How Instructional Feedback Has Been Employed in Instructional Units for Teaching Software Project Management Tools

A Systematic Literature Review

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Abstract— **The software industry has a growing demand for project managers which has leveraged the efforts to improve the teaching of project management competencies in higher education computer courses. Part of these efforts has been concentrated on improving instructional feedback when teaching these competencies. Instructional feedback is essential in order to help the students to learn based on an evaluation of their actions and decisions. However, so far there is few information available on how to provide this instructional feedback when teaching software project management. Therefore, we performed a systematic literature review that aims at providing an overview on existing feedback strategies, specifically when teaching the use of project management tools, such as MS Project or dotProject. As result we identified 8 relevant studies. Their results are systematically presented and a discussion is carried out, identifying the most adopted feedback strategies, how they were implemented, as well as their effects on student learning. These results may be useful for software engineering instructors to decide on the adoption some of the strategies as well as for instructional designers that may employ some of these feedback strategies when developing new instructional units.**

Keywords-Project Management; PMBOK; PM tool; Instructional feedback;Instructional Unit; SLR.

I. INTRODUCTION

Software Project Management (PM) is emerging as a critical Software Engineering area for many software organizations. Many projects still fail due to a lack of proper management, leading to deadline or budget overrun, or the lack of scope coverage [1]. Therefore an essential requirement is to establish systematic PM using knowledge, abilities, tools and techniques that enable a project to reach its goals [1, 2, 3]. The adoption of a PM process may be aided by the usage of a PM tool [4]. A PM tool (e.g. MS Project or dotProject) is a software that either supports the whole PM process or any part of it. Typical functionalities include: schedule development, cost planning, risk analysis, etc. [9]. And, although, small software organizations often do not employ any PM tool, their potential benefits have increased the interest in their usage [5]. A possible cause for the shortfall of a broad adoption may be the lack of PM competencies of current project managers and team members as they are often allocated without sufficient training [1, 4, 6].

However, PM knowledge and skills are an important competency of Software Engineering (SE) professionals [8], requiring the teaching of PM tools amongst the competencies defined in the ACM/IEEE reference curriculum for computer science [7]. In this context, few Instructional Units (IUs) aiming at the teaching of PM tools in higher education computer courses have been presented [10, 11]. An IU is a set of classes and instructional materials designed to teach certain learning objectives to a specific target audience [12]. Despite the progress, there are still gaps in this area, such as a limited content coverage and lack of students' motivation [13]. In this context, an important approach to improve students learning is the instructional feedback, which provides a response to student actions, indicating how they may improve it in order to achieve the IU's learning goals [14].

Aiming at the identification on how instructional feedback has been employed for teaching of PM tools, this study presents a Systematic Literature Review (SLR) [15], identifying existing IUs and analyzing and discussing their variations and benefits.

II. BACKGROUND

A. Project Management

PM directs project activities and its resources in order to meet the project requirements. It is organized in 5 process groups, from initiation to closure (Fig. 1) based on the PMBOK [2], as the main reference widely accepted worldwide [4].
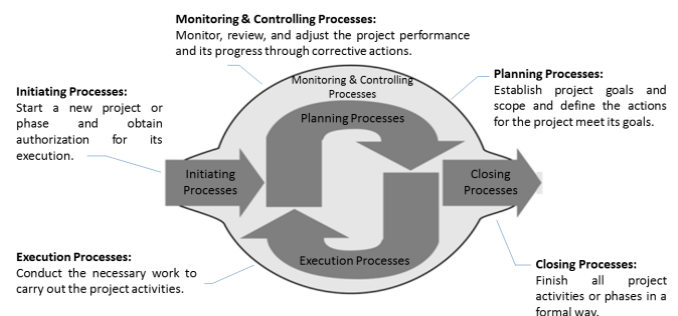

Figure 1. PM processes groups [2].

Orthogonally to the processes groups, PM processes are organized in 10 knowledge areas (TABLE **I**).

TABLE I. PM knowledge areas [2].

Knowledge area	Processes to:
Integration	Identify and coordinate PM processes and PM activities.
Scope	Ensure the project addresses the entire work to meet its requirements.
Time	Plan and control the activities that will be carried out during the project, so it concludes within the deadline.
Cost	Plan, estimate, and control project costs, so it concludes within the approved budget.
Quality	Define the goals and quality policies, so the project meets the needs that have initiated it.
HR	Organize and manage the project team.
Communication	Ensure the generation, collection and distribution of project information.
Risk	Identify and control the project risks.
Acquisition	Buy or contract products, services or any resources that are not available as project internal resources.
Stakeholder	Identify and manage the stakeholders and its expectations.

