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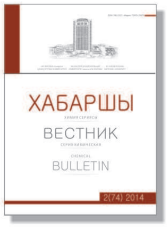

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Some key approaches that could improve learning chemistry in higher education

This article considers some key approaches, which could improve learning in chemistry. Some important factors, which aid learning in higher education, are feedback, active learning techniques, developing critical thinking skills and avoiding plagiarism. Students often have to act on feedback and employ critical thinking skills in the laboratories, lectures and seminars in order to develop skills and progress in their discipline. The University of Reading has studied techniques to aid learning throughout the educational process. Roles of an educator and a student are emphasized. Active learning approaches have shown increase in student knowledge and understanding as well as enhanced critical thinking and communication skills. Active learning approaches include solving problems in pairs and small groups, self-study techniques including writing essays, revision and consolidation work, preparing and giving presentations, report writing and carrying out mini projects or investigations. Also, some measures of assessment used in higher education are given in the paper.
Key words: higher education; educator; knowledge; active learning; feedback; critical thinking skills; plagiarism.

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Некоторые основные подходы, которые способствуют улучшению обучения химии

В данной статье рассмотрены некоторые основные подходы, которые способствуют улучшению обучения химии. Обсуждены такие важные факторы обучения химии в ВУЗе, как обратная связь, интерактивное обучение, развитие критического мышления и плагиат. Студенты должны часто применять метод обратной связи в лаборатории, на лекциях и семинарах, для того чтобы формировать умения и навыки в образовательном процессе. Кроме того, показаны некоторые подходы развития коммуникативной компетентности студентов при выполнении некоторых видов самостоятельных работ студентов, таких, как написание эссе, проведение рубежного контроля, подготовка презентаций, докладов и защита дипломных работ, применяя методы активного обучения. Также приведены и раскрыты сущности шкалы оценки высшего образования.
Ключевые слова: высшее образование; педагог; знание; активное обучение; обратная связь; критическое мышление; плагиат.

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Химияны оқытудың кейбір маңызды ыңғайлары

Бұл мақалада химияны белсенді оқытудың кейбір маңызды ыңғайлары қарастырылған. Мақалада ЖОО-да химияны оқытудағы мынадай маңызды дәйектер талданған. Олар: кері байланыс, белсенді оқыту, сыни ойлауды дамыту және плагиаттылықты жою. Студенттер білім беру үдерісінде, яғни, пәндік зертханада эксперименттік жұмыстарды орындауда, дәрістерді тыңдауда және семинар сабақтарында тақырыпты талқылауда білік пен дағдыны қалыптастыруда кері байланысты жиі қолдану қажет екендігі жазылған. Сонымен қатар, Редиng университетінің оқыту үдерісіне белсенді оқытуды енгізудің жолдары зерттеліп жатқандығы айтылған. Белсенді оқыту арқылы студенттердің өздік жұмыстарды орындауында яғни, эссе жазу, аралық бақылау жазу-

ларында, презентациялар арқылы баяндамалар дайындаулары мен оны көпшіліктің алдында баяндаулары және бітіру жұмыстарын қорғау барысында қалыптасатын коммуникативтік құзіреттілікті дамытуға болатындығы келтірілген. Мақала соңында жоғары оқу орнында білімді бағалауда қолданылатын бағалау шкаласының мәні ашылып келтірілген.

Түйін сөздер: жоғары оқу орны; педагог; білім; белсенді оқыту; кері байланыс; сыни ойлау; плагиат.

Introduction

Today, studying chemistry is an essential feature of our lives. Learning chemistry enables us to develop skills in both practical work and in problem solving. Such skills help individuals compete in the workplace and help economies to become and remain competitive. These skills are developed throughout primary and secondary school and in Higher Education. Learners in Higher Education are increasingly demanding that their education be at the cutting edge of their subject. Teachers in primary and secondary school lay the foundations of fundamental knowledge and are responsible for establishing motivation in their young learners. The interaction between the teachers and learners is an extremely important part of any education system. The teachers signpost learning for students or pupils through the use of learning objectives and learning outcomes. Teachers also use active learning methods to motivate their students and to generate interest in their subject. Active learning used in secondary and Higher Education often involves students working in pairs or small groups discussing and solving problems. The teacher directs and gives fundamental knowledge, essentially acting as a facilitator of their students learning. The overall aim of a teacher is to develop students who take responsibility for their own learning, and ultimately become independent learners. This process starts from the first day of a student's education [1].

