GAMES FOR LEARNING ALGORITHMIC THINKING (GLAT) PROJECT: PERCEIVED FACTORS ACCOUNTING FOR TEACHER ACCEPTANCE AND USAGE OF A NEW LEARNING SCENARIOS DESIGN TOOL – THE LEPLANNER

J.S. Quaicoe[1], M. Laanpere[1], K. Pata[1], N. Hoić-Božić[2], R. Rõbtšenkov[1]

[1]Tallinn University (ESTONIA)
[2]University of Rijeka (CROATIA)

Abstract

Training students to be critical thinkers has become essential in today's education. GLAT (Games for Learning Algorithmic Thinking) is an Erasmus funded institutional partnership project that seeks to prepare teachers with innovative teaching skills to achieve the feat of teaching coding. Teachers drawn from schools in Croatia were trained in innovative teaching and learning practices to acquire programming and critical thinking skills to facilitate the teaching of coding in schools. In this paper a descriptive overview of the perceptions of the teachers participating in the project are explored in the dimensions of a) digital self-efficacy, b) Digital/ICT Usage, c) the digital supports in their schools, the perceived usefulness and the actual use of LePlanner – a new tool introduced; and further explore how the age of the teachers could influence the perceptions they hold. The study was organized as an online survey for purposively sampled subjects who were non-ICT teachers. In all 24 teachers participated in the survey. Most teachers had an above average perception rating across all the five variables that were measured. The responses were homogeneous implying shared perceptions by teachers. However, the study discovered two cluster groupings: Cluster 1; had 16 members (66.7% of the sample); Cluster 2, had 8 members, (33.3% of the sample); the clusters did not display exclusive age groupings. Hence, age could not be argued as an influencing factor for determining how far the teachers will be successful in their new roles as programming teachers. Nonetheless, a total of 66.7% of the teachers seemed to require some form of attention in the light of their Digital/Computer Self-efficacy and school-based support perceptions towards the usage of digital tools and the acceptance of the LePlanner. GLAT is an ongoing project, therefore subsequent workshops would factor in training components that will address the concerns of the teachers.

Keywords: Games for Learning Algorithmic Thinking, GLAT, Computation thinking, Learning Scenarios design, LePlanner, Game-based Learning, Project Based Learning, Inquiry.

1 INTRODUCTION

Training students to be critical thinkers has become essential in this knowledge age. Using approaches such as design thinking, problem-based learning and project-based learning among other approaches had been ways in which learning is organised to stimulate the mental faculties of learners [1], [2]. Like every aspect of the school curriculum the teacher is a key hub around which the teaching and learning organization revolves. The teachers' challenges, strengths, needs, ICT conflicts among others should to be established, understood and the needed motivational action plans drawn to mitigate any adverse effects[3], [4]

The subject of self-efficacy, technology use and age, among other factors continue to receive attention by researchers in the various fields including health and education [5], [6]. In the school settings it is crucial for stakeholders in education to know the factors leveraging teachers' appropriation of technology; in the context of the teachers' personal dispositions[7]. This paves the way for authentic interventions and schemes to be drawn for the schools in relation to the teachers' professional roles. This line of action become more crucial in situations where the new teacher role is to be accomplished within a technology mediated learning environment and associated with teaching coding; as in the case of the GLAT Project - Games for Learning Algorithmic Thinking.

GLAT is an Erasmus funded institutional partnership project. It seeks to encourage the introduction of coding and algorithmic thinking into every day teaching and learning activities in schools. This objective in part is tied to pursuance of the European Union Digital Competence Framework – DigComp [8]. Ultimately, GLAT is intended to allay the fears of the students about coding by creating

fun-based learning patterns that equip them with algorithmic thinking skills. The protect consortium is made up five institutions, namely University of Rijeka, Tallinn University (Estonia), University of Ljubljana, South-West University “Neofit Rilski” (Bulgaria) and St. Cyril and Methodius University in Skopje. University of Rijeka, Croatia is the project management institution and center of all workshops.

