Chapter 3
Building Bridges and Remediating Illiteracy: How Intergenerational Cooperation Foster Better Engineering Professionals

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3.1 Introduction

Developing logical and arithmetic skills contributes significantly to improve senior citizens' mental capacity and avoid some health conditions. Distance education (DE) or long-distance learning alludes to training who are not physically at a classroom to accommodate their lives to societal and workforce fluctuations [1].

Dyscalculia is the math equivalent to dyslexia and independent from IQ. Nowadays, it hinders math literacy deterring people from using it in their lives and keeping their brains sharp by using this type of knowledge experiencing time, measurements, and spatial perception [2, 3].

Exploratory information was obtained from meetings with stakeholders: all either individually as each person works on the environment or through the

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intercession of a tutor. The numerical information database (problem bank) about the four operations allows math training with decimal places. This database can be expanded altogether with only a guide conversing with the subjects (remotely or not), a group of learners and tutors, or learners alone.

3.1.1 Motivation

The elderly need math skills to perform everyday tasks like managing medicine dosages, doing income taxes, paying bills, time management, budget control, and preparing meals to exemplify and demonstrate the meaning and usefulness of math [4].

Technology keeps on delivering more and more gadgets to face these challenges that often eliminate mental calculations, critical thinking, and awareness of the self. However, calculations and estimations are essential for intuitive perception and critical concerns about the desired outcome. The relevance of mathematics skills for making decisions in everyday life (i.e., the propensity to recognize and solve quantitative issues in real-life situations) lacks adequate metrics and evaluation methods.

Emotions play a role in math anxiety, which is performance-based anxiety with symptoms akin to social anxiety, and it is related to situations demanding or anticipating performance [4, 5]. The mutual relationship between self-belief and math performance is essential, as well. High math confidence may favor its use. In daily life, mathematical reasoning may benefit medical and financial selections significantly but might be troubled in several ways.

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3.1.2 Distance Education

The Internet of Things (IoT) and cloud-enabled solutions arrange for the prospect to shape new, attractive smart, connected distance education (DE) frameworks, assistive learning, collaborative caregiving, and healthcare systems [4, 6].

DE can be paced (PDE) and self-paced (SPDE). The PDE format resembles traditional classroom-based paradigms in which learners initiate and finish a class on a given subject at an equal time. SPDE is presently the most common style of DE delivery. Alternatively, some establishments offer SPDE programs that permit registration at any time, and a variable course duration set according to the learner's timing, abilities, and dedication levels. SPDE is generally asynchronous, whereas PDE can be either synchronous or asynchronous. Each delivery pattern has both benefits and drawbacks for learners, instructors, and institutions.

SPDE affords autonomy for learners to commence their revisions and training at any time. Nonetheless, they can also proceed with sessions speedily, if they want. Students often enter SPDE when they experience stress to finish programs or accomplish a particular task, cannot complete an orthodox course, require extra classes, or have some other hardship, which impedes standard study for any period. The SPDE nature of the virtual classrooms, though, is an intimidating education paradigm for a plentiful of learners and can incite procrastination besides course incompletion. Although learning assessment can be a caveat as tests can happen on any day, allowing students to share test questions with subsequent loss of academic honor, this can be circumvented by having some random number generation. Ultimately, coordinating collaborative effort activities can be a hurdle. However, some schools have cooperative models relying on networked and connected SPDE pedagogics.

This manuscript comprises these parts: Section 3.2 describes the methodology, and Sects. 3.3 and 3.4 address, respectively, the discussions and conclusions of this project.

3.2 Methodology

The Dynamic System for Assemblage and Execution of Interactive Classes (SISDI) has as its primary objective to train individuals that struggle to perform mathematical calculations with decimal places. SISDI encompasses a set of choices for the learner to elect the intended content. Then, the SISDI employs this knowledge to mount and display an adequate class, and the student must choose the class development pace. The examples' varieties to be explored involve the quantity, detail level, and degree of difficulty and are pre-set by the instructor. The student solves cases interactively informing the data necessary to

(i) Feed the learning engine
(ii) Accomplish a particular task
(iii) Go either to the subsequent step or try to resignify the content

