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# Evaluation Model of Student Competencies for Discussion Forums: An Application in a Post-Graduate Course in Production Engineering*

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This study aims to propose a competency assessment model for students in online discussion forums, using the Rubrics scoring tool and the Bloom's Taxonomy to define evaluation feedback. First, the competencies to be evaluated in on-line discussion forums for theoretical courses in engineering courses were identified, then, the curricular guidelines of the engineering courses and the competencies identified in the literature by the research authors were considered. A questionnaire was developed with experts to evaluate the proposed model, comparing it with other models of skills assessment already used by them. The proposed model was evaluated by the specialists, with the average scale of more than 4 points for all items. All items were better evaluated when compared to models commonly used by the experts. The overall general index of instrument validity is 90%. It used as a pre-test of the model in two classes of a discipline of a postgraduate course in production engineering of a university of the interior of the state of São Paulo. Three lecturers evaluated the forums of the referred classes according to the proposed model to verify the reliability of the same. The reliability of each item of the proposed model was greater than 82%. The research contributes to the engineering education literature as it provides a new way of assessing competencies in discussion forums.

**Keywords:** competency evaluation; rubrics; Bloom's taxonomy; discussion forums

## 1. Introduction

In the twenty-first century, student-centered learning and the development of its competencies are valued as well as to produce of flexible, adaptable, persistent, curious and responsible professionals [1, 2]. Thus, the creation of evaluation methods that adequately determine the development of these competences becomes necessary [3]. Rubrics has become an important resource for assessing skills and guiding students in their learning processes [4]. Rubrics is a scoring tool used to evaluate performance in a given situation, based on a list of criteria describing the characteristics analyzed at different levels of achievement [5, 6]. The need to establish clear and explicit assessment standards for students and educators led to the use of Rubrics for competence assessment in several university studies [4, 7, 8].

The Rubrics can improve teaching, provide feedback to students, contribute to a consistent assessment and can be an important source of information for improving the teaching and learning program [6]. In addition to assisting educators in the correction of the activity, standardizing the evaluation criteria, it also helps the students to identify how their activity will be evaluated, specifies the level of performance expected for the various levels of quality, which students recognize if they have successfully achieved the expected objectives in their own activities before delivering them.

Distance Education can offer opportunities to increase the quality of teaching and learning, such as collaborative learning through online discussion forums and the use of learning objects; the reach of education and the reduction of its cost to the student [9]. Online discussion forums are a form of computer-mediated communication increasingly integrated into educational environments, with the aim of broadening learning activities beyond traditional classroom time [10].

Research indicates that participation in discussion forums can improve knowledge sharing among students [11, 12], critical thinking [13–18], active thinking and interaction [19, 20], problem solving [21, 22], knowledge building [14, 23] and collaborative learning [24, 25]. In order to generate high-level learning in an interactive environment, online discussion forums should provide building and sharing knowledge in a collaborative way, resulting in integration, synthesis and evaluation of the topics discussed [14]. Bloom's Taxonomy can help in this learning because it is structured in six levels of increasing complexity, in which the student acquires a new knowledge as it rises in level and for this must master the knowledge acquired in the previous level.



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Thus, the student who reaches the last level will be able to remember, understand, apply, analyze and evaluate the topics discussed.

Bloom's Taxonomy is a hierarchical organization of global educational objectives, which allows guiding the construction of competences, since it creates conditions for the pedagogical team to organize learning, equating content and pedagogical strategy, according to the objectives outlined for the attainment of the competences envisioned [26]. The Bloom's Taxonomy of the cognitive domain has been used to improve pedagogy in various science, technology, engineering, and mathematics disciplines, while helping to improve assessment methods in these disciplines [27].

Current works on competency assessment, Bloom's Taxonomy and Rubrics indicate research opportunities that involve:

- Evaluation of the impact of different student performance assessment strategies [28];
- Application of the Bloom's Taxonomy in different disciplines and courses [15, 29];
- Use of the Bloom's Taxonomy in collaborative activities [30];
- Verification of dependence between messages marked at different levels of the Bloom's Taxonomy [30];
- Validity and reliability of Rubrics in various educational contexts [31];
- Relationship of students' participation and involvement with results obtained [20].

