

## SIGNIFICANCE OF ASSESSMENT AND COMMUNICATION WITH THE TEACHER IN THE CHEMICAL TECHNOLOGY LEARNING PROCESS

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### ABSTRACT

*Given the complexity of the learning content, in modern engineering education, the need for feedback from the students is also relevant. Not only during an exam when they demonstrate the outcomes of their studying. There is a need to research students' opinions on effective communication with teachers, teaching methods and assessment. The goal of this publication is to show the results of a study conducted with students in the Fundamentals of Chemical and Metallurgical Technologies (FCME) major at the University of Chemical Technology and Metallurgy (UCTM), Sofia. Students' opinions are presented regarding the teacher's requirements for independent work and presentation of results, teaching methods and assessment of knowledge and skills. Respondents were third year full-time and part-time students at the Faculty of Chemical Technologies, major FCME.*

*The outcomes of the study we conducted demonstrate that the use of different methods of teaching and assessment, as part of it, including giving tasks for self-assessment, increase students' understanding and satisfaction of the learning process. Good communication between teachers and students, clear work requirements and criteria make the course content and assessment more understandable and meaningful for the students. They become active participants in the learning process, which leads to exhibited responsibility and commitment towards it.*

*Keywords: engineering education, learning, assessment, effective communication, chemical technologies.*

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### INTRODUCTION

Learners' perceptions of assessment and their concomitant approaches to studying are very personal and individual constructs of the learner. Assessment should be objective, carefully planned, outlining the scope and requirements of the training. It is a key element in the effective teaching because it measures the learning outcomes addressed in the teaching-learning process [1]. Often, assessment can have a greater impact on the learning process than teaching itself. Research has focused on the impact of assessment on student learning in higher education [1 - 9]. Clearly, to be motivated to acquire knowledge, learners must believe that the intended instructions and study material are

related to their motives for making a connection with the environment, and such connection may be based on personal choice, as concluded in [10]. Assessment of learning should be based on gathering information that allows teachers and learners to use it for feedback. This means that the outcome of the assessment should be some information that the teacher and the learner can interpret to improve the task [11].

Obviously, assessment affects both the motivation to learn and the active participation in the learning process [1 - 11]. Some authors point out that the assessment task, the context, the teacher, and the previous experience have their significant influence on the presentation of the learning outcomes [12]. Many students express the opinion that they perceive traditional assessment tasks

as arbitrary and irrelevant. It is concluded that this does not lead to effective learning, because learners' study only for the purpose of the specific assessment, with no intention of maintaining their knowledge in any long-term way [12]. On the other hand, however, the most complex scientific knowledge is rarely suitable as cognitive goals in the curriculum. Rather, there is a process of rationalizing the scientific knowledge into something more appropriate for the learners, as concluded in [13].

Chemical engineering (CEng) is a versatile major, both in educational context and as a job. The curricula taught are diverse and offer problem solving, design, control, management, materials science, safety, economics, and environmental impact, along with the CEng fundamentals. Thus, students are prepared for a range of roles in the industry and the scientific research. This set of diverse knowledge is part of the educational process that helps students to develop key transferable skills needed in the chemical and engineering industries [14]. The conclusion that the study of students' opinions about assessment helps to analyze their satisfaction of the learning process.

In the broad context of the chemical engineering education, Low [15] points out that some students may have difficulty visualizing industrial equipment, unit operating packages, and how these sections fit together as part of a particular process for multifaceted applications [16, 17]. Students may also feel burdened by questions that require text responses which take more time, and this may affect their mood and attention span [18].

In the modern educational process, students are encouraged not only to master knowledge and skills, but also to engage in professional development activities in order to reflect on their own progress. As is known, many universities offer specific skills in each educational qualification level, to be applied in the context of the European Higher Education Area (EHEA) [19]. Communication skills, problem solving, teamwork, information technology, to name a few, are some of the main key skill areas recognized by the lecturers. The shared experience of introducing key employability skills into the curricula of higher education students is also of interest, with a view to the development and assessment of key skills in the undergraduate degree, as presented by Fernández et al., Universidad Europea de Madrid, Spain [19].

The idea of assessing the skills and abilities through a questionnaire, which was implemented at the University of Strathclyde, Glasgow, United Kingdom, is valuable. The University of Glasgow's survey was performed through an online questionnaire. It aims to assess the views of future chemical engineers on personal employability both before and after graduation. The results of the survey show that, in general, the respondents believe that their technical knowledge exceeds the job requirements, while transferable skills and topics related to management and self-control are generally not available. The conclusion from this is that although the educational outcomes are useful for learning and teaching, students may not be fully aware of what skills they have developed during their time at university if these skills are not explicitly stated [14].