The application of a PM process is aided by the usage of PM tools, which take advantage from technology. Currently, many PM tools have been developed, such as MS-Project (microsoft.com/project), GanttProject (ganttproject.biz), dotProject (dotproject.net), Project.net (project.net), etc. [16]. The support provided by these tools may semi-automatize a few activities of the PM process such as registering and sequencing project activities, providing online forms to record their duration estimates or resource allocations, as well as generating a Gantt chart [5]. Some PM process activities may even be totally automated by PM tools, for instance, the calculation of the project total cost, the identification of the critical path or over-allocated resources [4, 10].

B. Teaching of Project Management

Knowing how to use PM tools is an important competency for project manager and SE professionals [2, 7, 8]. This includes the competency on how to use PM tools in order to develop a project schedule, to perform risk analysis, to monitor the project performance, etc. Often the teaching of PM tools also covers the following techniques [2, 6, 11]:

- **Critical Path Method (CPM):** to identify project activities that cannot be delayed without affecting the deadline;
- **Program Evaluation and Review Technique (PERT):** to calculate the estimated effort to carry out an activity based on three estimates (worst case, most common case, and best case);
- **Earned Value Analysis (EVA):** to measure project performance and progress in an objective manner;
- **Resources Leveling:** to adjust start and finish dates based on resource constraints, with the goal of balancing resource demand and availability.

Several approaches already have been developed to assist in the teaching of these competencies, such as educational PM tools. It may provide exercises (scenarios) that propitiate the carrying out of these PM techniques, the configuration of difficulty levels, and the adoption of instructional feedback, which may assist students during PM tools usage [6, 10, 11].

C. Instructional Feedback

Instructional feedback aims at assisting and stimulating students to reflect about their responses, providing information to direct the student way of thinking and acting, thus promoting their learning [17].

There are different ways to promote feedback depending on the adopted instructional strategy [18]. A feedback may be verifying (informing if the student response is correct or incorrect) or elaborating (providing information to assist in the improvement of student response) [19]. Feedback may focus on different aspects of student response correctness, as it may be positive (highlight the students correct responses), negative (highlight the students mistakes) or constructive (not only informing if a certain response is wrong or incomplete, but also providing means for the student to improve it) [20].

Feedback may also have different goals. Formative feedback aims at instructing students during some activity, assisting in the response improvement before its delivery. On the other hand, summative feedback is given at the end of an activity, and is normally used for evaluation/assignments [21].

Feedback also may be classified according to the moment of its delivery to the student. Basically it can be immediate, when delivered just after some student response, or delayed, when provided some time after the conclusion of some activity [22]. Yet, the moment of delivering feedback is quite related to the adopted channel for its delivery, which may vary from computer-based, orally or written by the instructor. Especially in computer-based environments, immediate (automated) feedback has been an interesting alternative. On the other hand, when done manually by the instructor, generally delayed feedback is more suitable [23].

III. DEFINITION OF THE SYSTEMATIC LITERATURE REVIEW

Aiming at the identification of studies that have employed some instructional feedback strategy for teaching PM tools, we conducted a Systematic Literature Review (SLR). A SLR aims at the identification, analysis and interpretation of existing studies and that are relevant to the research question [15]. We followed the process defined by [15], organized in 4 phases:

1. **SLR Definition:** defining the research goal, the research questions, data sources, keywords, and inclusion/exclusion criteria for studies selection.
2. **SLR Execution:** based on defined keywords, queries are executed in each data source, and the relevant results are selected.
3. **Data extraction and synthesis:** data is extracted from each relevant study, aiming at the collection of data that support the answering of the research questions.
4. **Analysis and discussion:** the research questions are answered based on the analysis of the collected data, and the results are discussed achieving the research goal.

A. Research Question

With the objective to identify and characterize existing IUs for teaching PM tools that adopt some instructional feedback strategy to improve student learning, the following research questions are defined:

- **RQ1.** What are the existing IUs to teach PM tools, employing some instructional feedback strategy?
- **RQ2.** What are their instructional feedbacks?
- **RQ3.** What software tools are adopted to assist the delivery of feedback?

- **RQ4.** How the effectiveness of the feedback strategy has been evaluated?