Based on previous research [15, 29–31], the objective of this work is to propose a model of student competence evaluation in discussion forums using Rubrics as grading tool and Bloom's Taxonomy of Cognitive Domain to define the evaluation feedback.

## 2. Literature review

The competitive market requires people with knowledge and proactivity, the ability to take initiative, analyze problems and make decisions. Therefore, teaching and learning models need to be flexible and comprehensive, aiming at the formation of a qualified, versatile professional with continuous improvement potential.

In the current educational context, the teacher should be responsible for guiding and coordinating the process of building student knowledge, supported by technologies and is no longer the center of the educational process or the only holder of knowledge. The apprentice is one who must discover and transform knowledge. The cognitive process is the link between the teacher and the learner, which occurs with the transmission of information through various media and methodologies, and each person learns differently, and develops their own strategies to facilitate their learning process.

In Brazil, Law 9,394 of December 20, 1996 (Law on the Guidelines and Bases of National Education) supports teaching for the development of skills and abilities and brings with it the challenge of bringing skills and abilities acquired at school together with those necessary in the world of work and society in general.

It is observed in the literature the lack of a single, clear and consensual definition of competence, and in several official documents there is an overlap between the terms competences and abilities which are considered similar, leading to uncertainty as to the relative identification of each one [32]. Knowledge is built through relationships with the environment [33]. The development of competencies is related to the ability to apply coherent and critically acquired knowledge [34].

Skill is the element of competence that demonstrates what the subject knows and can learn and is related to the productive application of knowledge. It can be constructed, through practice, as well as undergo changes according to the sociocultural and cognitive context of the subject. Yet for the authors, it is the attitudes that determine how individuals position themselves in relation to others and to events, and it is their function to evaluate feelings, behaviours and choices [33]. For this work the definition used is that competence is a set of knowledge, skills and attitudes that, when integrated and used strategically, allows a person to successfully achieve the expected results [35].

In order to verify whether a given competence has been acquired, it is necessary to evaluate. Evaluating competence is a difficult process as it is necessary to fulfil the criteria of validity, reliability, specificity and sensitivity [36, 37]. Competency assessment helps to structure a more objective view of the potential of each student, looking to evaluate learning, to overcome weaknesses, to strengthen and develop potentials for change [38].

Table 1 summarized relevant papers about competency evaluation, which include rubric used in the exact sciences [39] and health sciences [7, 8, 40, 41].

A rubric is a scoring tool that sets specific expectations for a particular activity. It divides an activity into its component parts by providing a detailed description of what constitutes acceptable performance levels for each of those parts [5].

Rubrics can be of the holistic or analytical types, the choice for one or the other depends on their purpose [47]. In the holistic rubric, the evaluator makes an overall assessment of the quality of student performance, while in the analytical

**Table 1.** Studies on competence assessment

| Author(s) | Field | Subfield | Evaluation Method | Objective |
|---|---|---|---|---|
| 7 | Health | Odontology | Rubrics | Evaluate the competence of the student of odontology through portfolios. |
| 8 | Health | Medicine | Rubrics | Build a valid instrument to evaluate skills in strabismus surgeries. |
| 39 | Exact | Engineering | Rubrics + Bloom's Taxonomy | Develop a competency assessment matrix based on the first four levels of Bloom's Taxonomy. |
| 40 | Health | Medicine | Rubrics | Develop and evaluate the validity of a tool to quantitatively evaluate the capsulorhexis portion of cataract surgery performed by residents. |
| 41 | Health | Medicine | Rubrics | Develop and evaluate the validity of a tool for the quantitative evaluation of portions of hydro dissection and phacoemulsification in cataract surgery performed by residents. |
| 42 | Health | Medicine | Verification List | Evaluate the usefulness of a specific tool to assess the performance in the final clinical examination of medical students. |
| 43 | Exact | Engineering | Self-assessment Slip | Evaluate the cultural diversity of students from four engineering courses. |
| 44 | Humans | Education | Questionnaire (Open Response Questions) | Evaluate the teacher's perception of the reliability and validity of the competency assessment through video portfolios. |
| 45 | Health | Nursing | Verification List | Describe the conception, implementation and evaluation of a model of evaluation of clinical competence of nursing students. |
| 46 | Health | Farmacy | Questionnaire | Evaluate communication competence of pharmacy students. |

rubric, the evaluator assigns a score for each of the dimensions to be assessed in the activity [48].