On the other hand, the question of how different forms of assessment affect student learning and/or performance has been studied by various authors [12, 20 - 22]. For example, Cooper et al. distinguish between direct and indirect assessment, considering an online course held at the University of North Carolina, North Carolina State University [20]. The authors state that direct course evaluation is derived from student performance on individual homework, quizzes, and exam problems related to each of the course's learning objectives. Indirect assessments are collected through end-of-semester course evaluations and responses to structured lists of qualitative indicators related to motivation (task value, interest, and personal effectiveness) and course experience (time spent in the course, connectivity, and Moodle structure) [20].

In order for chemical engineering research to be adopted into teaching practice, Wankat notes that there should be a close relationship between researchers and teachers in order to have an impact on chemical engineering students [22]. Based on this, our interest is based on the significance of exploring ways and methods of assessing both knowledge and skills, as well as student motivation. More specifically: how to help students learn to self-assess so they can take control over their own learning; how learners' understanding rather than just problem solving can be assessed by incorporating specific chemical engineering topics such as mass and energy balances; what are the best assessment methods for each educational program outcome. And finally, in the process of the survey, to identify understandings

and expectations of students in chemical engineering regarding the importance of communication with the teacher and independent activity in the learning process.

The University of Chemical Technology and Metallurgy (UCTM) also has in its curricula courses in which skills necessary for successful professional realization are studied. These are: “Career Development and Entrepreneurship”; “Communications in Social Systems” and “Organizational Development and Staff Training”; “Business Psychology”. More and more teachers of fundamental and engineering disciplines in various majors include self-assessment, teamwork, critical thinking, problem solving, and collaboration skills in the assessment of the learning outcomes demonstrated by the students. For example, the course in FCME is technologically fundamental. General knowledge of processes and devices in the chemical industry, inorganic and organic chemistry, ecology and heat engineering are being interconnected and deepened. During lectures, laboratory exercises and solving technological tasks, individual presentations are made and presented by the students. There is ongoing assessment, midterms and an exam.

UCTM also conducts surveys among first-year students regarding their satisfaction of the introductory courses in fundamental disciplines. Due to the specificity of the chemistry as a science and the complex chemical and technological processes being studied, it is important both to identify the knowledge before entering university, and to carry out regular control of the acquired basic knowledge in each discipline.

Nowadays there is increasing talk about continuous assessment. Regular feedback, ongoing assessment – even if only verbal, qualitative rather than quantitative (numerical) - is recommended, so that the student knows whether he has correctly understood the task, directions and work recommendations and is confident of the progress made. A running grade can help for an actual and fair overall grade if the final exam grade is dubious. Regular verification of knowledge and skills in chemical technologies could be carried out for a certain topic or section, for example, by giving tasks to make a presentation on lecture material. Students’ understanding, their satisfaction of the communication with the teacher in the learning process and specifically during assessment, is of utmost importance. Therefore, this whole set of questions is also the subject of our

research. When assigning tasks for independent work, it is necessary for the teacher to set the performance criteria. They must be clearly worded in order to be understood. Another way to collect assessment data is for the teacher to provide an opportunity for self-assessment or for peer assessment based on the criteria given. It is also necessary to emphasize that self-assessment is an important element of education, as it implies a critical attitude to one’s own work and is the basis for clarifying personal educational goals and building a personal development plan. Self-assessment helps students build lifelong learning skills and habits. In order to achieve positive results from self-assessment and make it a factor in effective learning, it is necessary to discuss the assessment criteria together with the students; give them instruction how the criteria are applied; to provide feedback from the teacher, for example, about possible differences between self-assessment and the teacher’s assessments.

As stated above, many learners perceive traditional assessment tasks as arbitrary, even irrelevant. This does not lead to effective learning, as they aim to learn only for the purpose of the specific assessment, with no intention of maintaining the knowledge in any long-term way [12]. Assessment is an important stimulus in learning activity. The more objectively and comprehensively the knowledge and skills check is carried out, the more objective the assessment. Feedback from students has a positive effect. Therefore, a questionnaire was designed for this study, the purpose of which was not only to obtain data, but also to provide an opportunity for the students to give feedback and to reflect on their own learning process. With a change in the feedback, in the assessment technologies, learners will take a proactive rather than a reactive role in providing feedback, states [23].