To achieve the set goals for the GLAT project, teachers have been drawn from schools in Croatia to undergo a training in innovative teaching and learning practices, and coding. The teacher training scheme is organised into three separate workshops, where teachers will be taken through topics such Game-based learning approaches, developing learning scenarios, using Multimedia tools and resources, Problem-based learning, Inquiry learning, and Programming skills. So far, as at the time of conducting this study, the first out of the three scheduled workshops have been successfully carried out in Rijeka, Croatia. In this workshop, teachers had two sessions of training on designing learning scenarios – firstly as an unplugged activity, and secondly as a wired activity. With the unplugged lesson scenarios as a backdrop, teachers were then introduced to a new tool - the LePlanner. Practically, teachers would be expected to use the tool in designing learning scenarios throughout the project.

The LePlanner is an application designed at the Tallinn University. It offers the functionality of designing lesson scenarios, visualizing lesson plans, promoting co-authorship between teacher and students, creating repositories of teaching and learning materials and facilitation of learning modes (see Fig 1a). It offers an opportunity for blended lessons to be designed by designating which learning activities would be done in class and which are to be done out of the class. LePlanner offers a flexible feature where both the teaching and learning resources to be used by both the teacher and students are displayed on the timeline of the lesson plan. Fig 1a shows the digital tools and resources associated with a lesson and it is organised under two domains, I) teacher resources and ii) student resources. Interestingly, LePlanner helps teachers to manage the lesson delivery time, visualize how much students are functioning as co-creators in the teaching and learning process; all these are visualized on the timeline as shown on Fig 1a.

Fig 1a. Timeline representation of lesson scenario

Fig 1a. Timeline representation of a lesson scenario

The tool (LePlanner) is the outcome of a participatory design-research activity, which was underpinned with the intent to facilitate social networking learning spaces, sharing knowledge and archiving teaching and learning resources (see Fig 1b). In practice, empirically studies relating to this usefulness of the LePlanner is found in [9]. On Fig 1b, an extract of already published learning scenarios is displayed. LePlanner is a free and open tool and currently functional in three languages. English Language, Estonia and Croatian. All users have their designed lesson scenarios archived and other users of the platform could search and reuse the resources that are relevant to their needs.

