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1,2,3 – GETTING READY! CONSTRUCTING AN ONLINE MODULE OF MATHEMATICS FOR SECOND LANGUAGE LEARNERS OF SOCIAL SERVICES AND HEALTHCARE STUDIES IN A HIGHER EDUCATION PREPARATORY PROGRAM

K. Kuparinen, M. Tanskanen

Laurea University of Applied Sciences (FINLAND)

Abstract

This paper presents a development project of a module of mathematics of social sector and healthcare within a higher education preparatory program for adult immigrants. The pilot of this module was planned and implemented in the framework of a two-year project called Getting ready funded by the Ministry of Education and Culture in Finland. The module at hand was implemented online in summer semester 2019 and it was provided by Laurea University of Applied Sciences in the metropolitan area of Finland. The target group of the project is adult immigrants pursuing higher education in Finland, it is they are Finnish as a second language (S2) learners. In order to serve the needs of this group, an understanding of the language's role in mathematics learning is of the essence.

The online mathematics module was planned and implemented in spring – summer 2019. We utilized a web-based learning platform and compiled an entity of tutorial videos, theoretical explanations and a wide range of exercises for the purposes of social services and health care. The wording was modified in taking account the S2 learners. To support the students, we also organized Skype workshops to enhance the usage of mathematical language in interaction.

According to the students' feedback and learning results, the methods of the module were quite effective and as such, they are applicable also in future implementations.

Keywords: mathematics, higher education, web-based, preparatory program, pedagogical development project, second language.

1 INTRODUCTION

As in many western countries, there are two major trends in Finland: on one hand, the requirements of labour force are rapidly changing due to technological progress. On the other hand, the ageing of the population challenges societies to make use of all potential work force. One way to tackle both these tendencies is to promote education and skills of groups that experience difficulties is entering the labour market, such as the immigrants. To highlight this, the current government has included it in Government Programme [1].

In Finland, the universities of applied sciences (UAS) are responsible for organizing training courses in higher education for immigrants, including preparatory programmes that take into account the needs of Finnish as a Second Language (S2) teaching in the higher education community. A project called *Getting Ready* started on 2017 to further develop and harmonize these trainings. The development process of the project is implemented by nine universities of applied sciences around Finland and it is funded by the Ministry of Education and Culture [2].

The training entity of higher education preparatory program planned and piloted in Getting Ready consist of 30 ects (European Credit Transfer and Accumulation System points), and it was targeted at students striving for entering studies in a university or in a university of applied sciences. In order to enable access to the training regardless of the location of the students, the training was web-based and implemented on a Moodle platform. While applying to the training, the candidates had the opportunity to choose among four different study paths: the ones for pursuing Degree Programmes of Engineering and Technology, Social Services and Healthcare, Business as well as a Multi-Disciplined one.

The study paths included six modules of five credit points each. The training commenced with a five-credit orientation that focused on study skills, digital tools and teamwork. There were three modules (15 ects) integrating preparatory studies of the field to second language studies. In addition to these

the studies of English (5 ects) and mathematics (5 ects) were specific to the field of the student's choice.

The aims of the mathematics module were described in the prospectus as follows:

The students know how to correctly interpret mathematical word problems in health care and social services. The students develop their mathematical skills and know how to use various means to alleviate calculation processes and to confirm their correct results.

The course includes unit conversions, different operations of calculations and estimations of size range. The course introduces important key concepts of mathematics in the field of health care and social services, e.g. concentration and proportionality.

By viewing the development process and analyzing the students' feedback we seek to further improve the effectivity of the module.

2 STUDYING MATHEMATICS IN A SECOND LANGUAGE

Mathematics is a language of its' own. For an adult second language learner, there are universal elements in it that can ease up the studies. On the other hand, one might need to interpret very complex sentences dense with information while solving a mathematical problem and even do it with utmost precision. In teaching, learning and testing mathematical skills language is also used in way novel to many. The terminology differs from everyday vocabulary and even familiar words can be used in a specific way, e.g. the meaning of 'cancel' is quite different when talking about digits or a dentist's appointment.

For a second language learner acquiring mathematical terminology and the manner of speaking is an integral part of learning the subject [3]. In terms of numeracy – as in many other aspects – the skills and knowledge of adult immigrant students vary on a wide scope. For some of the students learning the language might be the most prominent topic of the preparatory module of mathematics. Some other students may not have previous knowledge of all the mathematical topics, and they need to get acquainted both with the contents and the language (see [4]) and this has to be taken into account when estimating the cognitive burden of the student.