B. Inclusion/Exclusion Criteria

We focused on articles published between January 2006 and January 2016 (a 10 years range), written in English language and published in journals or conference proceedings, assuring a peer review process. Studies not related to teaching PM tools were excluded, such as studies focused on teaching programming, agile methodologies, like XP and SCRUM, or exclusively focusing on PM theory or certifications. Due to our focus on the software domain, we also excluded any studies not related to computing.

C. Data Sources and Keywords

For our search we chose prominent data sources based on their relevance for SE and their availability via Portal CAPES – a web library provided by the Brazilian government, giving access to relevant international scientific production. Thus, the selected data sources are: IEEEXplore (ieeexplore.ieee.org), ACM Digital Library (dl.acm.org), ScienceDirect (sciencedirect.com), Wiley online library (onlinelibrary.wiley.com), SpringerLink (springerlink.com), and Scopus (scopus.com).

For the identification of relevant studies the following keywords and synonyms were defined based on the main concepts of the research goal (TABLE **II**).

TABLE II. Search keywords.

Concept	Keyword and synonymous
Feedback	*Feedback, formative evaluation, formative assessment.*
Education	*Education, teaching, learning,*
Project Management	*Project management, PMBOK.*
Tool	*Tool, system, software.*

IV. EXECUTION OF THE SLR

The defined SLR was carried out in January 2016 by the authors, and the results from each data source are presented in TABLE III.

TABLE III. Number of retrieval results per data source.

Data source	Number of retrieval results
ACM Digital Library	18
IEEEXplore	39
ScienceDirect	3
Scopus	26
SpringerLink	178
Wiley online library	15
Total	**279**

These initial retrieval results were analyzed by their title and abstract and potentially relevant results were selected with respect to the defined inclusion/exclusion criteria. These results were analyzed in detail based on their full text, and again based on the inclusion/exclusion criteria. Many retrieval results were excluded because they do not focus on teaching PM tools but programming, agile methods, among others. Other results were excluded as they dealt with an evaluation of the UI interpreting the term "feedback" as the students' opinion about some teaching strategy, and, thus, not related to the employment of some feedback strategy by an IU. Some studies rather focused on the employment of feedback techniques by project managers when managing the team members. Another significant amount of studies was excluded as they were not related to the computing area. As a result, we identified 8 relevant studies as presented in TABLE IV.

TABLE IV. Selected studies.

ID	Reference
S1	D. Rodriguez et al. E-Learning in Project Management Using Simulation Models: A Case Study Based on the Replication of an Experiment. IEEE Transactions on Education, vol. 49, n. 4, pp. 451-463, 2006.
S2	Y. Tachikawa et al. A method for evaluating project management competency acquired from role-play training. In: Proc. of IEEE Global Engineering Education Conference, Berlin/Germany, 2013.
S3	R. Vivian et al. The Development of a Dashboard Tool for Visualising Online Teamwork Discussions. In: Proc. of 37th IEEE International Conference on Software Engineering (ICSE), Florence/Italy, 2015.
S4	L. Xiao et al. Promoting Reflective Thinking in Collaborative Learning Activities. In: Proc. of 8th Int. Conf. on Advanced Learning Technologies, Cantabria/Spain, 2008.
S5	A. Chua, and R. Balkunje. An Exploratory Study of Game-based M-learning for Software Project Management Journal of Universal Computer Science, vol. 18, n. 14, pp. 1933-1949, 2012.
S6	G. Dixon. Service learning and integrated, collaborative project management. Project Management Journal, vol. 42, n. 1, pp. 42-58, 2011.
S7	G. Gregoriou, K. Kirytopoulos, and C.Kiriklidis. Project Management Educational Software (ProMES). Computer Applications in Engineering Education, vol. 21, n. 1, pp. 46–59, 2010.
S8	U. Ojiako et al. The criticality of transferable skills development and virtual learning environments used in the teaching of project management. Project Management Journal, vol. 42, n. 4, pp. 76-86, 2011.

V. DATA EXTRACTION AND SYNTHESIS

In alignment with the defined research questions we extracted the relevant information from the selected studies. With respect to the first research question we identified their learning goals and instructional activities, than characterizing the IUs (TABLE V).

TABLE V. Characterization of Instructional Units (RQ1).