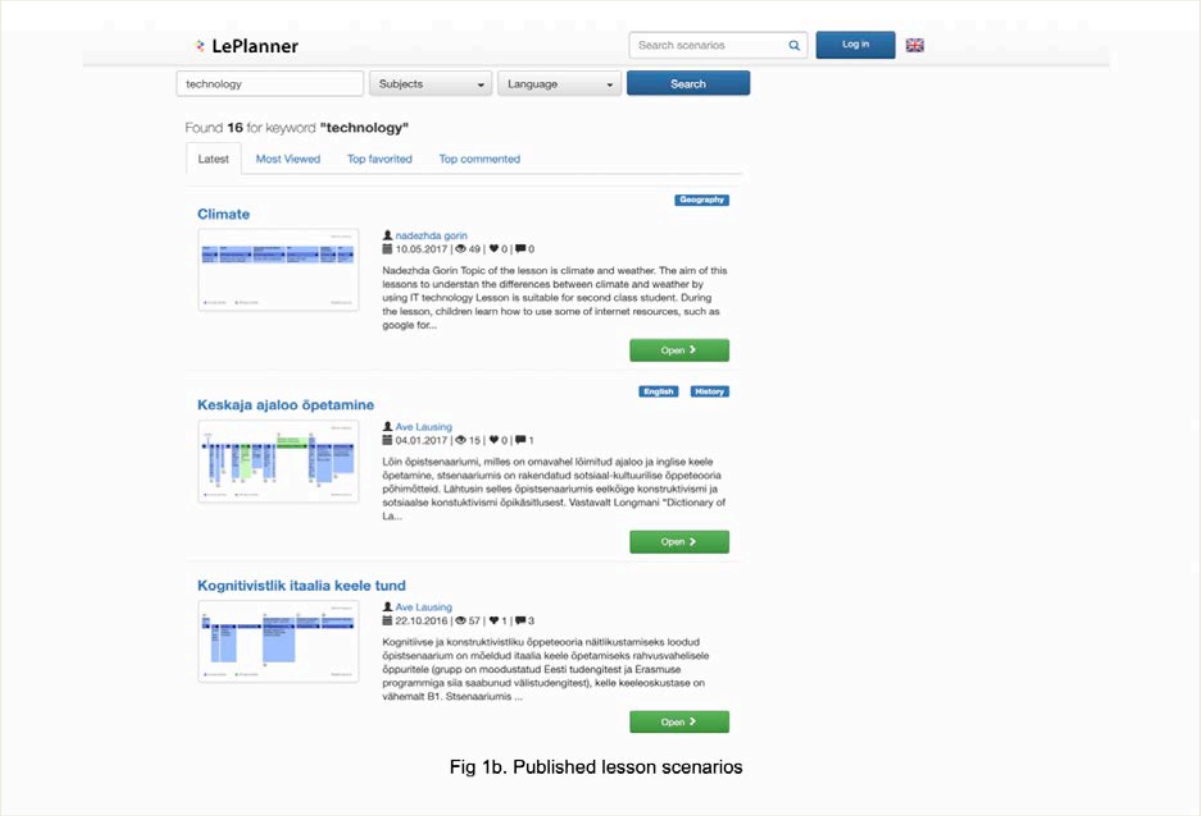


Fig 1b. Published lesson scenarios

Fig 1b. Published lesson scenarios

This paper thrived on the assumption that since the subjects of the GLAT project are non-ICT related teachers there is the possibility of taking up the new role as coding teachers might be challenging; and not only that but the pursuance of technology-driven lesson and use of design tools might be new in professional practices. The relevance of the teacher in promoting meaningful learning outcomes cannot be ignored in the quest for innovations in schools[10]. Teachers require some digital and professional competence coupled with consistent supporting structures to enable them to function as expected. The needs of the teacher would be better met only when the concerns are brought to the fore. Stakeholders on the GLAT project will not be able remedy teacher concerns unless they are known; therefore, among other studies this current research sought to elicit the possible challenges, needs and the digital endowments the teachers bring on board the project. Inputs from the teachers would enable the stakeholders in GLAT to use them to prepare the participants adequately for the new professional roles - as algorithmic thinking and coding teachers. Hence, this article gives a report on the investigations done regarding the raised concerns.

The overall objective of this paper is to report a descriptive overview about the perceptions of the teachers participating in the GLAT project on; a) digital self-efficacy, b) Digital ICT usage c) the digital supports in their schools, the perceived usefulness and the actual use of LePlanner – a new tool introduced; and further explore how the age of the teachers influence the perceptions. Ultimately, the study is to unearth the strengths and challenges of the teachers as they prepare to introduce coding in their respective schools.

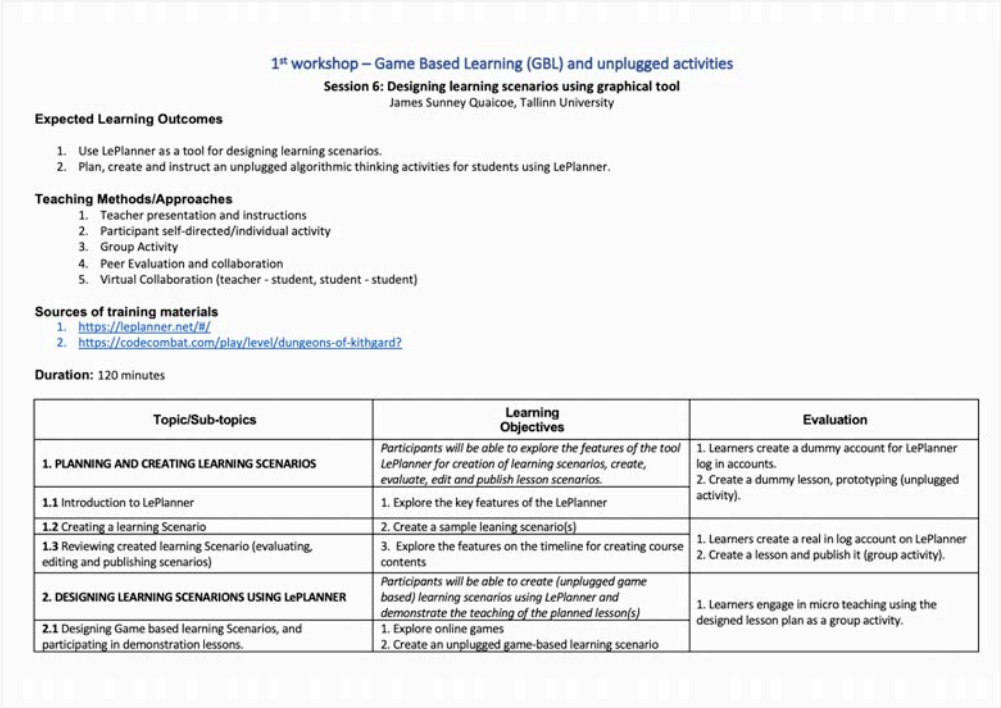
In the light of the forgone, answers were sought for the following research questions;