Studies have identified three linguistic aspects that may affect numeracy learning. The first and the most evident is that the students must comprehend the key terminology and concepts well enough to be able to apply them.

Secondly, it is of the essence that the students can apply the concepts in interaction with the others in order to pose questions, explain and justify their way of problem solving. In case the students lack means of formulating questions, expressing their thinking and co-operating with other learners, their development may slow down. [5] From a linguistic point of view, being able to negotiate the meaning is paramount, and this is done by rewording mathematical problems and their solutions and this way verify and focus one's own usage of the terminology. While doing this, the spotlight is not on grammatical correctness but on ensuring the meaning and the being able to adapt [3], [6].

The third aspect consists of complex variables and it is therefore the most difficult to tackle. In higher education preparatory training, level B1 (in Common European Framework of Reference) is required of the students. The level is characterized as *independent user, threshold level* and some of its' elements are described as follows

-- **I can understand the main points** of clear standard speech on familiar matters regularly encountered in work, school, leisure, etc.

I can **enter unprepared into conversation** on topics that are **familiar, of personal interest or pertinent to everyday life** (e.g. family, hobbies, work, travel and current events). -- [7]

In other words, at this level the students' linguistic skills are related to their everyday routines where understanding is based on recognizing core topics and on interaction. As being able to solve mathematical problems, on the other hand, requires detailed and precise interpretation, learning mathematics sets the learner in a contradictive position. In practise, a student that transacts with ease in a mundane context might need to take an effort in order to understand teacher's speech, to pose relevant questions and to be able to discuss the solutions of a problem. Even misunderstanding a single word may block the operations. (see [6]) There is no shortcut to prevent this. However, as the language skills advance as a whole, it is also reflected in better options of solving problems that need applied maths. To work towards this, the student benefits of teaching related to real-life situations.

According to Lemke [8] it is important to teach numeracy “as a co-equal partner with language with visual representation in the analysis of natural and social phenomena.”

3 PLANNING AND IMPLEMENTATION OF THE MODULE OF MATHEMATICS

The module targeted at future students of social services and nursing was planned in spring 2019 by a group of teachers: a healthcare professional, a mathematics teacher and a teacher of Finnish as a second language (S2). We focused on constructing the contents as meaningful as possible for the students. We selected the topics according to the interests for the both vocational branches, we scheduled online tutoring to support students prior to independent studies and modified the instructions to best serve our target group to enhance easy access to calculations and to avoid any unnecessary burdening.

The module of mathematics of the social sector and healthcare was implemented on learning platform called Vioppe. We applied a training entity previously constructed for native speaker (Finnish) Degree students that need to brush up their skills. The entity consists of video tutorials, theoretical explanations as well as diverse exercises of calculations among which the teacher can compose a selection suitable for the group of students at hand. We also paid attention to the linguistic needs of our students and rewrote some of the texts in terms of structure and vocabulary usage.

The implementation took place in June – July 2019 and we started out with ten students. First, the learning platform and resources were introduced. The online tutoring was implemented utilizing Skype meetings. During the first three weeks of the module we were able to carry out quite intense guidance and support for the participants: they had the opportunity to attend to three weekly online workshops provided by the mathematics teacher. During this period the students also had the possibility to practice mathematical words and verbal structures on the learning platform. The following two weeks there were two workshops conducted by the healthcare teacher. Finally, during the three final weeks of the module, the students were to study online both independently and in small groups.

During the first three-week period, each week's studies consisted of two themes being 1) basic operations using decimals and Roman numerals, 2) unit conversions and fractions and 3) percentage calculation and equation solving. The students also had the opportunity to get acquainted with terminology by some linguistic exercises. To alleviate students' participation in the workshops, we adapted *flipped learning* approach: the students were instructed to watch the tutorial and get orientated with the written theory of each theme before attending the workshops. This way the students had practical tools to more efficiently elaborate the themes in the workshops in regard to the subject, vocabulary and to communication. As their independent task, the students were to solve 20 theme related calculations a week. In general, the students completed more exercises that required. The students got instant feedback of these operations in the learning platform and the teachers were able to follow their advancement.

The module then moved on to applying operations to mathematical problems incorporated to authentic client cases or policies in nursing and social services. In addition to real-life resemblance, the topics were linked to the ongoing studies of the field that the students were attending. The case descriptions discussed in the workshops were equipped with some word explanations covering the most infrequent expressions. By using these elements to support the students' comprehension we aimed at facilitating the challenging task of finding out what to sort out of the case in order to solve the problem. The students had two two-hour online workshops a week and the aim of the elaboration was to analyze the case top-down, to proceed from the gist of the case towards details relevant to the problem posed. These workshops were conducted by a healthcare teacher.