The main hypothesis in this publication is that the students’ attitude towards learning (teaching and assessment) in FCME is based on good communication between the learners and the teacher, the high level of preparation in the course, the many independent tasks that stimulate self-training, self-evaluation, good discipline and behavior during learning, as well as on the dissatisfaction of learners regarding testing (testing and assessment of knowledge) during the education. In this regard, demonstrated activity, independence, and initiative by the students are of great significance for the satisfaction of the FCME learning. They are manifested

given the teacher's positive attitude (evaluates progress, not only errors in performance), the desire to complete the assigned tasks, self-assessment. For the formation of a positive attitude towards learning in the discipline, both classroom and extracurricular activities, which are organized by the teacher, are of great importance.

There is evidence that teachers and students agree with involving the latter in the assessment of their own learning, although both groups still have the perception that assessment should only be managed by experts [24]. Students report that they learn how to improve their own performance by critically examining the performance of others [25].

Previous research by Traikova et al. shows that students rely more on the assessment performed by an expert (teacher) than on their self-assessment in the learning process [26]. It can be concluded that this is so due to the fact that only the teacher's assessment is valid and legitimate; a stereotype is demonstrated that the expert assessment is more important. It is considered that, in general, no specific requirements are set for the performance of tasks, there are no clear criteria and indicators for self-assessment that can be compared with the teacher's assessment [26]. It is on the basis of the results of previous observations and studies that the usefulness of the present publication is justified, namely, to determine whether there has been a change in the expectations of students and in teaching practices. On the other hand, the interest in the research of students' opinions is related to the lack of data regarding students' attitudes and understanding of the assessment process and of how it affects their learning and presentation of outcomes. In the results published here, from a study conducted in 2022, it can be seen that self-assessment tasks stimulate motivation to learn, according to 39 % of respondents (see Table 1, question 7).

## RESULTS AND DISCUSSION

In the research presented in this publication, the respondents were 31 third-year full-time and part-time students at UCTM, major FCME. The method was a questionnaire. The survey card (Table 1, column Question No) includes questions with the aim of studying the students' understanding of the teacher's instructions and establishing their opinion about communication in the FCME learning process. Table 1 summarizes the

results of the conducted survey.

The interpretation of the data in Table 1 is based on the following indicators:

- The students' attitude towards the teacher's requirements for communication during the educational process (Questions 1, 4, 8).
- The students' attitude towards the teacher's requirements related to the preparation in FCME (Questions 2, 3, 5).
- The students' attitude towards the teacher's requirements regarding the testing (testing and assessment of knowledge) during the education (Questions 4, 6, 11).
- The students' attitude towards the teacher's requirements, set in relation to individual work and self-learning (Questions 7, 8, 11).
- The students' attitude towards the teacher's requirements aimed at motivation for making and delivering presentations (Questions 9, 10).

When analyzing the results of our study, the following conclusions were drawn:

1. In general, students have a positive attitude towards the process of communication in education. Most of the students are definite in their opinion that there is effective communication between the teacher and the students in the FCME course.

2. Although positive answers prevail, it cannot be categorically stated that the attitude of the students towards the teacher's requirements related to their FCME preparation is unanimously positive (68 %). Students who experience difficulties in learning and individual preparation also experience difficulties in understanding and learning the educational content. Some students think that the content is difficult, that the criteria for presenting knowledge and skills are too high.

3. It is clear from the answers that the students' attitude towards the requirements of the teachers regarding the examination (testing and assessment of knowledge) is definitely positive. They are given guiding questions and individual tasks.

4. Regarding the requirements set in relation to individual work and self-preparation, it can be concluded that the opinions are wavering. For example, on question 7: "Do you think that self-assessment tasks stimulate motivation to learn in FCME?" only

Table 1. Research questions and results.

