E-SUPPORTING PERFORMANCE STYLES BASED ON LEARNING ANALYTICS FOR DEVELOPMENT OF TEACHING PRACTICES IN TEACHING SCIENCE

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ABSTRACT

This study aims to identify the effectiveness of delivering electronic supporting performance styles that are based on learning analytics for the development of teaching practices in teaching science, moreover, the Electronic and face to face supporting performance styles will deliver according to the data analytics that extracted from observations, (participating rate- page views) data from platform, therefore, to determine the effectiveness, the researchers design observation rubric based on teaching practices standard that extract from (ASTE/NSTA, AITSL) to observe teaching practices of student science teachers. Regarding the participants they were science students who enrolled in educational diplomas, researchers use the mixed method in collected data and quantitative data, furthermore, they will study a supportive program of considering data analyses to develop their teaching practices in teaching science, the results exposed that providing a supporting program that considers learning analytics, helps increase teaching practices in teaching science for student's science teachers.

KEYWORDS

E-supporting styles, Learning analytics, teaching practices.

1. INTRODUCTION

With regard to the obstacles of e-training environments, it is difficult for the instructor to follow the learners during their learning in the electronic environment, and to overcome this, learning analytics have appeared, which are collected and analyzed data in the electronic learning environment during learning process , and in light of the analytics of this data, the rules and regulation of learning are designed, and the learners were tracked , further, during improve the learning environment through learning analytics, the performance of learners can be improved also, by providing the help they need because they are to develop their performance and skills, moreover, we can also analyze the advantages of the personal learning environment, where the trainees can have effective educational experiences (Dietz-Uhler & Hurn 2013)

In addition, there are other ways work with data analytics to improve e-learning environment and facilitate learning, that is delivering Support performance styles which considered one of the instructional variables that learners need in the e-training environment, and face to face, the goal of providing supporting performance is to help and mentor learners during learning until they were able to learn individually(Kert & Kurt, 2012).

Furthermore, Supporting performance was depended on specific factors, such as time of support immediately or delayed, and how to provide support in (videos-pictures-diagrams), even if the

support was a technical support belong to platforms such as navigations, or content cantered support related to the content (Askar, 2018).

In addition, student science teachers are the most important part of the learning process, so developing teaching practices for teachers leads to student academic performance and personalities. (Gibbs & Coffey, 2004).

Moreover, developing teaching practices is linked to the procedures for applying theoretical issues and to improving pre-service teachers before they go to school, therefore the development of teaching practices is essential to teachers and it reflects on students too.(Taş & Karabay, 2016).

In terms of, this study, authors tried to identify and achieve the effectiveness of delivering electronic supporting performance styles based on learning analyses for teaching practices

The structure of paper includes the following sections: literature review, methodology, results and discussion, conclusions, recommendations and directions for future research, and references.

1.1. Study Purpose:

Authors sought to identify the effectiveness of design E-supporting performance styles based on learning analyses for developing instructional practices in teaching science, and we are guided by the following research questions:

1.2. Study Questions:

How we can design the E-supporting styles?

How we can use the data from learning analytics in supporting performance?

What is the effectiveness of using E-supporting styles based on learning analytics for development of teaching practices for pre-service teachers?

1.3. Study Significance and Expected Outcomes

The study is important in terms of the following:

This study aims to deliver E-supporting performance styles based on learning analytics.

This study may inform science educators and researchers may use the findings of this research to inform their practice and as a springboard for additional research into the influence of designing E-supporting styles for development of in-service science teachers.

2. LITERATURE REVIEW:

2.1. Supporting Performance Styles:

Considering, performance supporting based on the social constructivism theory by Vygotsky, and Vygotsky stresses that social interactions are essential for development learning process and learner's performance, and the importance of the role of the teacher and learners in teaching each other, in addition, the social constructivism theory assumes that firstly learner will build his own

cognition, after that he needs supporting and assistant to complete his/her building cognitive construction process (Verenikina, 2010).