- **RQ 1**: What perceptions do teachers hold about their a) personal digital dispositions (self-efficacy and technology appropriation), b) digital support in schools and c) the usefulness and possible usage of new digital tool (LePlanner) which was introduced to them.
- **RQ 2:** Is age a factor influencing teachers' perceptions as indicated in **RQ1?**

2 METHODOLOGY

The study was organised as an online survey for purposively sampled subjects. These were teachers from elementary schools in Croatia, who were being trained to facilitate the teaching of coding to their children – under the curriculum theme Games for Algorithmic Thinking. In all 24 teachers participated in an online survey. It is worth mentioning that the subjects were non-ICT teachers, and they came on board the project with varied subject specialties and age groups. An online questionnaire was administered to the teachers during the first workshop meeting of the project; after they had received training on the use of the LePlanner. The instrument sought to elicit the perceptions of the teachers in the dimensions of their personal dispositions towards their capacities to use digital tools and resources and the kind of support their school would offer in this direction. In addition, the instrument gathered data on the perceptions of the teachers regarding the usefulness of the new tool (the LePlanner) that has been introduced to them; and further explore their readiness to adopt it as a professional working tool or otherwise.

As part of the whole project agenda, the research instruments were administered to the teachers after they had received two sessions of training on unplugged version of designing learning scenarios. The LePlanner was introduced as a digital tool and resource for designing learning scenarios. Fig 2 shows the syllabus designed for teacher training on the usage of the LePlanner.



1st workshop – Game Based Learning (GBL) and unplugged activities

Session 6: Designing learning scenarios using graphical tool

James Sunney Quaicoe, Tallinn University

Expected Learning Outcomes

1. Use LePlanner as a tool for designing learning scenarios.
2. Plan, create and instruct an unplugged algorithmic thinking activities for students using LePlanner.

Teaching Methods/Approaches

1. Teacher presentation and instructions
2. Participant self-directed/individual activity
3. Group Activity
4. Peer Evaluation and collaboration
5. Virtual Collaboration (teacher - student, student - student)

Sources of training materials

1. https://leplanner.net/#/
2. https://codecombat.com/play/level/dungeons-of-kithgard?

Duration: 120 minutes

Topic/Sub-topics	Learning Objectives	Evaluation
1. PLANNING AND CREATING LEARNING SCENARIOS	*Participants will be able to explore the features of the tool LePlanner for creation of learning scenarios, create, evaluate, edit and publish lesson scenarios.*	1. Learners create a dummy account for LePlanner log in accounts. 2. Create a dummy lesson, prototyping (unplugged activity).
1.1 Introduction to LePlanner	1. Explore the key features of the LePlanner	
1.2 Creating a learning Scenario	2. Create a sample leaning scenario(s)	1. Learners create a real in log account on LePlanner 2. Create a lesson and publish it (group activity).
1.3 Reviewing created learning Scenario (evaluating, editing and publishing scenarios)	3. Explore the features on the timeline for creating course contents	
2. DESIGNING LEARNING SCENARIONS USING LePLANNER	*Participants will be able to create (unplugged game based) learning scenarios using LePlanner and demonstrate the teaching of the planned lesson(s)*	1. Learners engage in micro teaching using the designed lesson plan as a group activity.
2.1 Designing Game based learning Scenarios, and participating in demonstration lessons.	1. Explore online games 2. Create an unplugged game-based learning scenario	

Fig 2. GLAT Workshop training Syllabus on designing learning scenarios using graphical tool (the LePlanner)

Various data analysis approaches were used to give meaning to the responses of the teachers. All analyses were done using the SPSS. Descriptive statistical technique was used in obtaining the perceptions of the teachers on the respective variables; with the focus being on the mean and standard deviations of the responses. Subsequently, series of cluster analysis were done to determine possible cluster groupings across the subjects. Finally, K-means cluster analysis was carried out – where k = 2. This activity offered bases to identify the differences among the teachers, and which factors could be responsible.