The Bloom's Taxonomy of Cognitive Domain is structured in six levels of increasing complexity, and in order to acquire a new knowledge belonging to the next level, the student must master the knowledge acquired in the previous level. The Bloom's Taxonomy is a possibility of hierarchical organization of the cognitive processes, based on the levels of complexity and the desired and planned cognitive objectives [26]. These cognitive processes should represent learning outcomes and be cumulative, characterizing a relationship of dependence between levels [34, 49]. The six levels of Bloom's Taxonomy of Cognitive Domain are: Remember, Understand, Apply, Analyse, Evaluate and Create.

## 3. Method

The methodological procedure used in the present research had a qualitative approach and contemplates three phases detailed below:

A Systematic Literature Review (Phase 1) was carried out with the keywords evaluation of competences, Rubrics, Bloom's Taxonomy and discussion forums to support the proposed competency assessment model.

For the elaboration of the evaluation model we opted for the development of analytical rubrics. The analytical rubric was selected due to its greater objectivity and ability to target specific elements, identify where students are standing out or having problems [50].

First, the competencies to be evaluated in discussion forums for theoretical courses in engineering courses were identified. For this, the curricular guidelines of the engineering courses and competences identified in the literature by the researched authors were taken into account. The chosen competencies were Express themselves in written form, collaborate with the team and think critically and analytically. The first competence was chosen since it belongs to most of the curricular guidelines of the courses studied and the other competences for its closeness to the quality criteria defined by [51] for discussion forums.

The proposal for the rubric model followed the first five steps suggested by [52], described below:

*Step 1—Identification of learning objectives to be measured*

The learning objective should be clearly and accurately defined so that students understand what is being asked of them, and how it should be accomplished. The evaluation model developed was designed to be used in theoretical disciplines of undergraduate and postgraduate courses in engineering that assess through discussion forums. As the subject to be discussed in each forum is specific, it can be said that the learning objective for the proposed model is: *Discuss collaboratively about (specify subject)*.

**Table 2.** Attributes evaluated in discussion forums

| Category | Item |
|---|---|
| Content | Quality and relevance of the arguments.<br>Thought, reflection and reasoning.<br>Ideas, connections and links with the content addressed.<br>Content and Information.<br>Citations and references. |
| Quality of Interaction | Grammar, spelling, language and punctuation.<br>Writing and writing style.<br>Expression and organization<br>Writing, composition and style. |
| Participation | Time, frequency and initiative<br>Participation Type. |

Source: Adapted from [53].

*Step 2—Identification of attributes to be evaluated*
In order to define the attributes related to the knowledge dimension, it was considered the rubric proposed by [16], where they assess the relevance and breadth of the messages, the work reported in reference [53], based on the review of 50 rubrics of discussion forums and the research of [51], which defines the quality criteria for discussion forums. Three categories should be evaluated: content, quality of interaction and participation [51]. From these categories, the attributes that appeared most in the rubrics analysed by [53] were related to them, resulting in Table 2.

The intention is that the proposed evaluation model assess competencies. By the definition of competence used in this work, one must also evaluate the attitude of the students in relation to the execution of the forum activity. The attributes related to student attitudes were identified from the questionnaire applied with the teachers participating in the 2015 Census, choosing the most marked attitudes, also taking into account the ease of them to be measured.

Consequently, the identified attributes for evaluation of discussion forums are: Communication and Expression, Grammar and Punctuation, Comment on Colleagues' posts, Additional Resources, Relevance of Posts and Participation.

*Step 3—Identification of the performance levels to be evaluated*
The proposed model is based on the Bloom's Taxonomy of Cognitive Domain, which has six levels ranging from the initial process of acquiring a new knowledge to the ability to create new solutions from that acquired knowledge. These six levels were allocated in three groups in the work reported in reference [54]: Remember and Understand, Apply and Analyse, and Evaluate and Create. Table 3 shows the levels of Bloom's Taxonomy grouped in verbs that can be used to describe the knowledge in each of them.

Therefore, for this research three levels of performance were defined, being the three groups presented presented in reference [54].