Regarding the definition of Electronic performance support, it refers to an Internet-based system that aims to provide support and guidance to learners in order to improve their performance and skills, and provide personal control for the learner in the learning environment (Kert & Kurt, 2012).

Moreover, Askar (2018) Define E-performance support as a suitable and easy-to-use education aid design for e-learning, whether this educational aid is for educational content or non-educational aid to create planned changes in learning and performance.

McManus and Rossett (2006) State that e-support performance is a set of tools that support learner performance and interaction by providing information and resources during learning and guidance.

In this study we can refer to e-support performance as types of support and guidance tools that provide to diploma students such as: Support related to scientific content, navigation support, that will help students achieve their tasks.

2.1.1. Principles of Supporting Performance Styles

There are mainly three core principles for a successful supporting performance, firstly: assessing performance before any kind of support, secondly: There are differences in supporting, it might be when student demand or without student demand, thirdly: provide support for bunch of students or individually or it could be among students (Schaik, Pearson, & Barker, 2002).

Barker, et al (2007) Describe a set of principles as follows: Use a specific style of supporting performance, it could be in shape of text, videos, images, further, offer a synchronous support, and avoid delaying supporting, moreover, providing content support not just a technical support related to using the platform, design the supporting styles whatever, were text, videos, images, charts in a simple way far from complex and easy to use, and when present procedures of any task it must be step by step.

As noted above, we can show that there is a critical principle we will follow and that principles are: assessing student performance before providing support, analyzing students ' performance before providing any support,

Describe ways to provide support (text-videos diagrams), identify the most important situations students need support first, offer individual or group support, design support in a simple design.

2.2. Learning Analytics:

Learning analytics refers to the process of collecting, analyzing, measuring, and preparing a data report related to student's interactions through e-learning environment and this report leads to understanding the learning process and improving it.(Bronnimann, West, Huijser, & Heath, 2018; Sahin & Yurdugül, 2017).

In addition, (Clow, 2013; Marzouk et al., 2016) refer to learning analytics as reports and visualizations aim to identify and summarize the learning activity during learning process in e-learning.

The literature consent that learning analytics are collecting, measuring, and analyzing data and performance of learners, after that prepare reports related to learner's performance in order to improve learner's performance and the educational process.

In the context of this study, learning analytics is defined as collecting and analyzing data belonging to student's learning performances, also this data will be inside or outside the electronic training environment in order to provide support suitable for their needs.

2.2.1. Types of Learning Analytics:

Wise, Zhao, and Hausknecht (2014) Divided learning analyses into two categories: Blended learning analyses occurs in e-learning and in real classrooms to track student learning interactions, through this data we can guide and support learners, Secondly, External learning analytics: include the learner's data for instance: direct learner's interactions with their teachers or with each other, and with this data we can create personalized learning environments, and create social relations between students and teachers

In this study we will depend on blended learning analysis whereby analyze learners' performance during learning process (face-to-face), and in e- training environment, because the supportive content will be presented in face-to-face sessions that include discussions and applications on practices and the other part will be through an e- training environment.

2.2.2. Types of Data:

(Dietz-Uhler & Hurn, 2013; Gregg, Wilson, & Parrish, 2018) State that there are two types of data, Qualitative data: extracted by the interactions between teacher and learners directly, such as: (the number and type of questions that learners ask in discussion groups - personal interviews - learners ’past experiences - their personal experiences - the number of electronic messages that are sent to the teacher via e-mail), Quantitative data that can collect and analyze during the interaction of learners with the electronic learning environment such as: (exam degrees - final grades - the number of times the content is available through the electronic system - the date and time of the visit - the number of discussions on specific publications - the number of discussions and publications are read - The type of resources that are displayed through the environment - success rates - assignments).

This classification will be used to suit the educational content and general diploma students (online) Science Division, and it will be data on the electronic training environment, namely: entry rates on the electronic training environment, learning resources used by learners, the number of visits to additional sources, comments on publications, as for the tools of the class environment, will be the tasks, interactions with the teacher and with each other, and these tools were used for their clarity, easy for analysis and extracting results from them.