In our opinion, the learning objectives and learning outcomes are important in outlining the learning that is to take place (objectives) and the end product or result (outcome) of the knowledge, skills or experience that has taken place. Students in Higher Education together with active learning techniques, work independently and in-groups, to aid learning using their preferred learning style and at their own pace. Active learning methods also develop essential skills in communication. The achievement of the student is apparent when students give oral presentations, write reports and essays, and present the results of projects in different areas of the curriculum. Developing critical thinking in Higher Education often using Why? When? Where? What? Who? questions also help develop skills in communication, which are essential for a student's future career.

Feedback is an essential part of the teaching and learning process. For example feedback aids learning and can be both oral and written, and can be given by both the teacher and peers. It is essential that students act on the feedback received. Feedback is important for teachers as well as students. Feedback can help teachers create their teaching in response to learners' needs. It helps to improve quality in different areas of knowledge and helps to develop independent learners and critical thinking skills among students. Oral and written feedback, are both used extensively at Universities.

In today's world the most important issue in front of all teachers is improving the quality of their educational system. Plagiarism by students is not permitted at any level in the educational system. With the increased use of technology both personal and within education settings the incidence of plagiarism has expanded among students. Now students would find it easy to use ready-made materials taken from the Internet in their essays, reports, course work, project work and dissertations. Students, who are studying at universities, have to know the requirements of their writing and oral presentations and have to be to be critically evaluative of their own and others work. In order to deal with the increasing amount of plagiarism in student work, essays, assignments and coursework are submitted through plagiarism software that gives a percentage score for the works overall plagiarism nature, indicating the possible presence of copied text [2].

The University of Reading can support international students whose first language is not English. A course covers both speaking and writing and is free for students who are studying at the University. Teachers on this course are very helpful and friendly. They outline to students the necessary requirements and rules for formal writing, speaking, reading and listening which students need in order to participate in seminars, webinars and different conferences that aim to improve skills. The writing course is divided into two sections, academic writing and research writing. The academic writing is useful

for beginners to upper-intermediate levels. The main idea of the academic writing is using the general words carefully and correctly. The research writing is essential for students who are studying for a year because learners have to write research papers and a dissertation using academic writing and definitely avoiding plagiarism. A key skill is to conduct and write a literature review of world research avoiding any plagiarism. After a face to face course there is opportunity for further self-study. Much of this involves active learning and critical thinking. Every teacher at every level in the educational system has to know the criteria for plagiarism. Accordingly it is important to check work for plagiarism and evaluate it objectively [3, 4].

Discussion

At the current time many potential applicants hope to obtain knowledge and understanding at the top universities in the world in order to be competitive in their future careers. Student's who study at universities, receive in-depth theoretical knowledge and practical skills from their lecturers in order to meet the assessment requirements of the university course. Many parents and students aspire to teaching in educational establishments especially universities. So every student has to distinguish and act upon differences in feedback, be actively involved in their own learning and avoid plagiarism from the 1st year at university. For instance, if we could consider one of the foundations of chemistry, the topic of «Chemical bonds» on the course «Theoretical basics of inorganic chemistry», A Lecturer, first introduces the idea of forming of chemical bonds and then explains this by quantum chemical calculation methods, outlined by the work of Heitler – London. They then explain the important properties of chemical bonds such as saturation, and the direction, the polarity and characteristics of chemical bonds such as length, energy, and angle. After lectures, the students have to practice doing exercises and to solve problems that aim to improve their knowledge by self-study. The students are now actively involved in their learning and can receive feedback on their work. The students could discuss in pairs or small groups how they are to act on the feedback given. This should enable students to extend their knowledge and understanding. At the end of the module learners could know and explain differences between valence bonds and molecular orbital and also the shapes of the molecules in space.

Feedback is an important factor in the assessment of students' skills and differs widely in how it is given. The opinion of the students about solving problems is considered and teachers could try to use more effective feedback methods in order to improve learning at university. Educators who are teaching at University could prepare students in advance in order to improve the quality of experiments in the laboratory, by asking questions, practicing calculations and having discussions about experimental work, during tutor time. Individual and group tutor time can be given to students but the important outcome is that each student receives feedback in order to develop knowledge and understanding of chemistry. Students' participation in tutor time is a pre-requisite for attendance and involvement in experimental laboratory classes. This process of linking tutor time activity to laboratory classes needs to occur throughout a student's time at university from the 1st year to the final year.

For instance, during tutor time, students could discuss and explain about the shapes of molecules and ions and differences of the electron pair repulsions (tetrahedral), lone pairs count too (NH_3, H_2O), other shapes (linear molecules-$BeCl_2$, planar molecules-BF_3, bi-pyramidal molecules-PCl5, octahedral molecules-SF6), the shapes of ions such as NH_4^+, NH_2^-. Students could also construct simple 3-dimensional models of molecules and ions explaining their thinking about the shape and explaining about the limitations of their model. Further examples include; drawing and explaining, dative covalent bonds, the 3 dimensional bond arrangement, electronegativity and metallic bonding. These can all be self-study tasks. Students also need to practice chemistry techniques. Examples include drawing diagrams to show the bonds and lone pairs of electrons in each of the following molecules (NH_2OH, $COCl_2$), drawing dot-cross diagrams for molecules such as NF_3 and ions NH_2^-, NH_2^+ and predicting the bond angles in each of them.