Study	Learning goal After the IU classes the students are able to:	Instructional activities
S1	Understand the trade-off between time, cost, scope, and its effects during the management of a project.	Students use a PM tool simulator to input information related to the project plan. Then, they run several simulation rounds and are presented with the effects of their planning to the project performance.
S2	Interpret the project performance indicators and take proper decisions based on these data.	Students use a PM tool simulator that presents information related to the project EVA. Then, the simulator includes a chatter bot that play the role of different stakeholders, such as team member, client, and sponsor, to whom the student has to provide the proper information based on the EVA information.
S3	Understand how to use a PM tool to register the project documents and use communication channels to communicate with other stakeholders.	Students organized in groups have to develop a software project and use a PM tool to register its documentation. The teamwork interactions (leadership, communication, feedback seeker, feedback provider) is automatically analyzed, resulting in an immediate feedback about the teamwork communication, based on a graphic dashboard.
S4	Understand how to use a PM tool to register the rationales about the PM decisions they have to take during the project planning and execution.	Students organized in groups have to develop a software project, planning it in a collaborative PM tool. Then, during its planning and execution, the rationales about all decision-making should be documented in this tool. The explanations provided by a student may be improved by others, leading to a collaborative feedback among students.
S5	Understand how to use a PM tool to evaluate the CPM and perform resource levelling technique.	Students use a PM tool simulator to run several simulation rounds and, between each round, students have to take decisions based on analysis of the CPM, Gantt chart, and resource leveling.
S6	Understand the whole PM process and apply the	Students have to carry out real software project derived from a university community service program. Organized in

	concepts in a practical software project.	groups they work as a project team and must plan and execute the project, receiving constant feedback from teachers.
S7	Understand how to apply CPM, PERT and RACI matrix techniques in a PM tool.	Students have to carry out exercises using a PM tool, which are related to CPM, PERT and RACI matrix techniques. The tool automatically evaluates student interactions and provides an automated feedback.
S8	Understand how to use a PM tool to define project scope, develop its schedule and HRs allocation.	Students use a PM tool simulator to deal with 5 different scenarios, each one containing some problem related to scope, time or HR knowledge areas. The IU also includes some exercise to be performed directly using MS-Project.

Once we identified the IUs, the adopted feedback strategies are characterized (TABLE VI). The information we extracted includes the feedback goal, its approach, the correctness evaluation, the moment and its delivery channel.

TABLE VI. Characterization of feedback strategies (RQ2).

Study	Goal	Approach	Correctness evaluation	Moment	Delivered Channel
S1	Formative	Elaborated	Constructive	Immediate	Computer-based
S2	Formative	Elaborated	Constructive	Delayed and Immediate	Computer-based and written by teacher
S3	Summative	Elaborated	Positive and negative	Immediate	Computer-based
S4	Formative	Verified	Constructive	Delayed	Computer-based and by other students
S5	Formative and summative	Elaborated	Constructive	Immediate and Delayed	Computer-based
S6	Formative and summative	Elaborated	Constructive	Delayed	Personally by teacher (orally and written)
S7	Formative	Verified	Negative	Immediate	Computer-based
S8	Summative	Verified	Positive and Negative	Immediate	Computer-based

Most of the identified IUs adopt some software tool for providing the instructional feedback. Therefore, we also have extracted data to characterize these tools (TABLE **VII**), including its main functionalities, educational features, etc.

TABLE VII. Characterization of educational software tools adopted to assist with feedback delivery (RQ3).

Study	Educational tool	Main PM functionalities	Educational features	Availability	Screen example
S1	Project simulator	Plan scope size, schedule, and HR allocation.	Runs simulations based on a project plan and students may analyze the simulations results to re-plan the project, aiming at conclude it successfully. The activities carried out in the tool are scenario driven, propitiating the application of PM techniques.	Not available	
S2	ProMASTER	Monitor a project using EVA.	Presents different stakeholders behavior by its chatterbot. And during the activities, it presents hints about calculation of EVA indicators.	Not available	Not presented
S3	PIAZZA	Manage communication by a document repository (wiki) and forums.	Although not being an educational tool, it has been adopted for educational proposes. Students use it to register project documentation, using wiki and forum structures. Later, this data is automatically extracted and analyzed, providing feedback to students.	Proprietary	
S4	Workspace	Register project communication.	Provides a shared whiteboard for students to register their decision rationales. Each rationale is discussed with other students that provide feedback to enhance the rationale ideas.	Not available	
S5	MAPLE	CPM, Gantt Chart, PERT, HR leveling.	Presents student performance based on remaining time and budget in the simulated software project. Periodically (each quarter of project duration) provides feedback to students. It also presents a glossary with the activity related vocabulary.	Not available	
S6	Does not adopt any software tool for feedback delivering.				
S7	ProMES	CPM, PERT, and RACI matrix.	Provides scenarios (exercises) for the application of PM techniques. Feedback is based on student interaction with the PM tool, indicating when they wrongly perform its functionalities, or take decisions which may lead to undesired results.	Open-source	
S8	HBSP	Plan scope size, schedule, and HR allocation.	Runs simulations based on a project plan, providing a dashboard for project performance tracking. Students may analyze this dashboard and re-plan the project aiming at conclude it successfully. The dashboard is a graphical representation of feedback related to students' performance.	Proprietary	