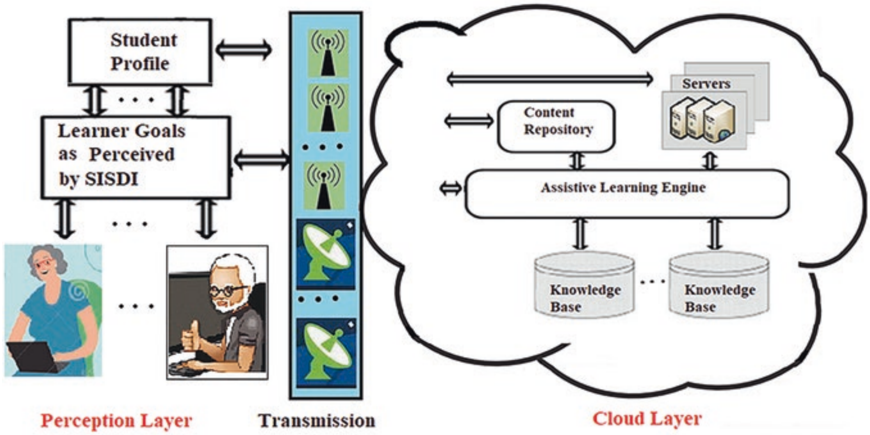

Fig. 3.1 SISDI perceived as a cyber-physical system

Figure 3.1 shows the cyber-physical system corresponding to the whole SISDI framework relying on a web-based environment comprising a content repository (CR) and the students' profile storage (SPS) [7–10]. This last module handles the information about the students, their behavior, and their goals. Each learner requires a knowledge evolution record identifying the necessary adaptation and a monitoring module providing tutors with data on the person's progression

The assistive learning engine (ALE) adapts the content displayed to the learner, the type of pedagogy, and the presentation to each student.

A typical object-oriented (OO) system has multiple layers [11–13], e.g., if the framework possesses three layers, (i) graphical user interfaces (GUIs), (ii) design of the application logic layer with domain objects, and (iii) the technical services layer, such as interfaces with database or registry error – usually independent of the application and reusable [13–15]. Creating layers breaks the complexity of software [13, 16, 17]. The SISDI analysis uses case diagrams and actors, and their associations appear in Fig. 3.2.

The use cases address the outer framework interface and specify many of the SISDI necessities to attain goals better. Figures 3.3 and 3.4 allude to the SISDI's Choose Example use case [14–17], where the user chooses an example to train. The SISDI's activity diagram demonstrates the accomplishments and changes starting from one activity to the next with the events happening in any part of the framework.

Sequence diagrams depict the flow of messages between different items, which are represented by dashed vertical lines with the name of the item on the top. The time axis is vertical at the same time expanding, so messages to be sent commence with one item and then onto the next as bolts with the activity and the names of the parameters, as the SISDI model example (Fig. 3.4). In implementing the SISDI, the case study was a division with decimal places by the fact that people find great difficulties in this type of mathematical operation. SISDI comprises several screens as follows (Figs. 3.5, 3.6, 3.7 and 3.8).

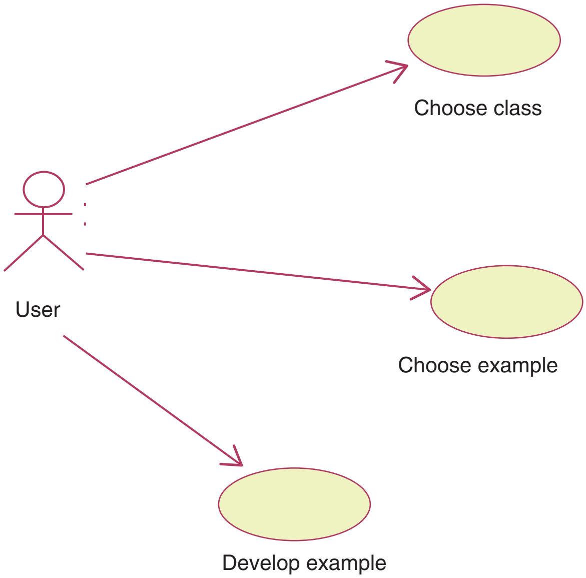

Fig. 3.2 Use case diagram

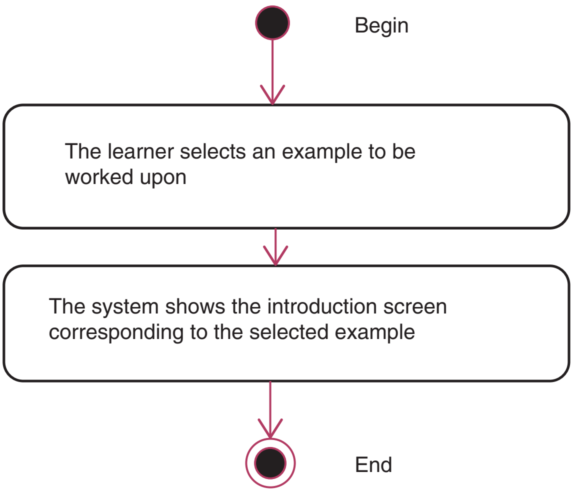

Fig. 3.3 Activity diagram: choose example

3.3 Discussion

A better semantic-based IoT engine would help to improve the system addressing these requirements:

- Interoperability among applications, even from heterogeneous domains
- IoT data interpretation
- Straightforwardness implementation and deployment of IoT applications
- Adaptivity to the different users' necessities (e.g., ensure privacy, interfaces to wearable/mobile devices)

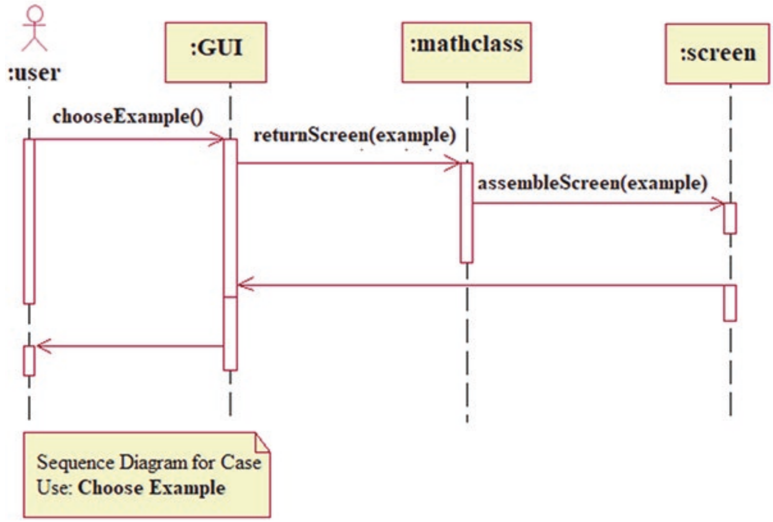

Fig. 3.4 Sequence diagram: choose example

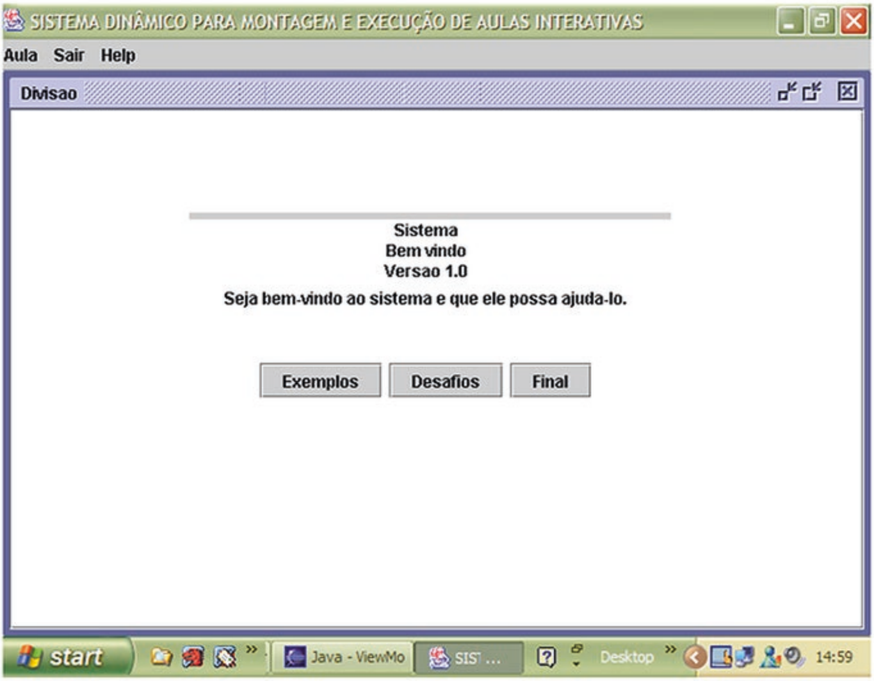

Fig. 3.5 Introduction screen: Allows the student to control the examples' difficulty degree