Students in the 1st year have to explain and ask questions of each other using the theoretical knowledge passed on by the teacher during lectures. Teachers listen to the explanations and provide feedback to students in order to move the students on in their learning. Teachers also use the student explanations to reflect on the student's knowledge and explanations from their lecture. This will

inform future planning of other lectures. In this way students learn knowledge and understanding about the shapes of molecules and ions and the teachers learn how to teach this topic in a more effective way.

Every student who is studying chemistry is given a project to complete during the final year of the course. Projects are important when studying chemistry. The objective of the chemistry project is to develop knowledge, understanding and skills in an area of chemistry. Assessment criteria are shared with students before the work starts so students are clear about the project objectives and outcomes. During the project they should consider some typical areas such as writing a literature review, planning chemical experiments, considering health and safety implications, predicting the outcome, conducting the experiments, using advanced experimental techniques, time management, writing scientific papers, presenting final results in front of an audience and evaluating their results and project.. At the end of the course teachers assess the work of the students on a grid indicating all the assessment criteria and outcomes.

An example of an assessment grid indicating the level of knowledge achieved by a student in higher education is shown below (Table 1). The table shows an index of an assessment scale by letters, (countable equivalent,) percentage and meaning of assessment. There is an explanation of the meaning of each level of assessment. The student who wants to achieve a particular result must know the criteria for each scale in order to work towards that assessment grade. With effective feedback from the teacher and active engagement of the student it should be possible for all students to obtain the grade they set out to achieve.

Conclusion

To sum up, the main approaches which could improve learning in chemistry in Higher Education are feedback, active learning, avoiding plagiarism and developing critical thinking in students. This is because, assessment of knowledge is a major part of any education system and it is important that the head of department should control the assessment systems in Universities. Also, every teacher, who works at a learning establishment, must be able

Table 1 – The scale of assessment

By letters	Countable equivalent	Percentage	Meaning of assessment
A	4.0	95-100	Excellent. Work shows evidence of a wide variety of reading, beyond the reading list. And will show a thorough understanding and appreciation of the necessary material. Evidence will be original and critical. All written work has a clear structure. and shows talent, maturity and self-confidence.
A-	3.67	90-94	
B+	3.33	85-89	Good, Work shows evidence of a wide variety of reading from the reading list and should show a clear understanding of the issues raised by their reading. All, important material on the topic that students have to know at University should be covered in the work, the work should be well structured, clearly written and well presented. The work should contain no significant errors or mis-understanding. All writing should be clear, coherent and fluent.
B	3.0	80-84	
B-	2.67	75-79	
C+	2.33	70-74	Satisfactory, Work shows evidence of basic reading and understanding of the material for the topic. There may be some signs of weakness, such as a mild confusion about a complicated issue or argument, or a not-too-serious misinterpretation of some evidence, provided the overall grasp of the material is evident.
C	2.0	65-69	
C-	1.67	60-64	
D+	1.33	55-59	Work shows only basic reading of necessary materials, which might be drawn from particular evidence. The exercise or an essay or writing work that students will complete is at a very basic level of understanding of the material.
D-	1.0	50-54	
F	0	0-49	Unsatisfactory, Students show little evidence of reading on the topic. There may be no clear argument; work that is completed and is marked below 30% will show no understanding of the course material at University.
I (Incomplete)	-	-	Not complete

to use methods that aid learning for individual students, this also means that they must be skilled in giving and using feedback.

Universities must control their approaches to assessment, including emphasizing the importance of assessment for learning. Assessment provides a basis for sharing educational targets with students and for measuring and supporting their progress. It can also generate feedback information that can be used by students to enhance learning and achievement. This feedback information could also help teachers create their teaching in response to learners' needs. Such assessment should be an integral part of teaching and learning in Higher Education. At the University of Reading, feedback is very well developed between teachers and students and it is very helpful in order for students to extend their knowledge and understanding. Teachers always try to understand what students need. This also means that, students know how to ask for feedback in order to improve their learning and organization, such as time management, in future years. This is very important if people are to obtain quality education and to be successful in their learning.

The students must be informed, active and knowledgeable in order to achieve goals from secondary school before entering Higher Education. In such cases, teachers could help and develop the knowledge and skills of students at University that will make them compete and succeed in their future working life.

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