

# FIVE YEARS OF PCK SUMMIT, WHAT HAS ENDURED: 2. A FACTORIAL ANALYSIS OF CORRESPONDENCE OF THE SCIENCE PCK PUBLISHED PAPERS

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**ABSTRACT:** Tring to understand teacher's professional knowledge, Shulman has popularised the Pedagogical Content Knowledge, from then on several models were proposed. To minimise such differences the PCK Summit was held aiming to develop a single model to unify the field. However, five years has passed and none of the researchers present at the event has adopted the Consensus Model, leaving a question of its impact on them. To access it, a lexicometric analysis of the papers published before and after the Summit was performed, being presented here the factorial analysis of correspondence, which has shown that the questions of the papers published before lead to the main questions of the event, and were solved in it, changing the subject of interest of the researchers. Another important aspect is that the discourse of the researchers put in the same work group in the Summit became more similar after it, showing that the Summit exert some effect on the researchers

**KEYWORD:** Factorial Analysis of Correspondence; PCK Summit;

**OBJECTIVES:** This work consists of the second part of a two-part work concerning the impact of the PCK Summit on the PCK-Summit researchers, based on the changes in the discourse of the papers published by them before and after the encounter. In this part, the aim was analyse if there was any change in the discourse of the research groups, and the relation of such changes (if any) with the changes from the other groups. The point in such analysis is to determine if any change can be observed in the discourse thought the years, and they can be pinned to the Summit.

## **THEORETICAL FRAMEWORK**

Since Shulman (1986) introduced Pedagogical Content Knowledge (PCK), several models to representing it were proposed (e.g. Grossman, 1990; Magnusson, Krajcik, & Borko, 1999). Those models presenting divergences in some aspects, as nature of PCK, model and measurement (Borowski et al., 2011). To solve these divergences, PCK's leading research groups conducted a meeting, called PCK Summit, which gathered researchers (Table 1) around the objective of "formation of a professional learning community to explore the potential of a consensus model of PCK to guide science education

research [and the] identification of specific next steps that would move the field forward” (Carlson, Stokes, Helms, Gess-Newsome, & Gardner, 2015, p. 16).

Table 1.  
Summit Group members (Carlson et al., 2015; Helms & Stokes, 2013)

Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7
K. R. Daehler, J. I. Heller, J. W. Little, K. Sheingold, M. Shinohara, N. Wong	J. Gess - Newsome, J. Carlson, A. Gardner	R. Schneider	A. Berry, R. Cooper, J. Loughran	M. Rollnick, E. Mavhunga	E. Banilower, S. Smith	J. van Driel, I. Henze
Group 8	Group 9	Group 10	Group 11	Group 12	Group 13	
P. Friedrichsen, J. Lannin, A. SICKEL	V. Kind	K. Padilla, A. Garritz	H. Hill, D. L. Ball, H. Bass, M. Blunk, M. Thames, J. Lewis, G. Phelps, L. Sleep	S. Kirschner, A. Borowski, H. Fischer	S. Park, J. K. Suh	

Hence, 5 years have passed and it is important to know the impact of such meeting on PCK research. Therefore, the aim of this research is to understand if the PCK Summit influenced the discourse among those who participated in this event, answering the questions: did the Summit guided science teacher PCK research?

## METHODS

A lexicometric exploratory, descriptive and comparative analysis of the papers published before ( $\alpha$ ), during ( $\epsilon$ ) and after ( $\beta$ ) the PCK Summit was adopted. Data collection was made using the selected data base: Google Scholar, Research Gate, ERIC and Directory of Open Access Journals (Harzing & van der Wal, 2008). The selected scope was English, science PCK, peer-reviewed papers, having one authors attending the Summit and published between 2008 and 2016.

The initial corpus was divided in sub-corpus for the moments  $\alpha$ ,  $\epsilon$  and  $\beta$ . Then, the analysis was performed using the IRAMUTEQ (Sarrica, Mingo, Mazzara, & Leone, 2016). A statistical lexicography was made from those sub-corpora and, from it a factorial analysis of correspondence (Fallery & Montpellier-Management, 2007).