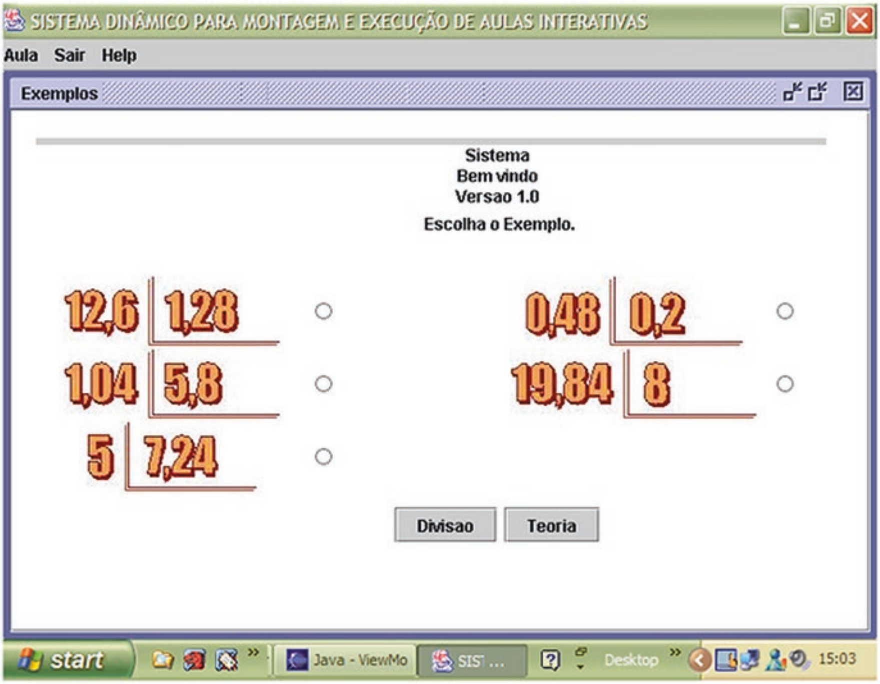

Fig. 3.6 Examples screen: permits the student to choose the example course of action

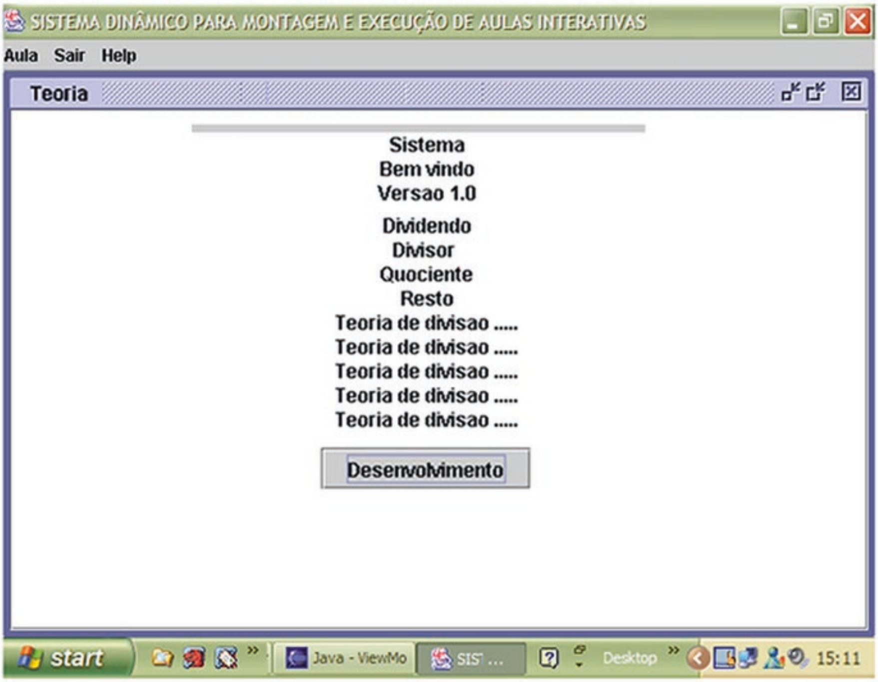

Fig. 3.7 Theory screen: allows the user to seek explanation and learn the concepts of division