In order to aid the decision on the adoption of such feedback strategy, we also analyze the question on their impacts on the students' learning and, therefore, extracting data on how they were evaluated. This data is presented in TABLE **VIII**, describing the adopted evaluation method, how the data were collected, what were the analysis results. Among the evaluation methods are: *ad-hoc* (informally analyzing students reaction); case study (explicitly defining the evaluation and collecting data without a control group); and experiment (explicitly defining the evaluation and collecting data with a control group adopting another IU) [24]. Nonetheless, the evaluated dimensions (i.e. what was analyzed) were identified, including students learning and motivation, or their perception about instructional strategy effectiveness.

TABLE VIII. Data related to the feedback strategies evaluation RQ4.

Study	Evaluation goal	Evaluation method	Sample size	Data collection instrument	Evaluated dimensions	Evaluation results
S1	Evaluate students have learned with the assistance of the e-learning tool, with support for PM simulation and immediate feedback delivery.	Experiment	11	Pre-test and post-test: containing questions related to planning of software project.	• Learning • Motivation	The students using the e-learning tool with the incorporated PM simulation model gained a better understanding about typical behavior patterns of software development projects.
S2	Evaluate student learning through the execution of role playing training.	Case study	27	The messages students have exchanged with the charter bot.	• Learning • Strategy • Materials	Student learning was evaluated according to a defined rubric. Feedback was perceived to make an important contribution on students learning.
S3	Evaluate student communication in a software project, through the analysis of documentation shared in a PM tool.	Case Study	26	The exchanged messages on the PM tool.	• Learning • Motivation	The immediate feedback provided through the dashboard allows the students to spend less time analyzing the teamwork and more time exploring

						teamwork activity and team progression.
S4	Evaluate the students' capability to document their rationales using the communication channels of a PM tool.	Ad-hoc	30	Questionnaire (*Likert* scale)	• Learning • Strategy • Motivation	The results show the students identified that the process of generating and sharing their rationales helped the group members to clarify their ideas, exploring the basic concepts of PM.
S5	Evaluate if the students have learned and got motivated when using MAPPLE tool.	Case Study	55	Questionnaire (closed and open-ended questions)	• Learning • Motivation • Strategy	The feedback features provided by MAPPLE has contributed to student learning and the gaming aspects have contributed for student's motivation.
S6	Evaluate the impact of student participation in a real software project in their PM learning.	Case Study	-	Questionnaire (*Likert* scale)	• Learning • Strategy	The students highlighted the feedback assisted them to be constantly engaged in the whole PM process during the project they were involved.
S7	Evaluate if students learned about the application of CPM PERT and RACI matrix techniques in PM tools.	Ad-hoc	20	Observation, Students testimony.	• Learning • Motivation • Strategy	Students found the feedback very helpful. They stated the fact it indicated the problems of each solution, instead of revealing it, giving to them the opportunity to find the right answer.
S8	Evaluate student perception about their learning when carrying out the simulation exercises.	Case study	113	Questionnaire *Likert* scale	• Learning • Motivation	Students considered the simulation a low-risk way for obtaining experience at managing projects. The formative feedback served to improve their learning.

VI. ANALYSIS AND DISCUSSION

In this section we analyze each research question in order to achieve the research goal defined.

RQ1. What are the existing IUs to teach PM tools, employing some instructional feedback strategy?

In general the learning goals of the IUs are related to the teaching of techniques related to scope, time, communication, and HRs knowledge areas (S1, S5, S7, S8), including CPM, PERT, EVA, etc. It is important to highlight that some IUs (S2, S3, S4) are centered on the communication knowledge area, providing communication channels among students, who may assume different stakeholder roles in a software project. All identified studies reported that they adopt an experiential learning instructional strategy, so students learn about PM tools using it, either by developing a software project (S3, S4, S6), or by simulating its execution (S1, S2, S5, S7, S8).