In the last trimester of the module, the students had two online meetings a week scheduled for revision, sharing resources and knowledge and solving problems together. The arrangement was to consolidate the learning by interaction. The module ended with an online exam that covered all the studied themes. All the students that participated the exam managed to pass it.

4 STUDENTS' FEEDBACK

As this was a pilot of an online implementation for this target group, we wished to have our feedback as frequently, as practically and simply as possible. Therefore, we designed a weekly online enquiry that bore the title 'Mathematics and me'. We expected to gain some insight of the effectiveness of the methods, the positive experiences and the possible challenges that the students had encountered. In

addition to collecting information to serve our purposes, the idea was also to have the participants observe their own learning, as self-reflection is an integral part of higher education. We asked for the students' permission to use their responses as the data of this text. In the beginning of the module, all eight students responded. Unfortunately, we only received few feedbacks of the last weeks of the module.

The form contained one question of multiple choice and three sentences for the students to complete. The multiple-choice question concerned students' estimations of the time they had invested in studying mathematics in a week's period. The options were less than an hour, 1-2 hours, 2-4 hours, 4-6 hours and more than 6 hours. The replies mainly varied between 1-2 hours and 2-4 hours. No respondents had used more than 6 hours. Due to the small data, no specific subject could be pointed out as more challenging than the others from the point of view of time used. It seems that the workload of the course was not excessive – at least for the students that did respond.

The sentences to be completed were *This week I understood...*, *This week I was able to...* and *This week I had some difficulties in...* Most of the written feedback dealt with the positive aspects of students' knowledge and abilities. All and all, the students mainly wrote a sentence or two. Many of respondents reported having understood everything, which is consistent to the rather short time they have spent doing their exercises as well as their overall success in completing the assignments. Below some examples of students' ways of turning their learning experiences into writing during different weeks of the module (original replies written in Finnish):

This week I understood... / This week I was able to...

- 1 *Mixed numbers, fractions, cancelling and expanding*
- 2 his week I understood about unit *conversion* and *fraction*. To me the theme was of interest.
- 3 How to *change units* to into others.
- 4 Even better how to solve *equations*.
- 5 solve *percentages* although I still practice calculating *interests*.
- 6 write *proportions* about *verbal assignments*.
- 7 in my opinion, to some extent how to convert a case description into calculation
- 8 I think I understand more after I've completed a lot of exercises.

In terms of language acquisition, it is inspiring that the students have been able to adapt the mathematical terms in phrases of their own and mostly using them in a more varied way (2-5) than just listing (1). This can be interpreted as a signal of the students' progress in their ability to communicate mathematical topics. The feedback about challenging topics was scarcer.

This week I had some difficulties in...

- 9 mathematical terms in Finnish
- 10 I had none.
- 11 percentage, calculating interest and solution
- 12 to understand verbal assignments.
- 13 I was able to do almost everything but] the verbal assignments were difficult to me.
- 14 still, verbal assignments and cases and [their] conversion into calculations

The terminology (9) was only mentioned once, during the first week. Some referred difficulties coincide with the feedback of this kind of a course in general, independent of language (11). The problematics of transforming verbal assignments into calculations was found difficult (12-14) as could be anticipated for twofold reasons: on one hand, this is the kind of complexity that many of the students struggle with on a course like this. On the other hand, the hardships could be anticipated due to the language skill level of the students.

The feedback of the pilot is mostly encouraging but it raises some questions. What did we miss as many of the participants only gave their feedback in the very first weeks of the module? What could we learn from the students that have no difficulties? What kind of support would be most useful in terms of verbal assignments? In future implementations, a theme interview could give us a deeper insight of the students' points of view.

5 WAY FORWARD

Looking back, we learned a lot during this process. First, the teacher co-operation provided us with multi-disciplined pedagogical aspects in composing the module. This kind of an approach could be recommended to any subject when taught integrated to second language learning as it promotes linguistic awareness and cross-disciplinary development. Secondly, the students managed to pass the course and many of them reported being able to understand the themes of the module. The students were not too burdened by the workload in terms of time used for studying. Of this – even though we need to keep in mind the small group at hand – we might conclude that the methods of this module were quite effective for this target group. Thirdly, according to the feedback we still need to find more tools to help the students with applying mathematics to verbal assignments, as this kind of task they will frequently face in higher education.

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