2.3. Teaching Practices:

There are many institutions that have identified teaching practices, and include them in the teaching development standards for teacher preparation, as the AITSL(Australian institution standards for teachers and leadership) standards create set of standards for teaching practices, and divided into 3 main domains (Hill, etal;2018)

A-The first domain is: the professional knowledge of teachers and it includes two indicators, the first is for the teacher to know his students, and the appropriate way for their learning, the second defines the educational content and methods of teaching.

B- The second domain, is teaching practices: includes three main indicators, the first is that teacher can plan and implement teaching effectively, the second: providing support and a safe learning environment to students, the third: evaluating students, delivering relevant feedback, and writing reports about students behavior.

C- The third domain: teaching inclusion: it includes two indicators: the first teacher can engage into a teaching educational environment, and the second is engaged with colleagues, parents, and the whole society.

Furthermore, the ASTE (Association for Science Teacher Education) and NSTA (National Science Teacher Association) where they prepared a list of criteria for teacher science preparation, and consisted of six main criteria (Morrell, etal;2020):

A-The first standard: knowledge of the scientific content it describes an effective science teacher as who can understand and clarify contemporary information and practices in science and engineering and links the key ideas with common concepts and scientific and engineering practices.

B - The second standard: Knowing the nature of science, it describes the effective science teacher: Who can plan the learning process and for the units of study, spread equality and acceptance values among all students, and understands the nature of students' learning as the development of their scientific content, their skills and their own habits of mind.

C-Standard 3: Knowledge of learning environments, which includes planning to engage all students while learning science, building a socially equitable learning environment, and clarifying learning goals whose knowledge is later.

D-Standard 4: Safe, in which the science teacher clarifies classroom or laboratory chemical, physical and biological safety rules, also clarifies ethical aspects when using living organisms and chemicals.

E- Fifth Standard: The impact of learning on students, where the science teacher can give evidence of student learning, and applying the main ideas, common concepts, scientific and engineering practices.

F - The Sixth Standard: Professional Knowledge and Skills. The science teacher can constantly strive for professional development, whether in his knowledge of the content or his teaching methods and engage all students as part of the science learning community.

In this study we exclude our teaching practices list from those standards and modify regarding to the natural of students, the aim of the study, and Egyptian context, so we classify the teaching practices in three main aspects:

A - Planning an appropriate learning environment for all students, and it is defined as a set of procedures that begin to write learning goals based on the scientific content and identify learning resources and classroom activities.

B- Designing and establishing an effective learning environment for students, intended to focus on developing, supporting, engaging students in social and responsibility relationships between students during the learning process.

C-Assessment of student learning, defined as the process of observing and analyzing student performance through formal evaluation as test scores or informal as teacher self-reflections

3. METHODOLOGY

This research used a mixed-methods design, which is a procedure for collecting, analyzing, and "mixing" both quantitative and qualitative data during research to understand a research problem more completely(Creswell, 2002).

This mixed-methods design allowed the researcher to capture both quantitative data and rich qualitative descriptions that would not have otherwise been available by using one approach. Moreover, when used in combination, quantitative and qualitative methods complement each other and provide a more complete picture of the research problem (Creswell & Clark, 2017; Greene, Caracelli, & Graham, 1989).

The participates were a student's science teachers who enrolled in educational diploma (16) they received the supporting styles based on learning analytics that excluded from platform, observation.

3.1. Data Collection Instruments:

This study used observations rubric: that excluded from (ASTE/NSTA, AITSL) standards, and it contains 57 items describe the essential teaching practices for science teachers.

Data analytics from Canvas platform: it's provided by Canvas platform.

3.2. Data Collection Procedures:

Firstly we design the instruments and publish the content of the program and start the experiment with the experimental group during two weeks we observe their learning and participations on the platform and the most page they viewed and conduct a discussion session to discuss with them the advantages and obstacles they faced during their learning , after that we modify the content and the instruments according to data analysis.