RQ2. What are their instructional feedbacks?

The instructional feedback is a response message to some student action. When analyzing how it is employed in the identified IUs, we observed that both the elaborating and verifying approaches have been adopted. It is evident that the elaborated feedback is more adopted, with few studies employing verified feedback, normally highlighting the errors in student responses (S4, S7, S8). In relation to correctness evaluation, constructive feedback is the most employed, with few studies employing the negative feedback, just highlighting students' errors, without indicating how to make improvements (S3, S7). Most studies provide immediate feedback, delivered by a software tool. In two studies delayed feedback was delivered by a teacher after the students finished some activity (S2, S6), or by the educational tool at specific milestones reached by students (S4, S5). Hence, we can observe that formative feedback is the most adopted, presenting explanations about the content, or pointing out the errors in student responses, before the conclusion of the activities. On the other hand, summative feedback was used to evaluate the students' performance at the end of activities, but normally without assigning marks (S3, S5, S8), just presenting project performance indicators such as the remaining budget, time or scope.

RQ3. What software tools are adopted to assist the delivery of feedback?

Most IUs have adopted some software tool for feedback delivery. These tools usually presented feedback in form of text boxes (for explanations) or graphical panels (for performance tracking). Here, we can also differentiate 2 main types of tools:

a) **PM tool simulators** (S1, S5, S7, S8): in which students may plan an project and simulate its execution, having the opportunity to re-plan the project after each execution round;

b) **Collaborative PM tools** (S2, S3, S4): in which students are organized in groups documenting their decisions, providing feedback to each other and in this way building the knowledge together.

Only S7 does not present the adoption of any educational tool for feedback delivery, providing it directly by the teacher. The main particularity of this study are the real software projects the students have to manage, due to a cooperation between the educational institution and software industry, which may have reduced the need for an educational tool.

RQ4. How the effectiveness of the feedback strategy has been evaluated?

In general the evaluations aimed at analyzing the effectveness of instructional feedback in students learning. Moreover, many studies also analysed the students motivation and their perception about the instructional strategy. In relation to the evaluation method, most studies adopted the case study approach, where after have participated from the IU, the students were invited to answer a questionnaire, generally based on Likert scale items (S4, S6, S8).

Only study S1 performed an experiment, using the experiment group the proposed e-learning tool, and the control group the classic COCOMO model [25]. The students learning and motivation were evaluated, based on pre-test and post-test analysis. As a result, the students from the experimental group demonstrated a better learning than the control group, and were more motivated, presenting greater interest in the IU subject.

Thus, in general, we observed that although encountering some studies, there is still a lack of more comprehensive support of instructional feedback via an education PM tool.

As it seems that instructional feedback is welcome by the students and perceived by them to improve their learning, it certainly is an aspect worth to be explored more in order to make the learning process more effective. When being

automated as part of an educational tool it further more has the potential to reduce the instructor's effort. However, despite many advances already been implemented in this respect, there are still several improvement opportunities, especially in relation to content coverage, as most educational PM tools do not cover the whole PM process, including all processes groups and knowledge areas.

A. Threats to Validity

A common threat in any SLR is the bias inherent to scientific publications, due to the fact that most studies rather report successes, than failures. This threat may have hampered the identification of ways to evaluate the feedback effectiveness.

During the SLR search the main threat is to not find relevant studies. We tried to minimize this threat by including several data sources and the use of synonyms for all search keywords.

With respect to the selection of the studies, a principal threat is related to the influence of the researchers' personal opinion. We, therefore, explicitly defined inclusion/exclusion criteria beforehand. Furthermore the selection has been done by both authors in cooperation. This threat may impact data extraction, as some information is not explicit described in the articles, and had to be inferred by authors.

VII. CONCLUSION

This paper presents and overview on feedback strategies in IUs for teaching PM tools. As results of the systematic literature review, after analyzing more the 250 retrieval results, 8 relevant studies have been encountered. As a result, we observed that in general, instructional feedback is immediate and formative, providing the students hints or concept explanations to assist their understanding about the theory related to the instructional activities. Some studies demonstrated the usage of summative feedback, being graphically displayed at the end of activities. Based on their evaluations the studies also indicate that instructional feedback is perceived as an important tool to improve student learning and motivation. And, although there seem to exist only few research on this topic, future studies may take advantage of reported feedback strategies in the development of other IUs for teaching PM tools, thus improving the quality of the teaching of this important competency for SE professionals.

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