Relationship between content knowledge and general pedagogical knowledge on pedagogical content knowledge

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Abstract. Aim of the research is to investigate the relationship of content knowledge and general pedagogical knowledge on pedagogical content knowledge (PCK) in Acid Base. The research sample consisted of 18 chemistry preservice teachers. The lesson preparation task, content knowledge test, general pedagogical knowledge test, the task to developed CoRe and PaP-eRs, and semi-structured interview were used to collect data. This study shows that content knowledge and general pedagogical knowledge both have influence on pedagogical content knowledge 88.4% in significant way.

1. Introduction

Teacher should have four competencies, they are pedagogic competence, personality competence, professional competence, and social competence. Competencies related to the implementation of quality learning are pedagogical competence and professional competence. Become a teacher is not only to know how to teach but also how to teach in specific content. Thus a teacher needs having content knowledge that refers to one’s understanding of the subject matter, and pedagogical knowledge that refers to one’s understanding of the learning process of a subject matter [1]. There is different between knowing about a topic and knowledge about teaching and learning that topic [2].

There are seven types of teacher’s basic knowledge to promote student understanding: content knowledge, general pedagogical knowledge, curricular knowledge, pedagogical content knowledge, knowledge of learners and their characteristics, knowledge of educational context, knowledge of purposes, educational purposes and educational values and their philosophical and historical bases [3]. Pedagogical content knowledge is special amalgam of content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding. Key elements in shulmans’ conception for PCK are knowledge of representations of the specific content and instructional strategies on the one hand and understanding of learning difficulties and students’ conceptions of specific content on the other [4].

Content knowledge is defined as the concepts, principles, relationships, processes, and applications a student should know within a given subject matter [4]. It includes knowledge of concepts, theories, ideas, knowledge of proofs and evidences as well as practices and approaches to develop this knowledge [5]. Pedagogy is knowledge of teaching, instruction and training [4]. It includes the educational
purposes, the methods of teaching and learning, knowledge about techniques or methods used in the classroom, the nature of the target audience, and strategies for assessing students’ knowledge [5].

Some researchers have argued that experienced teachers have applied their knowledge to teaching by constructed knoeledge [6,7]. There was a significant interrelationship between subject matter and pedagogical knowledge of pre service science teachers [8].

2. Method
This research was conducted by using mixed method design with the number of respondents 18 preservice chemistry teacher. The developed instrument consists of tests to measure mastery of the taught content, in this case the Acid Base, and the general mastery test of pedagogy. Both of these instruments are used to look at the relationship between content knowledge and pedagogical knowledge on pedagogical content knowledge. Meanwhile, to see the development of preservice chemistry teacher’s PCK was required to developed CoRe and PaP-eRs and then the results are reported using the CoRe assessment sheet adopted from Loughran [9] and the PaP-eRs ones adopted from Mulhall et al [10]. CoRe and PaP-eRs assessment indicators can be seen in table 1 and table 2.

Table 1. Indicator of content representation.

| No | Indicator                                                                 |
|----|---------------------------------------------------------------------------|
| 1  | The accuracy of developing the appropriate essential ideas / content       |
| 2  | The accuracy of elaborate essential content should be taught              |
| 3  | Identify content that students do not need to learn                       |
| 4  | Identify difficulties in teaching content in terms of material characteristics |
| 5  | Identify student knowledge that affects difficulties in teaching content  |
| 6  | Identify factors that influence how to teach content other than the material characteristics and knowledge of students |
| 7  | Identify content that students do not need to learn                       |
| 8  | The accuracy of choosing procedures in teaching content                   |
| 9  | Determination of how to ensure students' understanding                    |

Table 2. Assessment indicator of PaP-eRs.

| No | Indikator                                                                 |
|----|---------------------------------------------------------------------------|
| 1  | Ability to formulate goals                                               |
| 2  | Analysis of difficulties in teaching content                             |
| 3  | The accuracy of choosing learning strategies                             |
| 4  | Describe the interaction of teachers and students                        |
| 5  | Anticipate the difficulties that may be encountered in learning          |
| 6  | Ensure students' understanding                                           |

3. Result and discussion
To see relationship between content knowledge (CK) and general pedagogical knowledge (GPK) on pedagogical content knowledge (PCK), multiple linear regression test was done. Previously, Kolmogorov-Smirnov test was conducted to see if the data were normally distributed or not and the linearity test to determine whether two variables had a significant linear relationship.

Table 3. Statistic data of CK-GPK-PCK.

|                          | CK    | GPK   | PCK   | PCK-CK | PPK-GPK |
|--------------------------|-------|-------|-------|--------|---------|
| Kolmogorov-Smirnov       | 0,063 | 0,097 | 0,110 |        |         |
| Anova (F/Sig)            |       | 0,362 | 0,831 | 0,868  | 0,482   |
| Pearson Correlation/Sig  |       | 0,688 | 0,001 | 0,902  | 0,000   |
| t/sig                    |       | 3,018 | 0,009 | 7,270  | 0,000   |
| R²                       |       | 0,884 |       |        |         |
| Anova (F/Sig)            |       | 56,930| 0,000 |        |         |
| Regression equation      | Y (PCK) = 30,569 + 0,178 (CK) + 0,397(GPK) |
Table 3 showing Pearson correlation between PCK and CK is known 0.688 with significance value 0.001. The Pearson correlation value indicates that PCK and CK correlate quite closely because the value is close to 1.0 in a linear direction. That is, an increase in content knowledge (CK) variables will be accompanied by improvements in pedagogical content knowledge (PCK). The significance value of 0.001 < 0.05 indicates that the correlation between PCK and CK is significant. While Pearson's correlation between PCK and GPK is 0.902 and a significance value of 0.000. This suggests that an increase in the general pedagogy knowledge (GPK) will be accompanied by an increase of pedagogical content knowledge (PCK), while the significance value of 0.000 < 0.05 indicates that the correlation between general pedagogical knowledge (GPK) and pedagogical content knowledge (PCK) is also significant.

The value of $R^2$ 0.884 shows the proportion of the influence of content knowledge (CK) and general pedagogical knowledge (GPK) simultaneously to pedagogical content knowledge (PCK), so it is known that content knowledge (CK) and general pedagogical knowledge (GPK) have influence on pedagogical content knowledge (PCK) of 88.4% while the rest (11.6%) is influenced by other variables that are not in the linear regression model.

![Figure 1. Development of content knowledge and pedagogical knowledge.](image)

Teaching requires complex management of instructional resources, including the teacher’s own subject matter and pedagogical content knowledge [11]. Teachers need to master correctly the concept to be taught [12]. According to Baird, pre conception is defined as prior knowledge possessed by students before learning the subject [13]. These preconceptions influenced by the culture of the social environment, and teaching in the classroom. The developments are different each person, some growing rapidly and the others not [14]. The development of content knowledge and general pedagogical knowledge of preservice chemistry teacher have been seen on Figure 1.

4. Conclusion

General conclusion of this study is that both content knowledge and general pedagogical knowledge have influence on pedagogical content knowledge.

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