Then we continue the rest of the program until we finished the number of the sessions were 14 session each session was 1 hour and half and it was face to face in first three sessions and just uploading their activities on line via platform, and the rest of the sessions were online via platform , zoom meeting cloud, WhatsApp group. As they recommended so, we adapt our instruments according to students needs and point of weakness that need to support.

After finishing the sessions, we applied the observation rubric again to determine the differences between the pre and post applying.

3.3. Data Analytics:

We applied the instruments and enrolled students' teachers in platform in terms of have a learning analytics, to make decision about the aspects of modifying and editing the content and structure of the instruments and platform.

Table 1. about the aspects of modifying and editing the content and structure of the instruments and platform.

Aspects of application	**Before the data analytics**	**after the data analytics (the final edition)**
Observation rubric	Consists of 57 items describe 3 major scales contain 14 subscales, and 57 performance indicators	Consists of 48 items describe 3 major scales contain 12 subscales, and 41 performance indicators, also we remove one subscale because the participants didn't need any support in it, also 16 indicators for the same reason.
Program content	Consist of 3 main topics divided into 14 topic and it is arranged by order as the list of teaching practices for science teachers, (Planning a suitable learning environment for all students and it is contain (writing learning objectives – understand the scientific content-plan for classroom activity-plan for using the educational aids-plan for teaching strategies-time management- writing lesson plan)), Designing and establishing an effective learning environment for students which contain 6 subtopics (arranging interactions and probing questions- link learning process with students' interests and experiences-guidance students' learning and modify teaching methods according to it- enhance the social relationships and responsibilities- establish safety learning environment), Assessment of student learning include one subskill (applying different ways of students' assessment)	It was the same in some aspects , it consist of 3 major topics divided into 13 sub topics, the sub topic that entitle writing lesson plan was removed cause they have experience in it , also some items in writing learning objectives , further second major topic entitled Designing and establishing an effective learning environment for students specifically in arranging interactive and probing questions, the part of probing questions was also deleted cause they studied before and don't need support in it, moreover in subtopic enhance the social relationships and responsibilities among students , some of the items were removed for the same reasons. In terms of priority, we change the order of presenting topics according to students' teachers need support in, so we start with understand scientific content- writing learning objectives-plan for teaching strategies- time management- plan for classroom activity-plan for using the educational aids).
Canvas platform	Before data analytics we deliver the content and all tools that available on canvas such as (discussions, collaboration, syllabus-assignments-announcement-files-people-rubrics-conferences)	We deactivate some tools cause students' teachers don't want to use or feel disruption so instead of using discussion on canvas we do it by zoon cloud meeting, and WhatsApp group, the assessment sessions, cause they feel not comfortable to use quiz tool on canvas.

The previous table exposed that the changes of structure of the observation rubric, and the Canvas platform, and how the learning analytics contributed in modifying those aspects.

Moreover, there are aspects that we tried to improve in content, such as adding more videos, more discussions to exchange ideas and opinions, and have a group reflection, rearrange topics according to the priority of students' needs.

Also, disable some tools that will be an obstacle for students to learn better, after each discussion and reflective session, we have something to improve whether, in the content or performance or platform.

In terms of deficiencies, we found that there are tools to consider an obstacle to students (collaboration, conferences, discussion), and we discover that by trying these tools with students and asking them about their needs and how they found using the tool, in fact most of their responses conclude that there are no value to them and it was too slowly and didn't fit them.

4. RESULTS AND DISCUSSIONS:

The section presents findings after quantitative data analysis. Moreover, it begins with the descriptive statistics of learning analytics, then the pre/post experiment, Finally, a discussion of the results is reviewed.

4.1. Data Analytics Statistics:

4.1.1. Data Analytics that Excluded from Canvas Platform:

Table 2. illustrate the proportions of page views and participations in analysis period for two weeks.

participation	Page views	Date
65	8.338	2/10–2/16
247	15.675	2/17–2/23

The table above shows the rate of participation and page views for two weeks of data analytics, it exposes that the proportion increase gradually, and it is indicated that the participant feels comfortable in learning via platform.

