Marks & Louis, 1997; Louis & Marks, 1998; Bolam et al., 2005) different effects were obtained when different statistical modeling or analytical techniques were used. Newmann and Wehlage (1995) used a method of comparing means and obtained a small to medium effect, without controlling for possible covariates effects. Marks and Louis (1997) and Bolam et al. (2005) used correlation analysis to analyze the relationship and both studies obtained small effects. Most important, when Louis and Marks (1998) used a modeling technique and controlled for the effect of the covariates, an insignificant effect of professional community on student achievement was found (Table 2)[29]. It is important to mention the importance controlling for covariates when investigating the effect of professional community on student achievement. As seen in Louis and Marks (1998), covariates like "social support for achievement" or "authentic pedagogy" (p.550), reduced the effect of professional community on student achievement until it became insignificant.

Trait characteristics

All the four studies mentioned before considered professional community as a school trait. Moreover, six of the seven quantitative studies analyzed, operationalized and measured professional community as a school trait. Only Visscher and Witziers (2003) measured the effect of mathematics professional community on mathematics student achievement, however without offering any information about the presence or the relation with the community on the school level.

It is important to mention that Talbert and McLaughlin (2002) concluded that a "community across a school faculty is rare[30] in American secondary education, given the prevalence of large comprehensive high schools and teachers' strong disciplines identity" (p.337). Moreover, in secondary schools in the Netherlands, Imants, Sleegers, and

[29] Moreover, the sample size, dependent variables, data source and type of test employed are similar in the studies of Newmann and Wehlage, (1995), Marks and Louis, (1997) and Louis and Marks, (1998).
[30] Talbert and McLaughlin found only three school based communities out of 16 schools investigated (2002, p.337).

Witziers (2001) concluded that professional community at school level is a new school characteristic, being part of a recent trend to support the process of replacing or integrating subject departments professional communities with "one system of integrated and decentralized team" (p.289).

When thinking of the five characteristics of professional community, it is easier to imagine them being active in concordance with a specific content or domain. The difficulty in measuring professional community at school level is evident and the question if teachers refer to school or subject related professional communities in their answers is present. Some new routes for research could be designs that take into consideration both types of professional communities, school based and subject department based and considering both effects in a common model. Moreover, it would be interesting to find out which belonging is more efficient for student success, to a subject related professional community or to a school based one.

In conclusion, professional community at school level is an important characteristic of schools, but possible hard to encounter or hard to measure. It seems that is easier for teachers to reflect on content, to collaborate and to give feedback on their practice within the same subject department. However, teachers can, at school level, share the same purpose and the same focus on student learning and reflect on their practices and understanding of school common goals and policies, as part of the professional community specific activities.

5. Conclusion

Limitations of the studies

The limitations that could influence the size of the effect of the predictors on the dependent variable are the methodological limitations. Most of the limitations are related to the statistical aspects of the studies, as samples, designs, variables or methods used to investigate the specific effect.

One of the most common limitations noted by the authors is related to sample and its selection, which limits the generalizability of the findings and the size of the effects. As example, the study of Marks and Louis (1997) and Louis and Marks (1998) had a nonrepresentative sample of 24 schools most of them located in urban environments and restructuring schools, engaged in an ambitious reform effort. In addition, the study of Supovitz (2002) is located only in the districts of Cincinnati.

Another methodological aspect is related to the quality of the measurements used in different studies. Louis and Marks (1998) mentioned that their measurements of authentic pedagogy and authentic student achievement were unique measures, which makes it hard to compare the results with other similar studies, the same being true for Marks and Louis (1997) and Newmann and Wehlage (1995) studies.

A very important limitation that influences directly the size of the effects is the design of the study and the type of statistical modeling technique implemented. An important aspect of the research on the effect of professional community on student achievement is the specific model used for investigation. Odden, Borman, and Fermanich (2004), at the end of a meta-analysis on the comprehensive reform movements in the USA, concluded that the best model of investigating these effects on student achievement is a multilevel educational model. In this specific case, only the study of Louis and Marks (1998) and Visscher and Witziers, (2003) used a multilevel analytical framework to identify the relationship between professional community and student achievement.

Other authors noticed as well the need for longitudinal studies when the continued development or fluctuations of professional community activities need to be studied. Only two of the seven studies, Bolam et al. (2005) and Supovitz (2002), used a longitudinal perspective when measuring the mentioned effect.

Change in methodology

These results point out an important limitation, as the statistical modeling technique used to investigate the effect of professional community on student achievement. When multilevel data analysis was used, which allowed for the control of the effect of other variables nested within levels, professional community went from a significant predictor of student achievement in a model with no classroom-level predictors, to no effect when other such predictors or covariates were added (Louis & Marks, 1998). Therefore, considering the specific of the data, multilevel data analysis is needed in order to detect the real effect of professional community on student achievement, as suggested also by Odden, Borman, and Fermanich (2004).

Moreover, a comprehensive model of predictors needs to be considered when the effect of professional community on student achievement is investigated, which allows for a simultaneous analysis of the effect of other related predictors.

Professional community is a concept with a long and diverse development process and an important component of school culture (Maslowski, 2001). A lot of attention was paid lately to its development and efficacy. Its manifestations are school or subject related. It seems to have reciprocal relationships with most of the school and teacher characteristics and its direct effects on student achievement are now under questioning. Interesting new routes of future research are open.

Appendix A

The reviewed quantitative empirical evidence of the direct effects of Professional Community on Student Achievement

Bolam, R., et al. (2005). *Creating and sustaining effective professional learning communities.* University of Bristol, UK. Retrieved February 12, 2008, from: http://www.dcsf.gov.uk/research/data/uploadfiles/RR637.pdf

Lee, V.E. & Smith, J.B. (1995). Effects of high school restructuring and size on early gains in achievement and engagement. *Sociology of Education, 68*(4), 241 – 270.

Louis, K.S. & Marks, H.M. (1998). Does professional community affect the classroom? Teachers' work and student experience in restructuring schools. *American Journal of Education, 106*, 532-575

Marks, H.M. & Louis, K.S. (1997). Does teacher empowerment affect the classroom? The implications of teacher empowerment for instructional practice and student achievement? *Educational Evaluation and Policy Analysis, 19*(3), 245-275.

Newmann, F.M. & Wehlage, G.G. (1995). *Successful school restructuring: a report to the public and educators*. American Federation of Teachers. Washington, DC.

Supovitz, J.A. (2002). Developing communities of instructional practice. *Teachers College Record, 104*(8), 1591-1626.

Visscher, A.J. & Witziers, B. (2004). Subject departments as professional communities? *British Educational Research Journal, 30*(6), 785-800.

Appendix B

Statistical issues and recalculations

The Pearson correlation coefficient transformed into Cohen's *d* effect size coefficient

$$2r_{xy} = d \qquad (1)$$

where

r_{xy}	Pearson correlation coefficient
d	Cohen's *d,* effect size coefficient

The variance explained on school level transformed into total variance explained between students

$$R^2_{\text{between students}} = R^2_{\text{school level}} * \frac{\tau^2}{\tau^2 + \sigma^2} \qquad (2)$$

where

R^2	total variance explained between students
τ^2	variance between schools
σ^2	variance within schools

The total variance explained between students transformed into Pearson correlation coefficient

$$r_{xy}{}^2 = R^2 \qquad r_{xy} = \sqrt{R^2} \qquad (3)$$

where

R^2	total variance explained between students
r_{xy}	Pearson correlation coefficient