Question No	Reply	Count	%
1. Are the explanations given by the teacher when assigning individual tasks clear and understandable to you?	Yes	22 out of 31	71 %
	Rather yes	4 out of 31	13 %
	Rather not	3 out of 31	10 %
	No	2 out of 31	6 %
2. Are you interested in attending FCME classes?	Yes	22 out of 31	71 %
	No	7 out of 31	23 %
	Don't know	2 out of 31	6 %
3. In your opinion, which methods of studying FCME are interesting?	Practical	27 out of 31	87 %
	Verbal	3 out of 17	10 %
	Visual	1 out of 31	3 %
4. For assessment tasks (in an exam), does the teacher give sufficiently clear guidelines for work and performance?	Yes	26 out of 31	84 %
	Rather yes	3 out of 17	6 %
	No	2 out of 31	10 %
	Rather not	-	
5. In your opinion, does the assigning of individual tasks of various difficulties to individual students help to increase knowledge?	Yes	18 out of 31	58 %
	Rather yes	9 out of 31	29 %
	No	2 out of 31	6 %
	Rather not	2 out of 31	7 %
6. In your opinion, what are the requirements for FCME assessment?	Achievable	26 out of 31	84 %
	Very high	3 out of 17	10 %
	Low	2 out of 31	6 %
7. Do you think that self-assessment tasks stimulate motivation to learn?	Yes	12 out of 31	39 %
	No	10 out of 31	32 %
	Rather yes	7 out of 31	23 %
	Rather not	2 out of 31	6 %
8. Does the teacher set specific/clear requirements for the performance of individual work?	Yes	21 out of 31	68 %
	Rather yes	7 out of 31	23 %
	No	3 out of 17	9 %
	Rather not	-	-
9. Is making presentations on FCME interesting and useful?	Yes	25 out of 31	84 %
	No	4 out of 17	13 %
	It depends	2 out of 31	3 %
10. Are clear criteria for performance and assessment of a presentation set for you?	Yes	25 out of 31	81 %
	No	4 out of 17	13 %
	Rather yes	1 out of 31	3 %
	Rather not	1 out of 31	3 %
11. Does FCME assessment motivate you to study harder and perform better?	Yes	28 out of 31	97 %
	No	3 out of 17	3 %



39 % answered definitely “yes”, and 32 % answered definitely “no”.

5. Regarding the students’ attitude towards the influence of the teacher’s requirements on their motivation to make and present presentations, it can be concluded that it is definitely positive. Question 9: Is making presentations on FCME interesting and useful? - “Yes” answers were 84 %; Question 10: Are clear criteria for performance and assessment of a presentation set for you? - “Yes” answers were 81 %; Question 11: Does FCME assessment motivate you to study harder and perform better? - “Yes” answers were 97 %.

Considering the positive attitude of the respondents, the above hypothesis can be confirmed by the results obtained. The students’ attitude towards the requirements of the teacher in the FCME course is built on the good relationship and cooperation between students and teachers. It can be concluded that the communication during education is successful and effective for the process. Students are satisfied of the communication with the teacher. They assess positively the high level of training in the FCME discipline. Individual work tasks, according to the respondents, stimulate active self-preparation and self-assessment. Students are also satisfied with the ways of testing and assessing their knowledge. The hypothesis is confirmed, based on the analysis of the results, which show the positive attitude of the learners towards the teacher’s requirements for the communication process during the training; towards the requirements related to the preparation in the FCME discipline; towards the requirements of the teachers regarding the preparation and delivering of presentations; towards the requirements set in relation to individual work and self-preparation in and outside the educational environment; towards the requirements of the teachers regarding the testing process (control and assessment of knowledge) during the training. With appropriate homework instructions and techniques, teachers could induce positive attitudes in students [27]. This was also confirmed in our research. Hailikari and Parpala point out that students’ attitudes and experiences regarding assessment and how it affects learning have not been addressed [4]. We think that this needs to be changed.

The learner is not expected to just learn alone or in groups without the intervention of the teacher

[28]. The new way of thinking of learners requires new teaching technologies as a natural progression of learning methodology. Electronic learning (e-learning) is considered to be at the forefront of teaching technologies in modern pedagogy [29] as part of quality management systems. Learners should be supported in developing skills to plan, observe and assess their learning [30]. Mourshed et al. suggest that well-used inquiry-based approaches can significantly raise achievements, but only when used sparingly and embedded in a wider context of high-quality teacher-directed learning [31]. The teacher explains and demonstrates ideas, discusses questions and leads discussions, motivates the active participation of students. This approach can be successfully applied in the teaching of chemical technology and other engineering disciplines.

## CONCLUSIONS

The study of students’ opinion and attitude towards the learning process and the assessment process, as its main component, becomes increasingly significant and relevant in the modern educational process. The way learners feel about the learning and teaching process determines how they cope with the requirements and what are their learning outcomes.

The influence of teacher’s requirements and assessment on learners’ confidence is of interest for both current and future studies of ours. Nowadays, the requirements to the teacher’s role and the teaching methods are changing to stimulate the individual and active learning of the students. As enablers of instructional communication, educators use strategies, including direct instruction, and teach metacognition. In order to adequately respond to the demands of both teachers and students, as well as employers, and to ensure an increase in the quality of higher education, it is necessary to study not only current knowledge, but also to develop questionnaires studying the students’ opinions and expectations for a more adequate assessment of knowledge, skills and competences that are important to them. Studying learners’ opinions and expectations about the learning process and the assessment as a factor influencing their motivation to learn is a useful way of collecting data which will provide information about the identification and development of good educational practices.

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