*Step 4—Description of feedback for higher and lower performance levels*
The definition of the feedback, it was based on the verbs belonging to the categories of Bloom's Taxonomy of Revised Cognitive Domain and in the descriptions of these categories presented by [26].

*Step 5—Description of feedback for intermediate performance levels*
In this stage the intermediate feedback were defined for the proposed rubric. They were defined from the feedback outlined in the previous step.

In Phase 2 the closed questionnaires were developed to identify attitudes that can be evaluated in discussion forums and to evaluate the model proposed by specialists.

The questionnaire to identify attitudes was composed of closed-ended questions where the Attitudes found in the literature were listed, which could be evaluated in discussion forums and an open-ended question so that the respondent could leave his comments. Respondents could choose all the attitudes they considered relevant to discussion forums, out of a total of 12 attitudes identified in the literature.

The questionnaire for evaluation of the model proposed by specialists was composed of nine questions, six of which were multiple choice, one question composed of four items to compare the proposed evaluation model with others that have been used by the specialists, which can be visualized in Table 4, one question for them to indicate other competencies that could be evaluated in discussion forums and the last one for the expert to indicate other experts to participate in the research.

**Table 3.** Bloom's Taxonomy levels and respective verbs that describe the knowledge

| Category | Item |
|---|---|
| Remember and Understand | Define, list, describe, identify, show, order, demonstrate, illustrate, interpret, summarize. |
| Apply and Analyse | Apply, develop, organize, modify, prioritize, discuss, analyse, compare. |
| Evaluate and Create | Categorize, combine, construct, create, elaborate, evaluate, interpret. |

Source: Adapted from [54].

**Table 4.** Comparison of competency evaluation models

| Evaluating Items | Proposed Model | | | | | Model already used by the Expert | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| The student's ability to communicate in written form is enhanced by the evaluation model. | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| The ability of the student to collaborate with other teammates is enhanced by the evaluation model. | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| The ability to think critically benefits from the evaluation model. | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| The student's willingness to participate in the forum benefits from the evaluation model. | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |

Source: Adapted from [55].

Compare the proposed Competency Evaluation Model with another competency assessment model that you use or have already used. Tick a number on the scale from 1 to 5, 5 being "very strong" and 1 "very weak". If you have never used a competency assessment model, mark the responses only to the proposed model.

Phase 3: Fieldwork. It contemplates the application of the closed questionnaires with the educators of Distance Education belonging to the 2015 Census and with the specialists in the area of study and its analysis. It focused on the area of distance education, which is particularly appropriate to the objectives of this work.

Respondents from the questionnaire to identify attitudes that can be measured by discussion forums were selected from Annex I—Instituições e professores independentes participantes do Censo EAD.BR 2015, p. 93-109.

For all the teachers listed in the census, a personalized email was sent with a cover letter and research objectives, requesting them the intention to participate in the research. The email was sent to 339 educators, of whom 80 responded to the survey.

The experts were selected with a search on the Lattes platform with the key words Rubrics, Discussion Forums, Bloom's Taxonomy and Skills Assessment. We identified 50 researchers with the desired profile. For these, a personalized email was sent with a cover letter and search objectives, requesting the research participation. The experts indicated by those who had already answered the survey, were also invited to attend.

The proposed competency evaluation model was evaluated by 34 experts with knowledge of the Bloom's Taxonomy, competency assessment, distance education and rubrics. For this evaluation there was a web search with the participants for the discussion of the proposed evaluation model as to its practicality, applicability and adherence to the Bloom's Taxonomy. The experts compared the proposed competency assessment model with that used by them for evaluation of discussion forums.

The questionnaire was answered by 34 experts, 44.4% of the technology and exacts sciences field, 44.4% of human sciences and 11.2% of health sciences. All respondents work or have already worked with distance education, with 72.2% working with distance education for more than five years. 41.7% of respondents are over 45 years old, 27.7% are between 41 and 45 years old, 16.7% are between 36 and 40 years old, 11.1% are between 31 and 35 years old and 2.8% are under 30 years old.

A pre-test was carried out with the proposed competency evaluation model, where it was applied to two classes of a course of a postgraduate course in Production Engineering of a university in the interior of the state of São Paulo. Three professors evaluated the forums of these classes, according to the proposed evaluation model, in order to verify the reliability of the same.