Finally, an individual sample t-test was conducted to compare differences in mean values across factors and the cluster groupings. This was done in order to obtain information about which factor(s) are significantly accounting for differences across the subject's under observation.

3 RESULTS

This paper sought to explore the perceptions of teachers in relation to the emerging new roles ahead of them due to the GLAT project objectives. Thus, the overall objective of this paper is to report the descriptive overview of the perceptions of the teachers participating in the project on in the context of: a) digital self-efficacy, b) Digital ICT usage c) the digital supports in their schools, the perceived usefulness and the actual use of LePlanner – a new tool introduced; and further explore how the age of the teachers could influence the perceptions. Ultimately, the study is to unearth the strengths and challenges of the teachers as they prepare to introduce coding in their respective schools. The outcomes of the study were as follows:

3.1 Descriptive overview of Teacher perceptions

An overview of the perceptions of the teacher participants during the first GLAT workshop were considered essential, because it sets to tone for appreciation of the dispositions of the teachers. Thus, in line with the objectives of this paper, RQ1 offered leads into the inquiry of the perceptions of the teachers regarding the factors associated with their new professional roles (see Table 1). On Table 1 the descriptive statistics of the teacher responses are provided.

Holistically, it is observed that most of the teachers have an above average perception ratings across all the five variables under consideration; and the distributions of the responses seems to be relatively homogeneous (standard deviations ranged from .354 to .597). This finding suggests that most of the teachers share common perceptions across the variables being measured and it could be inferred that they come on board the GLAT project with no extreme diverged professional backgrounds.

The findings however indicated that teacher could be saddled with some challenges relating to appropriation of digital tools and resources. For instance, the variables were measured on a five-continuous scale but as shown from Table 1 average maximum perception rating from the subjects was three (3) for all the five factors. The higher scales of 4 and 5 were not attained by the respondents. Meanwhile, the minimum value of scale which ranged from 1 to 2 were the starting point of the responses.

Table 1. Descriptive Statistics of Teacher perceptions

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Digital/Computer Self-efficacy	24	2.00	3.00	2.66	.387
Digital Tool Usage	24	1.00	3.00	2.28	.489
Perceived usefulness of LePlanner	24	1.75	3.00	2.48	.417
Perceived available school support	24	1.00	3.00	2.26	.597
Perceived actual usage of LePlanner	24	2.00	3.00	2.45	.354

Literal observation of the results on the table, suggest that teachers appear to have concerns about their *usage of digital tools and resources (M = 2.28, SD = .489),* and *availability of school support (M = 2.26, SD = .597).* The result shows that these variables are the ones with the least mean scores, and furthermore have the lowest minimum rating. However, further analysis will tend to offer an alternative impression. Focusing on evidences of possible acceptance and use of the Leaner the following were found; *Perceived usefulness of LePlanner* (M = 2.48, SD = .417) and Perceived *actual usage of LePlanner* (M = 2.26, SD = 2.45). The findings seem to suggest that there is a highly likelihood that teachers would use the LePlanner, they were not are not quite sure about its usefulness.

3.1.1 Age as influencing factor on teacher perceptions

This section of the article dealt with the subject of how the age of the teachers might relate to their perceptions. Preceding this quest, a cluster analysis was carried out to classify the teachers across the predicting variable items. The study discovered two main cluster groupings: Cluster 1, which denotes low rated perceptions had 16 members. This amounted to 66.7% of the sample; whereas, Cluster 2, representing the higher rated perceptions had 8 members, thus forming 33.3% of the sample.

The cluster groupings were further analysed in order to determine the age distributions across the sample. Two main teacher groupings were identified. These are teachers aged from 30 through 39 years, and the other being teachers aged 40 years and above. In practice, Cluster 1- members (age 30 – 39 years) were 7, whiles in the case of members in Cluster 2 (aged 40 years and above) were 9, totalling 16 members. In the case of Cluster 2- for the ages 30 through 39 years membership was zero (0), and for age 40 years and above the members hip were 8. From Table 2, it was observed that all the members of cluster two – constituting the higher rating group were within the age group of 40 years and above. Contrary to the initial assumption that age could influence the perceptions of teachers regarding their duties in the GLAT project, the results suggest that age is not defining the perceptions the teachers had regarding the five variables in relation to the expected new teaching roles. Rather, differences are existing based on the cluster groupings and this not depended on the ages of the teachers (see Table 2).