To increase trustworthiness, all data was analysed by two independent researchers followed by a post-hoc discussion (MacCoun & Perlmutter, 2015). Also the methods, data and full analyses were deposited in the Center for Open Science’s Framework to assure transparency and more details (Gastaldo & Castro, 2016).

## RESULTS

In this study, 52 papers (texts) were found within the scope to compose the corpus: 14 published before the PCK Summit ( $\alpha$ ), 25 after ( $\beta$ ), and 13 presented in the encounter ( $\epsilon$ ).

Despite that increase in  $\beta$  the number of publications per group has lowered as can be seen in Figure 1, showing a more homogeneous distribution of papers. The proportions between the groups has also changed (Figure 2), and the most perceptible modifications are related to groups 7 which went from  $\approx 27\%$  to  $\approx 13\%$  of the publications. In the opposite direction, G5 goes from  $\approx 13\%$  to  $\approx 26\%$ . A minor, but relevant, decrease can be noticed in G10 & G13, and increase in G12.

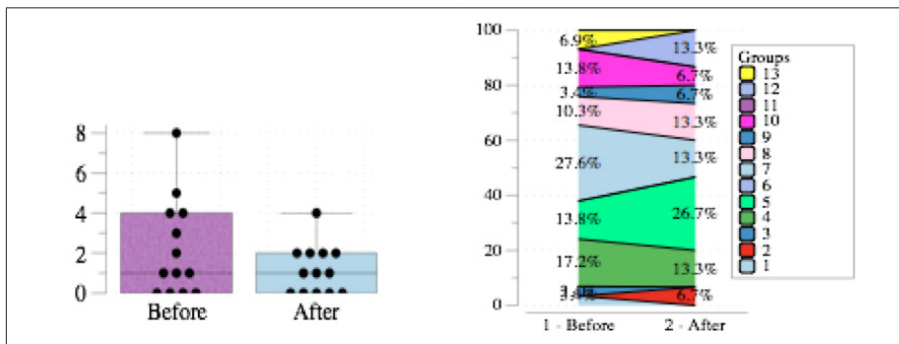


Fig. 1. Number of publications per group before and after PCK Summit

Fig. 2. Changes in the proportion of publications per group.

From the FAC (figure 3) it is noticeable that initially groups G1 & G9; G3 & G4; and G5, G7, G8, G10 & G13 form three different discourses, and groups G6, G2, G11 & G12 did not presented a strong relation with any discourse. However, in the Summit those relations change, G2, G12 & G13, form the first discourse, G1, G3, G7 & G8 the second, the third is formed by G10, and the fourth includes G4 & G5. Again, some groups did not present a strong relation with any discourse, they were G6, G9 & G11. Another set of relations is found after the summit, with G4, G7 & G10 in the first discourse type, G5 & G8 in the second, G7 characterizes the third, and the last is divided among G2 & G12. The ones that did not appeared are: G1, G3, G6, G9, G11 & G13. On  $\alpha$  papers, three discourses can be noticed (Figure 3  $\alpha$  - B), one, ( $\alpha$ -1) related to the Class Description discourse, on the right side of axis x, a second ( $\alpha$ -2), regarding Teacher's PCK Development, on the left superior quadrant (LSQ), and a third ( $\alpha$ -3), covering PCK Model, on the left inferior quadrant (LIQ). Despite a clear separation of discourses, the same does not apply for the groups nor does for the papers (T) in figure 3 -  $\alpha$  - A, where an overlap of the first and second discourses is seen in the right superior quadrant (RSQ), being G1 & G4 particularly close, despite producing different discourses, and within  $\alpha$ -2, G3 is extremely close to G4. On the opposite quadrant (LIQ) is found G13 and close to it, but not as far from the other discourses, are G5, 8 & 10. Interestingly G7 is allocated in the right side closer to  $\alpha$ -1 than all others.