For each teacher and specialist who proposed to participate in the survey, the search link was sent via email through the Survey Monkey platform.

## 4. Validity and reliability of the rubric

When developing a research instrument, the researcher should consider the internal validity of the instrument [56]. Validity is the degree to which the elements of the instrument are relevant and suitable to measure the construct or variable that it was designed to measure [49]. Poorly crafted instruments can influence the validity of the study. The reliability among evaluators is the degree of agreement between them in relation to the data, which is obtained by different evaluators, using the same instrument, when evaluating the same topics [57]. Reliability and validity of an instrument should be measured prior to data collection in a study [57].

In order to verify the reliability, two or more evaluators must use the same instrument to evaluate the phenomenon of interest, and the percentage of agreement must be calculated.

The purpose of assessing the validity of the instrument content is to determine whether it measures the concept or idea of interest [57]. A Content Validity Index (CVI) can be calculated to provide a

more accurate measure of validity. This measure is completed during the development of the instrument and is determined by a team of experts in the subject. Experts are invited to evaluate the relevance of each item. Relevance classifications are used to calculate the CVI [57, 58].

To establish the content validity of the evaluation model, 34 subject matter experts were invited to review and evaluate the instrument to determine the CVI. Experts evaluated each item of the model on a scale of 1 to 5, with 1 being "very weak" and 5 "very strong. In addition, the experts were invited to submit their comments on the proposed model in what could be improved.

A total of 34 experts completed the content validity judgment. The 4 items of the proposed model had an individual relevance above 88.24%. For the identification of relevance, we considered the one marked on scales 4 and 5. The overall CVI for the instrument is 90%; all items were considered relevant by the experts. Some experts made suggestions for other skills that could be evaluated through discussion forums. The suggestions have been analyzed and some will be incorporated.

In order to determine the reliability of the model, a pre-test was carried out with the application of the evaluation model in two classes of a course of a postgraduate course of a university in the interior of the state of São Paulo, where three professors used the proposed model to evaluate students' competences in these subjects. These professors are called assessors for reliability calculations. Classes 1 and 2 were composed of 35 and 27 students, respectively. The professors evaluated for each student all the items belonging to the proposed model using the scale: 1, 3 and 5. Then, the evaluations were compared, and the reliabilities were calculated by verifying by evaluative item the agreement among the evaluators. For instance, in Class 1, for the item "Communication and Expression" of the proposed model, there was agreement between the evaluators 1 and 2 for 27 of the 35 students evaluated, which represents a reliability of 77.1%, which can be calculated by dividing 27 by 35 and multiplying this value by 100. Tables 5 and 6 present the inter-evaluators reliability results for groups 1 and 2 for each item of the proposed evaluation model.

## 5. Results

Among the experts surveyed (34), 94.4% used discussion forums in the student's evaluation; 83.3% use a rubric for evaluation of the discussion forums and 86.1% believe that the Bloom's Taxonomy contributes to the student's evaluation.

Table 7 lists the results of the evaluation of the proposed evaluation models and the one commonly used by the specialist.

Table 7 shows that the total number of respondents for the proposed model was 34 and for the

**Table 5.** Reliability results among evaluators in the Class 1

| | Class 1 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AV1–AV2 | | | AV1–AV3 | | | AV2–AV3 | | | |
| Item | F | U | Rel. | F | U | Rel. | F | U | Rel. | Avg Rel. |
| Communication and Expression | 29 | 6 | 82.9% | 33 | 2 | 94.3% | 31 | 4 | 88.6% | 88.6% |
| Grammar and Punctuation | 34 | 1 | 97.1% | 29 | 6 | 82.9% | 30 | 5 | 88.6% | 88.6% |
| Comments on colleagues' posts | 33 | 2 | 94.3% | 29 | 6 | 82.9% | 30 | 5 | 87.6% | 87.6% |
| Additional Resources | 35 | 0 | 100.0% | 35 | 0 | 100.0% | 35 | 0 | 100.0% | 100.0% |
| Relevance of Posts | 30 | 5 | 85.7% | 35 | 0 | 100.0% | 30 | 5 | 85.7% | 90.5% |
| Participation | 32 | 3 | 91.4% | 35 | 0 | 100.0% | 32 | 3 | 91.4% | 94.3% |

Labels: F—Favorable; U—Unfavorable; Rel.—Reliability.