4.1.2. Data Analytics that Excluded from Observation Rubric

Table 3. descriptive statistics of observation rubric:

teaching practices	Total degree	Min of performance	max	min	mean	St-deviation	percentage
Planning a suitable learning environment for all students	84	28	50	42	44.06	2.08	52.45%
Designing and establishing an effective learning environment for students	72	24	44	42	43.38	0.80	60.25%
Assessment of student learning	15	5	5	5	5	0	100%
overall	171	57	97	90	92.44	1.89	54%

The table shows that the mean degree of responding about Assessment of student learning was (5) and it doesn't even reach the minimum performance, it indicates that they need to support in this aspect deeply, after that, Planning a suitable learning environment for all students became the next aspect that need to support the percentage manifest that 52.45% of teaching practices can apply in their classrooms, then Designing and establishing an effective learning environment for students came lastly in order of practices that need to improve in classrooms. According to Data we pointed above, we removed some performance indications from those practices that didn't need to be supported as mentioned previously.

4.2. Data Analysis Quantities Statistics:

In this section we examine the hypothesis of the study, authors use (Mann- Whitney-U) equation to identify the difference between the pre/post applying observation rubric after study a supportive program based on learning analytics.

Table 4. the differences between the mean of students' science teachers' grads in applying pre/post observation rubric.

teaching practices	**Experimental group**	**total**	**mean**	**St-deviation**	**Z value**	**sig**
Planning a suitable learning environment for all students	pre	63	42.68	8.46	3.36	Sig 0.01
	post	63	57.75	4.78		
Designing and establishing an effective learning environment for students	pre	45	27.06	8.74	3.41	Sig 0.01
	post	45	42.87	2.02		
Assessment of student learning	pre	15	12.00	2.50	2.36	Sig 0.05
	post	15	14.00	1.31		
overall	pre	123	88.56	19.89	3.31	Sig 0.01
	post	123	114.62	7.62		

Table exposes that there is a significant difference between the pre and post observation rubric for the post applying and z value that in table bigger the calculated value, so it is significant on 0.01 level for all aspects except Assessment of student learning aspect, the significant was on 0.05 level, and in the observation rubric overall.

Table 5. the rate of page views and participations after modifying platform, and content topics during learning process.

participation	**Page views**	**date**
885	16.556	2/24–3/1
1.704	30.481	3/2–3/8
519	28.222	3/9–3/15
5.519	127.111	3/16–3/22
556	16.111	3/23–3/29
1.222	29.778	3/30–4/5
704	26.667	4/6–4/12
666	14.185	4/13–4/19
774	17.667	4/20–4/26
519	17.778	4/27–5/3
667	19.407	5/4–5/10
337	15.185	5/11–5/17

The table above shows the rate of participation and page views during learning via platform, it indicate that there are a gradually increasing in the rate of participation and views until the week from 4/6-4/12 the proportion start to decline in terms of using zoom cloud meetings in all discussions and meetings and the participation prefer it , so the platform was just for up-loaded assignments and view the content and videos.

5. CONCLUSIONS

In terms of data analysis, literature review, and findings, we conclude that deliver supporting performance styles (in groups- immediately -briefly- simple) that based on learning analytics , further, how the learning analytics are a vital part in making-decision, and what are aspects that need support specifically, moreover, learning analytics are a beneficial in designing platform and use certain tools, also it gives us a predictable achievement if we consider it in establishing and designing any course, eventually using supporting performance styles in the light of learning analytics contributed in developing teaching practices in teaching science.

6. RECOMMENDATIONS AND DIRECTIONS FOR FUTURE RESEARCH:

In terms of the results and findings, we recommend using the results and build-up on to spread the idea of supporting performance during learning process and how it changed the entire environment in which became more social, personal, and more interaction with the content, instructor, and among students' teachers.

