

ABSTRACT

Nurhasanah, F. (2018). Mathematical Abstraction of Pre-Service Mathematics Teachers in Learning Non-Conventional Mathematics Concept.

One of the important processes in learning and teaching mathematics is mathematical abstraction. Having rich experiences with this will be beneficial for pre-service mathematics teachers in understanding students' learning processes as well as for designing mathematics instruction. Mathematical abstraction is a cognitive process that takes place in learners' mind. So, to be able to analyze the process, a learning context needs to be designed specifically for triggering this process. A theoretical framework that also provides methodological tools for investigating this process is *Abstraction in Context* (AiC). Using AiC framework, this study aims to investigate three particular issues: (1) the abstraction processes of pre-service mathematics teachers when they learn non-conventional mathematics concepts; (2) mathematical abstraction levels raised by pre-service mathematics teachers in learning non-conventional mathematics concepts; and (3) relationship between the abstraction process of pre-service mathematics teachers in learning non-conventional mathematics concepts and their performance in learning conventional mathematics concepts. This is a qualitative study that rely on the aims of the study. This study employed a grounded study using AiC framework and RBC model for answering the first and the second issue. In addition, a case study designed using descriptive statistics is used for answering the last issue. A context comprised a lesson plan, learning activities, a set of module, and classroom setting, while learning environment were designed as part of AiC framework. The topic of Parallel Coordinates was selected especially for the design. The study was conducted in six months, involving 45 participants in Analytic Geometry course. All participants have to construct six knowledge elements in Parallel Coordinates topic after learning concept of Cartesian coordinate, then taking a prior knowledge test on Cartesian coordinate concept. The data were collected through video recording, students' worksheet, test, and field notes. Related to the first issue, the abstraction process of pre-service mathematics teachers in learning low-level knowledge elements mostly takes place in group context. Whereas the abstraction process of them in learning high-level knowledge elements takes place in classroom context. In both contexts researcher find that *reducing abstraction* can help participants in constructing new mathematical knowledge. Regarding the second issue, Pre-service mathematics teachers as the participants in this study are can be categorized into three level of abstraction, less than half of participants are in level 1 (*perceptual abstraction*) and in level 2 (*internalization*). The rest of participants are in level 4 (*second level of interiorization*). There are no participants belong to level 3 (*interiorization*) while the others are still in pre-level of *perceptual abstraction* and in transition to level 1 and level 3. With regard to the final issue, there is a positive linear association between participants' scores in Parallel Coordinates test and participants' scores in Analytic Geometry test.

Keywords: Mathematical Abstraction, Parallel Coordinates, Non-Conventional Mathematics Concept, Abstraction Level.

ABSTRAK

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Abstraksi merupakan proses kognitif yang berlangsung di benak seorang individu yang mempelajari konsep baru, sehingga proses tersebut hanya dapat dianalisis ketika pembelajaran dirancang khusus untuk memicu munculnya proses tersebut. Salah satu kerangka teoretis yang dapat digunakan untuk mengkaji proses abstraksi adalah *Abstraction in Context* (AiC). Dengan menggunakan kerangka AiC, penelitian ini bertujuan untuk mengkaji tiga isu: (1) proses abstraksi calon guru matematika ketika mereka mempelajari konsep matematika non-konvensional; (2) level abstraksi matematis calon guru matematika dalam belajar konsep matematika non-konvensional; dan (3) hubungan antara proses abstraksi calon guru matematika dalam belajar konsep matematika non-konvensional dan hasil belajar mahasiswa calon guru matematika dalam belajar konsep matematika konvensional. Penelitian ini merupakan penelitian kualitatif yang menggunakan desain *grounded study* dengan menggunakan kerangka AiC dan model RBC untuk menjawab pertanyaan pertama dan kedua. Sedangkan desain studi kasus menggunakan statistik deskriptif digunakan untuk menjawab pertanyaan terakhir. Berdasarkan kerangka AiC, rencana pembelajaran, lembar aktivitas mahasiswa, modul, setting kelas, dan lingkungan belajar dirancang dengan memilih topik Koordinat Paralel sebagai konsep yang harus dikonstruksi. Penelitian dilakukan selama enam bulan, melibatkan 45 peserta pada kelas Geometri Analitik. Semua peserta harus membangun enam elemen pengetahuan dalam topik Koordinat Paralel. Data dikumpulkan melalui rekaman video, lembar kerja siswa, tes, wawancara, dan catatan lapangan. Proses abstraksi calon guru matematika sebagian besar berlangsung pada konteks kelompok saat membangun elemen pengetahuan yang memiliki tingkat abstraksi yang rendah dan terjadi pada konteks kelas ketika elemen pengetahuan memiliki tingkat abstraksi yang tinggi. Dalam penelitian ini, isu reduksi abstraksi ditemukan berperan penting dalam proses mengkonstruksi konsep matematika yang baru. Mengenai isu kedua, calon guru matematika sebagai dalam penelitian ini dapat dikategorikan menjadi tiga level. Sebagian besar peserta berada di level 1 (*perceptual abstraction*) dan level 2 (*internalization*). Sisanya berada di level 4 (*second level of interiorization*). Tidak ditemukan peserta yang berada di level 3. Masih ditemukan beberapa peserta yang berada pada level *pre-perceptual abstraction* dan masih dalam transisi ke level 1 dan level 3. Berkaitan dengan isu terakhir, diperoleh korelasi yang positif antara skor pada tes abstraksi matematis dan skor pada tes Geometri Analitik.

Keywords: Abstraksi Matematis, Koordinat Paralel, Konsep Matematika non-konvensional, Level Abstraksi.