**Table 6.** Reliability results among evaluators in the Class 2

| | Class 2 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AV1–AV2 | | | AV1–AV3 | | | AV2–AV3 | | | |
| Item | F | U | Rel. | F | U | Rel. | F | U | Rel. | Avg Rel. |
| Communication and Expression | 24 | 3 | 88.9% | 24 | 3 | 88.9% | 26 | 1 | 96.3% | 91.4% |
| Grammar and Punctuation | 23 | 4 | 85.2% | 23 | 4 | 85.2% | 26 | 1 | 96.3% | 88.9% |
| Comments on colleagues' posts | 26 | 1 | 96.3% | 26 | 1 | 96.3% | 26 | 1 | 96.3% | 96.3% |
| Additional Resources | 24 | 3 | 88.9% | 24 | 3 | 88.9% | 26 | 1 | 96.3% | 91.4% |
| Relevance of Posts | 23 | 4 | 85.2% | 23 | 4 | 85.2% | 26 | 1 | 96.3% | 88.9% |
| Participation | 25 | 2 | 92.6% | 25 | 2 | 92.6% | 26 | 1 | 96.3% | 93.8% |

Labels: F—Favorable; U—Unfavorable; Rel.—Reliability.

**Table 7.** Results of the evaluation of the proposed models and the one commonly used by the specialist

| | Proposed Model | | | | | | | Model already used by the Expert | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Scale | | | | | | | Scale | | | | | | | |
| **Evaluated Items** | **1** | **2** | **3** | **4** | **5** | **Total** | **Avg.** | **1** | **2** | **3** | **4** | **5** | **Total** | **Avg.** | **Difference between averages** |
| The student's ability to communicate in written form is enhanced by the evaluation model. | 0 | 0 | 3 | 9 | 22 | **34** | **4.56** | 0 | 6 | 11 | 5 | 8 | **30** | **3.50** | **1.06** |
| The student's ability to collaborate with other teammates is enhanced by the evaluation model. | 0 | 1 | 2 | 10 | 21 | **34** | **4.50** | 1 | 8 | 6 | 8 | 7 | **30** | **3.40** | **1.10** |
| The ability to think critically is benefited by the evaluation model. | 1 | 0 | 3 | 12 | 18 | **34** | **4.35** | 4 | 5 | 6 | 6 | 9 | **30** | **3.48** | **0.87** |
| The student's willingness to participate in the forum benefits from the evaluation model. | 0 | 1 | 3 | 10 | 20 | **34** | **4.44** | 4 | 3 | 7 | 8 | 8 | **30** | **3.43** | **1.01** |

model commonly used by the expert evaluator was 30. This is due to the fact that 4 experts do not use discussion forums for student evaluation or do not use template to evaluate discussion forums.

## 6. Discussion

The differences between the averages revolve around a point, and the smallest difference occurred for the item "The ability to think critically is benefited by the evaluation model", this being the item that received the lowest score, on average, for the proposed model.

Some experts have suggested the inclusion of other items in the model, which will still be analyzed for future adjustments.

The percentage of agreement between the evaluators is in a range of 90% to 95%, so that the instrument can be trusted [57]. According to the results obtained it is verified that for Class 1, the items "Communication and Expression"; "Grammar and Punctuation" and "comment on colleagues' posts" had a reliability close to, but less than 90%, and for Class 2 this occurred for the "Grammar and Punctuation" and "Relevance of posts" items. The remaining items had a percentage of agreement above 90%.

## 7. Conclusions

The competency evaluation model for discussion forums was well evaluated by the experts, with the average scale being above 4 for all evaluated items. All items were better evaluated when compared to models commonly used by researchers. From the results, it can be affirmed that the proposed model can efficiently evaluate students from discussion forums.

The next step of the work is to carry out adaptations suggested by the specialists and thus those to different disciplines of distance courses, face-to-face courses or mix distance and face-to-face courses, that use a virtual learning environment as support.

Another step to be taken is to adapt the model to disciplines that require logical reasoning and engineering problem solving, considering the skills required of engineers in the 21st century.

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