In the Summit each group presented a summary of their current work on the topics of interest of the organizers (Carlson et al., 2015; Helms & Stokes, 2013). Those papers showed four different discourses (Figure 3  $\epsilon$  - B) that were almost non-congruent being found on each of the four quadrants. In LSQ G1, 3, 7 & 8 worked on Longitudinal Studies ( $\epsilon$ -1), being 3 & 8 very close to each other; on the LIQ G2, 12 & 13 worked on PCK Measurement ( $\epsilon$ -2), all having similar approach; on RIQ G6, 9, 10, & 11 aimed at the Nature of the PCK ( $\epsilon$ -3) in different ways, 6 & 11 being the closest ones; and finally, RSQ are found G4 & 5 which focused on Portraying PCK ( $\epsilon$ -4) also by different manners. Once more some groups converged despite presenting different discourses, were they G5 & 6 and 5 & 11, however, within each class a closer relation can be observed, as is seen in G1, 3, 7 & 8, also in G2, 12 & 13.

The papers from  $\beta$  shown 4 discourses (Figure 1  $\beta$ -B), two of them ( $\beta$ -1 &  $\beta$ -2) almost co-occurring in the middle of the superior quadrants. The first has as authors G4, 9 & 10, and concerns CoRe Uses; the second is composed by G5 & 8 and discusses Content Transformation for Teaching; the following ( $\beta$ -3), which is on LIQ regards the Curriculum, and the last ( $\beta$ -4) on RIQ and is interested in PCK measures.  $\beta$ -1 & 2 groups are very close to each other and apart from the rest of the groups.

A deepened analysis showed that the relative distance ( $\Delta d$ ) between the groups has decreased in  $\beta$  in relation to  $\varepsilon$  and that, despite the latter presenting the greatest  $\Delta d$ , clusters are clearly seen, as are in  $\beta$  and within each a closer relation is observed, for instance G2 & G12 went to the Summit with a close discourse, presented in the same forum, and were even closer on  $\beta$ . Such was their relation that they publish one paper together (i.e. T51 on  $\beta$ -A) using the same discourse developed in the encounter (PCK measurement). G5 & G8 were close in  $\alpha$  and went on to different interests, however, were put in the same forum, shrinking their distance in  $\beta$  also maintaining the same discourse observed on  $\varepsilon$  alongside with G12, from whom they use the methodology. In fact, from the 8 groups that publishes in  $\beta$  only between G5 & 12 and G4 & 7 that the  $\Delta d$  between the discourses from groups of the same forum increased, against 6 cases of decrease (Gs 5-8, 8-12, 2-12 8-9 8-10 9-10).

Also, the discourses  $\alpha$  &  $\varepsilon$  (i.e. afore the forum takes place) have a remarkable resemblance with the forum themes. The forum 1 (Content Knowledge and PCK by G2, 11 & 12), 2 (Beliefs, Teaching Orientation, and PCK by G8, 9 & 10) and 4 (PCK Models and Assessment Implications by G5, 8 & 12), have a strong semantic similarity with  $\alpha$ -3, with G8 & 10 even contributing to it (G2, 11 & 12 do not publishes any paper within the scope in  $\alpha$ ); forum 3 (Nature of PCK by G4, 6 & 7) have an exact match on  $\varepsilon$ -3 on which is found G6 & 7; forum 5 (Assessment of PCK by G4, 6 & 13), is associated with  $\varepsilon$ -2 &  $\varepsilon$ -4, with G4, 13 & 6 contributing the first two to  $\varepsilon$ -2 and G4 to  $\varepsilon$ -4; and forum 6 (Research Findings on PCK by G1, 2 & 3) (BSCS, 2012; Carlson et al., 2015). Another relation is found between  $\beta$  discourses and Summit's research prospection, made at the end of the encounter, when some work groups (WG) were formed, aiming on aspects that needed more research in the future. The convergence are between WG2 (Developing PCK in teachers (over the trajectory from pre-service to experts)) and  $\beta$ -2; WG 4 (Connecting PCK to policy) and  $\beta$ -3.