Table 2. Descriptive statistics about teacher perceptions based on the Cluster groupings

Cluster Number of Case	N	Minimum	Maximum	Mean	Std. Deviation
Digital/Computer Self-efficacy	16	2.00	3.00	2.5469	.41047
Digital Tool Usage	16	1.00	3.00	2.1719	.50595
Perceived usefulness of LePlanner	16	1.75	3.00	2.4427	.38278
Perceived available school support	16	1.00	3.00	2.0833	.60246
Perceived actual usage of LePlanner	16	2.00	3.00	2.3906	.34118
Valid N (listwise) Cluster 1	16				
Digital/Computer Self-efficacy	8	2.50	3.00	2.9063	.18601
Digital Tool Usage	8	2.00	3.00	2.5208	.38253
Perceived usefulness of LePlanner	8	1.80	3.00	2.5750	.49497
Perceived available school support	8	2.00	3.00	2.6250	.41547
Perceived actual usage of LePlanner	8	2.00	3.00	2.5938	.36307
Valid N (listwise) Cluster 2	8				

Table 2 shows the cluster distributions and their respective descriptive statistics. The results show that most of the lowest perception ratings indicated by the minimum point of the scale were found under Cluster 1 cases. The variables *digital tool usage*, *perceived usefulness of LePlanner*, *school support and perception on actual usage of LePlanner* were found to be below average, this is in contrast to the perceptions of Cluster 2 which has above average score across all the variables. Further analysis offered room for the extraction of the variables influencing the differences across the clusters.

Focusing on evidences of possible acceptance and use of the Leaner the following across the clusters the following unfolded: *Cluster 1: Perceived usefulness of LePlanner* (M = 2.44, SD = .382) and Perceived *actual usage of LePlanner* (M = 2.39, SD = .341). *Cluster 2: Perceived usefulness of LePlanner* (M = 2.57, SD = .494) and Perceived *actual usage of LePlanner* (M = 2.59, SD = .363 These findings seem to suggest that there is a highly likelihood that teachers in cluster 2 would accept and use the LePlanner, more than their colleagues Cluster 1. It is worth mentioning that these inferences are premature until the actual evidences of usage of the LePlanner is established in the subsequent studies. Till then it is sufficient to rely on the outcome of the current study to put in place interventions to forestall any possible professional setbacks in the course of the project.

3.1.2 Factors accounting for differences in teacher perceptions

From the write-up of section 3.1.1 of this paper, the cluster groupings (Cluster 1 and Cluster 2) of the teachers were reported. The study suggested that there is about (66.7%) teachers who would need support in order to enhance their perception ratings. To obtain further insight into the assertion made that 66.7% require attention, further analysis was conducted. An independent sample T- test was carried out using the cluster groupings as the group variable and the five variables (see Table 2) as

the predictors. Table 3 contains the relevant extract of the outcome of the analysis. The study brought to the fore some crucial concerns of the teachers that were found in the dimensions of:

- *Perceptions teacher hold about their Digital/Computer Self-efficacy*
- *The perception* about school-based support for their professional responsibilities

Table 3. Results of Independent Sample T-test

Variable	Cluster	Mean	Std. Deviation	t	df	Sig. (2-tailed)
Digital/Computer Self-efficacy	1	2.5469	.41047	-2.339	22	.029
	2	2.9063	.18601			
Perceived available school support	1	2.0833	.60246	-2.575	19.432	.018
	2	2.6250	.41547			