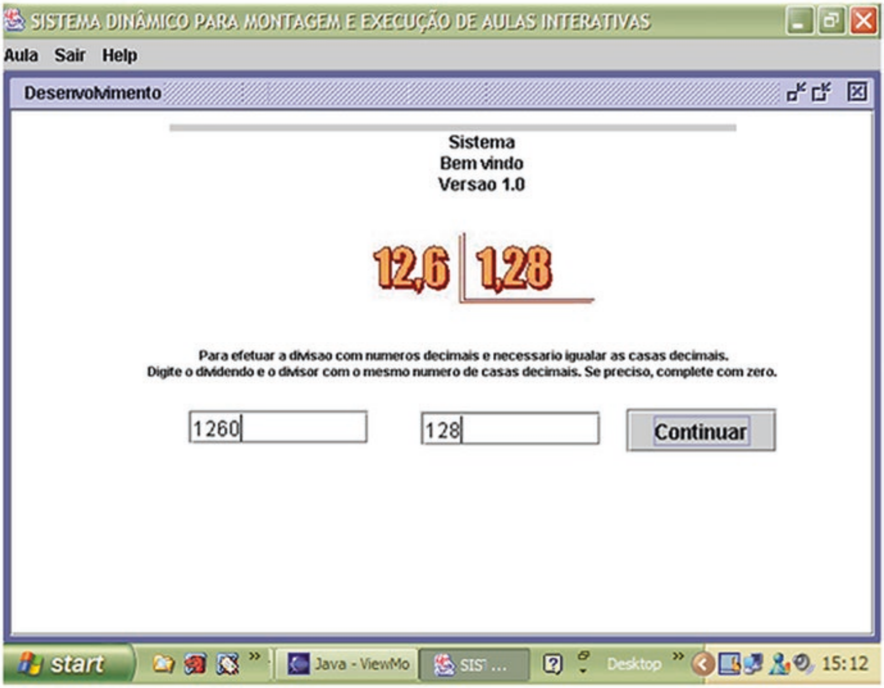

Fig. 3.8 Development screen: execution of tasks until the normal division

Replication with math anxiety questionnaires is necessary to include situations related to all respondents. Every day, math-related situations may vary from person to person. Likewise, the elderly deal with family responsibilities, medical conditions, and decisions that may use technology differently or even lack any technological help. Some examples have more common knowledge than an average real-life quantitative issue. Still, as the world changes, people will adjust their math use to technologies. For example, the amount of change in coins may decrease in the face of digital payments. Evaluation of full reliance on technology or mathematical thinking is still required.

A major challenge in the Cloud of Things (CoTs) handles the data created by too many IoT devices. Edge computing infrastructure, aka Edge of Things (EoT), solves problems by functioning as a middle layer connecting the IoT devices and cloud computing (CC). The Cognitive Internet of Things (CIoT) can deliver small-scale real-time storage and computing to guarantee low latency in addition to optimal IoT resource deployment. Still, the EoT has privacy issues, which is a noteworthy concern for systems with sensitive data. SISDI necessitates an EoT computing framework for safe and smart tutoring as well as surveillance services with fully homomorphic encryption. The SISDI framework needs scalability to aggregate and analyze the large-scale and heterogeneous data in the distributed EoT devices independently before sending them to the cloud.

All over history, anthropological cognitive systems have been changed by the introduction of technology (e.g., primitive tools, oral communication, text, and math systems). The Internet reshaped human cognition with its multifaceted features and transformed people's thoughts and behaviors profoundly [18]. The elderly sense some rejection of DE when compared to generations that grow up with Internet technologies aka digital natives (DNs). Seniors tend to show shallow Internet behaviors with fast attention shifting and lesser deliberations.

Last, improving people's cognitive reserve augments the quality of their lives, preventing the onset of dementia or other cognitive impairment in aging [19].

3.4 Conclusions

SISDI helps people to perform calculations with decimal places. The repercussions of the analyses from meetings with stakeholders' pointed towards the transmedia aspect of the mediation conveyed enhancements to the learning encounters, together with a commitment in the application space that expanded understudy energy, content use over numerous media modalities, and interest in game-based learning [5, 20–22].

The whole route ought to be further ameliorated by combining quantitative methodologies, computational intelligence, and experience obtained. Reflections about the outcomes must converge towards the upgrading of fresh class designs and to amalgamate diverse subjects like biology [23], dance [24], geography [25], health self-care [26], and so forth.

This work is malleable enough to fit in a semantic engine either on the cloud, constrained devices, or gateways.

The present framework needs to incorporate concepts related to skills, emotional, and drive factors from everyday life, which has not been reported earlier in the literature. Individuals with prominent math skills are the ones that make use of math more habitually and are also more self-reliant concerning their math abilities. For women, math anxiety relates adversely to using math in ordinary life and to math expertise. Utilizing math routinely, taking into consideration skills, affective and motivational elements may strengthen and mutually stimulate each other [4].

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