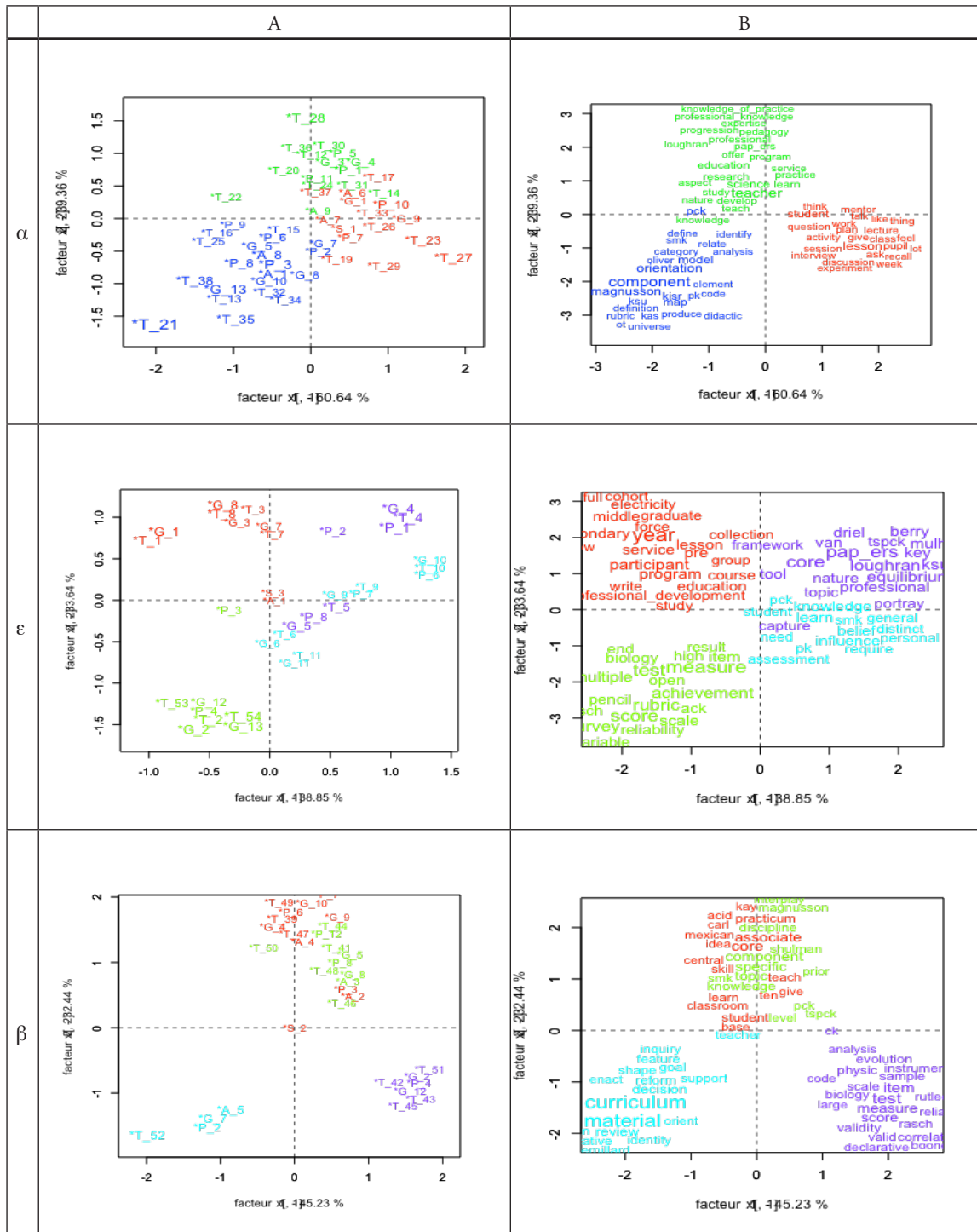


Fig. 3. Factorial analysis of correspondence (A- distance between the keywords used (G- group, A-year, and T- paper) and; B – distance between the main word in the discourses)

## CONCLUSION

The analysis of the FAC of  $\beta$  indicates that the discourse presented on  $\alpha$  and  $\varepsilon$ , expressed the doubts existing in some parts of the PCK construct, and lead to the main questions to be answered in the Summit, and that they were successfully answered, as the interest moved from the initially proposed to the ones developed on the work groups. It can be added that the groups that worked in the same forum on the Summit became more close, on regards of theirs discourse.

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