Based on the reported results on Table 3, the variable *Digital/Computer Self-efficacy* was found to be statistically significant across Cluster 1 (M =2.547, SD = .410) and Cluster 2 (M = 2.906, SD = .186), t(22) = -2.339, *p = .029;* while, the variable *Perceived Available Support* was found also to be significantly different across Cluster 1 (M=2.083, SD =.410) and Cluster 2 (M = 2.625, SD = .415), t (19) = -2.575, *p* = .018. Interestingly, the results as shown on Table 3 do not completely differ from inferences made from the Table 1 results, which suggested that teachers appear to have concerns about their *usage of digital tools and resources (M = 2.28, SD = .489),* and *availability of school support (M = 2.26, SD = .597).* The difference however, is in the highlight that is placed on the variable *Digital/Computer Self-efficacy.* In this light, the study suggests that the following three factors a) *Digital/Computer Self-efficacy,* b) *usage of digital tools and resources and* c) *availability of school support* which appear to be associated with the professional needs of the teachers should be given the require emphasis during the subsequent project training sessions. It is expected that such a professional boost will impact on teacher acceptance and usage of the LePlanner for lesson scenario designs.

4 CONCLUSIONS

Games for Learning Algorithmic Thinking – GLAT is an Erasmus funded project with a five-member institutional consortium - University of Rijeka (Croatia), Tallinn University (Estonia), University of Ljubljana (Slovenia), South-West University “Neofit Rilski” (Bulgaria) and St. Cyril and Methodius University in Skopje (Republic of North Macedonia). The GLAT project is intended to allay the fears of students about studying coding and engaging in computational and algorithmic activities. This is be attained by training teachers to teach and facilitate fun-based learning that equips them with algorithmic thinking skills for their professional practice. Croatia was the hosting nation of the project; with Rijeka University as the project management center.

In this paper attempt is made to explore the entrant perceptions of the teachers on the GLAT project in the context of a) digital self-efficacy, b) Digital ICT usage c) the digital supports in their schools, the perceived usefulness and the actual use of LePlanner – a new tool introduced; and further explore how the age of the teachers might influence their perceptions. This study was based on the assumptions that as non-ICT teachers, the 24 Croatian teachers participating might encounter some professional challenges as result of their age and usage of digital tools and resources – with a particular emphasis on the use of the LePlanner to prepare and teach coding in schools.

The result of study brings to the fore very important issues for discussion. Firstly, in this study teacher self-evaluations were used to establish the digital statuses of the teachers across five variables. In the works of [11] this approach is essential in opening doors to offer the project facilitators to understand the teachers’ needs in order to evolve the appropriate support. Complementing this point [12] was on the view that providing resources and tools is not enough to promote technology usage in schools, rather teachers need to be supported. Basically, this is the essence of this current paper in relation to the GLAT project. Thus, in this paper the digital statuses of the teachers are explored in order to offer leverage to remedy any professional digital shortcomings or shortfalls. Fortunately, the results do

suggest extreme professional digital challenges among the teachers. Literally, this is a good start for the project because the teachers come on board with similar digital capacities and competences.

Secondly, this paper argues that age is not a factor influencing the extent to which the teachers will take up their new professional roles. This finding is supported by various empirical studies [13]–[15]. Initial empirical studies had sustained the notion of the impact of age on technology usage, however later studies tend to refute is notion. Practically, the results of this current study suggest that the age of the teachers is not a significant factor in determining the digital perceptions they hold. The implication of the findings on the GLAT project is that facilitators need not worry about setting varying remedial training scheme based on ages, instead supporting teachers based on specific professional needs and competence as demanded by the project.

Finally, teacher acceptance of the LePlanner as a professional tool was explored with the variables Perceived usefulness of LePlanner and Perceived actual usage of LePlanner. It is worth mentioning that those variables measured the perceptions of the teachers so it could bae argues as to how perceptions will inform the extent of acceptance of the LePlanner. Nonetheless, because teachers have had some training on the usage of the LePlanner their perceptions based on the initial interactions with tool is relevant. In light on the overall findings this current study, it could be inferred that there is an immense likelihood that teachers would use the LePlanner as a professional tool, though they may not be quite sure about its usefulness – this position should be seen as normal since they yet to use the LePlanner extensively. In sum, it is recommended that based on the cluster groupings of the teachers, the respective digital professional gaps identified would need some attention. So far, the study suggests that *Digital/Computer Self-efficacy* and *Perceived available school support* should be critically looked at in the course of the training. By way of planning for future studies, the actual acceptance and usage of the LePlanner needs to be explored.

ACKNOWLEDGEMENTS

Games for Learning Algorithmic Thinking

Co-funded by the Erasmus+ Programme of the European Union

TALLINN UNIVERSITY

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