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Distance education at university level: opportunities and pitfalls

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Abstract. This paper presents an overview of distance education at university level and some of the associated challenges and pitfalls.

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1. Introduction

For the purposes of this paper, I shall define distance education as the case where: (1) the student is remote from a "bricks and mortar" institution, a university in this case; and (2) the student studies (mainly) at home and/or in the workplace. From a university a few astronomers can reach many students who otherwise would be unable to study astronomy at university level. Students can live at home, and do not have to travel. This reduces student costs. Distance-learning students can study part-time, enabling them to finance their studies. This also applies to on-campus students.

In this paper I shall discuss what is involved in going beyond "bricks and mortar" institutions, namely the prerequisites for students, the importance of high-quality materials (electronic and printed) suitable for the distance learner, the importance of student pacing and student support, continuous assessment of students, examinations and feedback from students. Space does not permit me to discuss important issues such as curricula, developing local staff skills in distance education, and specific learning materials/course programmes/degrees.

2. Prerequisites

There must be a full specification of what the student should bring to the course. This should encompass previous knowledge, previous skills and previous courses in the institution's programme. The student must also have received advice about what courses are needed and what achievement levels are required for the target outcome: e.g. Diploma in Astrophysics, BSc in Physics and Astronomy.

3. High-quality materials

High-quality materials, suitable for distance learning are essential. These remarks apply equally to electronic and printed media. The requirements are additional to the good writing desirable for any material. To compensate for the isolation of the distance learner the materials must be complete (given the likely inaccessibility of libraries, etc.), the style must be expansive and friendly. There must be a preliminary, self-administered self-test, with advice based on the outcome (e.g. remedial material for any prospective student falling just falling short of what is needed). There should also be embedded self-tests — short stop-and-think questions in the flow, longer end-of-section questions with

fully worked answers and comments. Beware of the uncritical use of lectures or outreach material made available over the Internet by some universities.

A mix of printed and electronic media is good. The latter is not essential for effective distance learning, but it greatly helps. Electronic media comprise CD-ROMs, DVDs, email, and the Internet. The cost of a computer and modem is high. In developing countries school ICT facilities often have time free of use that could be made available to distance learners. Internet cafés also offer another opportunity for the distance learner to access information. Distance-learning software should minimize the ICT skills required. The goal is to use ICT for astronomy education, not ICT education for astronomy. Avoid requiring specific commercial packages, such as Word, Excel, etc., except at the higher levels, where students are more likely to have access to such tools in their normal home or work environments.

4. Samples of material

Active learning must be encouraged. In a text, one useful device is the stop-and-think question, as follows.

> "... Thus, around aphelion the body is moving slowest, and around perihelion it is moving fastest. The difference in these two speeds is larger, the greater the eccentricity.
>
> **Q** What are the speeds at different positions in a circular orbit?
>
> In a circular orbit the equal areas correspond to equal length arcs around the circle, so the body moves at a constant speed around its orbit ..."

Here is some not very helpful material. Suppose that a section has introduced the planets and their order from the Sun. Their orbits have been described as "approximately circular". Nothing else on orbits has yet appeared in the course. Then the student comes to the following material.

> "... The orbits of the planets are described by Kepler's laws. There are three.
> 1 Each planet's orbit is an ellipse, with the Sun at one of the foci.
> 2 The radius vector from the Sun to the planet sweeps out equal areas in equal times.
> 3 $P = ka^{\frac{3}{2}}$ where P is the sidereal orbital period of the planet and a is the semi-major axis of its orbit.
>
> **Question X**
> Using what you know about the Earth's orbit, calculate the orbital period of an asteroid in an orbit with a semimajor axis of 2.3 AU.
> .
> .
> .
> (end of section)
>
> ---
>
> Question X answer: 3.5 years"

The teaching here needs to be "repaired" in several ways. Will the student know what an ellipse is? Likewise, focus, radius vector, sidereal orbital period, semi-major axis?

Where's the diagram of an ellipse? What is k? Also, this is far too terse. Who was Kepler? How did he arrive at his laws? Is there going to be any explanation of these laws based on Newton's laws? And so on. Furthermore the question "Using what you know about the Earth's orbit . . . " assumes that the student knows about and understands the Earth's orbit. Don't assume they know anything about the Earth's orbit. I hope a course prerequisite is simple algebra (or that this has been taught earlier in the course). The terse answer "3.5 years" is not enough for distance-learning students. You need the full working, with particular attention to units. A comment should be added on significant figures.

In addition to supportive texts, significant learning in astronomy can be accomplished via observations, without access to telescopes or laboratories, using readily available items, for example, to measure the luminosity of the Sun, with an electric light bulb (and power supply) as the most "advanced" item, or to measure the length of the sidereal day, which requires only a watch. Observational work can also be performed using virtual observatories and robotic telescopes. Regardless of how it is performed, observational work must be integrated with the rest of the course.

5. The importance of student pacing and student support

Pacing is required to prevent study-time build-up. Specify the hours needed to reach various stages of learning, with realistic ranges, based on real time, not the "university clock". Stop-and-think questions, and end-of-section questions not only aid learning, but enable the student to check that the learning outcomes associated with each stage have been reached. Continuous assessment not only provides student grades, but also provides pacing by setting submission deadlines a few times a year: some should be tutor marked assignments (TMAs), others (multiple choice) computer marked assignments (CMAs).

Student support is vital. Access to a tutor, via letter, but preferably via telephone or email, plus group meetings (tutorials) in urban areas, is desirable. Likewise, access to other students by similar means is also important, though easier in urban areas.

Continuous assessment also provides student support. As well as their grading and pacing functions, TMAs and CMAs should provide teaching, via tutor comments on TMAs, or via automated feedback on CMAs. Electronic submission and feedback could be an option, but *not* a requirement.

6. The problem of plagiarism

Plagiarism is a particular challenge for the assessment of distance-learning assignments. Take steps as follows. Avoid using questions openly available on the internet — at the very least, "version" them. Student self-help groups are to be encouraged, but plagiarism is a danger. Spot-checks on work from different students can be revealing (e.g. the curious case of the spelling mistakes common to two students' assignments points to "cut-and-paste" plagiarism!). An invigilated written examination will usually reveal if the continuous assessment grades are a fair reflection.

7. Examinations

If successful course completion is for professional advancement there needs to be an invigilated examination (which can be submitted electronically). Proof of identity with a photograph needs to be presented to the invigilator. A suitable examination venue and invigilation should be arranged as close to the student/group of students as possible. A

few determined cheats might still defeat the system, but as always, they are ultimately only cheating themselves.

8. Closing the loop - student feedback

Any educational system must seek to improve itself. A crucial ingredient is feedback from students. Do not rely passively on feedback, but design a system, perhaps with some enticement, such as reduced fees on future courses.

9. Conclusion

Distance education is not an easy option for the student, but it can reach students who otherwise would have no option at all.

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