Moreover, future studies should investigate about: 1) further studies on how to design and support under-graduated students' performance, 2) research about enhancing different aspects instead of teaching practices, 3) use specific theory in designing shapes of supporting and determine the effectiveness of this combination, 4) how can human center design approach effect on delivering supporting.

REFERENCES

[1] Askar, A. (2018). Mobile Electronic Performance Support System as a Learning and Performance Solution: A Qualitative Study Examining Usage, Performance, and Attitudes. Turkish Online Journal of Educational Technology-TOJET, 17(2), 76-88.

[2] Bronnimann, J., West, D., Huijser, H., & Heath, D. (2018). Applying learning analytics to the scholarship of teaching and learning. Innovative Higher Education, 43(5), 353-367.

[3] Clow, D. (2013). An overview of learning analytics. Teaching in Higher Education, 18(6), 683-695.

[4] Creswell, J. W. (2002). Educational research: Planning, conducting, and evaluating quantitative (pp. 146-166). Upper Saddle River, NJ: Prentice Hall.

[5] Creswell, J. W., & Clark, V. L. P. (2017). Designing and conducting mixed methods research. Sage publications.

[6] Dietz-Uhler, B., & Hurn, J. E. (2013). Using learning analytics to predict (and improve) student success: A faculty perspective. Journal of interactive online learning, 12(1), 17-26.

[7] Gibbs, G., & Coffey, M. (2004). The impact of training of university teachers on their teaching skills, their approach to teaching and the approach to learning of their students. Active learning in higher education, 5(1), 87-100.

[8] Greene, J. C., Caracelli, V. J., & Graham, W. F. (1989). Toward a conceptual framework for mixed-method evaluation designs. Educational evaluation and policy analysis, 11(3), 255-274.

[9] Gregg, A., Wilson, B. G., & Parrish, P. (2018). Do No Harm: A Balanced Approach to Vendor Relationships, Learning Analytics, and Higher Education. IDEA Paper# 72. IDEA Center, Inc.

[10] Hill, E., Keane, T., & Seemann, K. (2018). Pedagogies and practices for developing innovation capability: Beyond the AITSL standards. Fostering design-led innovation capabilities.

[11] Kert, S. B., & Kurt, A. A. (2012). The effect of electronic performance support systems on self-regulated learning skills. Interactive Learning Environments, 20(6), 485-500.

[12] Marzouk, Z., Rakovic, M., Liaqat, A., Vytasek, J., Samadi, D., Stewart-Alonso, J., ... & Nesbit, J. C. (2016). What if learning analytics were based on learning science?. Australasian Journal of Educational Technology, 32(6).

[13] McManus, P., & Rossett, A. (2006). Performance support tools. Performance Improvement, 45(2), 8.

[14] Morrell, P. D., Park Rogers, M. A., Pyle, E. J., Roehrig, G., & Veal, W. R. (2020). Preparing Teachers of Science for 2020 and Beyond: Highlighting Changes to the NSTA/ASTE Standards for Science Teacher Preparation.

[15] Sahin, M., & Yurdugül, H. (2017). The Framework of Intervention Engine Based on Learning Analytics. International Association for Development of the Information Society.

[16] Schaik, P. V., Pearson, R., & Barker, P. (2002). Designing electronic performance support systems to facilitate learning. Innovations in Education and Teaching International, 39(4), 289-306.

[17] Taş, M. A., & Karabay, A. (2016). Developing Teaching Skills through the School Practicum in Turkey: A Metasynthesis Study. Journal of Education and Training Studies, 4(11), 87-99.

[18] Verenikina, I. (2010). Vygotsky in twenty-first-century research. Paper presented at the EdMedia: World Conference on Educational Media and Technology.

[19] Wise, A., Zhao, Y., & Hausknecht, S. (2014). Learning analytics for online discussions: Embedded and extracted approaches. Journal of Learning Analytics, 1(2), 48-71.

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