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Analysis of The Influence Of Digital Quiz Formats On The Learning Success Of Learners In Vocational Education And Training Using The Example Of The Subjects Economics And Accounting

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ABSTRACT

In the context of vocational schools, a key didactic challenge is preparing learners for a digitalized professional world through media and digital education. This includes integrating new teaching approaches. Accordingly, this practical school research project investigates the relevance of the digital quiz platform "Kahoot!" in the learning process. The individualized, stimulus-rich, and interactive nature of such quizzes holds significant didactic potential and offers valuable feedback functions. The study focuses on the positive effects of Kahoot! on learning outcomes, with a differentiated analysis across various commercial subjects. Performance tests were conducted across different groups of learners at the end of a series of lessons to statistically measure the impact of the digital quiz. Results indicate that Kahoot! generally had a positive effect on learner performance, showing statistically significant differences. Moreover, learners in business studies with accounting tended to benefit more from Kahoot! than those in economics, though no statistically significant differences were found between these subjects.

KEYWORDS: digital quiz, learning success, vocational education, didactics of economics, Kahoot

1 INTRODUCTION

In the context of vocational schools, digital education is emerging as a particular didactic challenge. In line with the didactic principles of action orientation and practical relevance, it should be emphasized that vocational schools are particularly affected by the technological and economic changes of digitalization due to their proximity to the world of work. The increasing demands of the world of work are also reflected in practical teaching [1].

The interaction between teachers and learners as a typification of teaching, in which the learning activities of the learners are stimulated and supported by specific teaching activities, provides the didactic conclusion that digital media can function as learning material and at the same time as a learning tool in addition to traditional forms of teaching [2]. This results in formal and content-related restructuring of learning processes that promote both independence and the development of individual potential [1].

In general, study results on the use of media in connection with laptop or tablet projects show that the use of digital media strengthens interdisciplinary skills. These interdisciplinary competences include motivational effects, increased media skills, greater self-control and an improvement in cognitive complexity [2].

The potential of digital media in relation to the entire educational process arises in connection with sensory modalities and process structures. The combination of auditory, visual and haptic modalities in connection with the use of digital media enables learners to develop their full potential. In addition, the sequence structures enable a high degree of individualization and process-based learning progress. The type, number and difficulty of tasks in the digital space can be adapted to the level of performance and prior knowledge of the users [3]. This last feature in particular emphasizes the adaptability and feedback function of digital learning opportunities. The media are directly linked to the learning and performance requirements of the learners and can provide information about the learning progress for the learners themselves through direct feedback on the current level of knowledge [3]. Hattie [22] show that greater effectiveness can be achieved if there is a high level of control over the learning process by the learners, if peer relationships are activated and if feedback opportunities are created for the learners. It should also be noted that the effects increase when the learners' autonomy increases [2]. In order to meet the needs and lifeworld of learners, digital media are gradually being introduced into the classroom. "Digital natives" favour experiential learning over passive learning [4]. The game-based learning approach pursues the goal of activating learners by combining playful (learning) elements with knowledge acquisition. Digital quiz platforms such as Kahoot are a prime example of the increasing popularity of game-based learning.

The use of quizzes in teaching is a modern field of research that has been gaining more and more attention in empirical discourse in recent years due to the increasing digitalization of education. Most literature focuses on the effects of quizzes on learning success, classroom dynamics and the attitudes and perceptions of learners and teachers. The majority of empirical research can be assigned to the university context. In their studies, Nevid/Mahoon [5], Osman [6], Bawa [7] and Brink [8] demonstrate a positive effect on students' learning success through the use of quizzes in a university setting. In a school context, Gholami/Moghaddam [9] and Haigh [10] have shown a positive correlation between analog quiz formats and learning performance in their experiments. Current studies are investigating the effects of the increasingly popular online quiz format Kahoot on the learning performance of students and learners at mainstream schools. Ares et al. [11], Bawa [7], Esteves et al. [12], Göksün/Gürsoy [13], Toth/Logo/Logo [14] and Tsihouridis/Vavougios/Ioannidis [15]

demonstrate an increase in performance among students/learners at mainstream schools in experimental groups in which Kahoot was used as a didactic tool. In addition, studies come to the conclusion that a quiz promotes the participation of students/learners at mainstream schools, increases their motivation and boosts the knowledge they can recall (cf. [16], [17], [18], [19]). Gamified multiple-choice tests have the potential to improve the quality of learning by better involving learners in learning activities, increasing engagement and satisfaction and thus increasing learning effectiveness [20]. Regularly conducted quizzes can lead to better and more intensive preparation on the part of students/learners at mainstream schools [21], [8]. Digital quizzes have an immediate feedback function for the participants [8], can promote retention if repeated regularly [9] and lead to greater engagement on the part of the participants [7].

The study-based findings on laptop and tablet classes and the meta-studies by Hattie [22] as well as the wide-ranging international research on quiz formats outline the current state of research and the expected effectiveness for learning success. However, there is a research gap in terms of transferability to the target group-specific structure at vocational schools.

International comparative studies such as the ICIL study [23] on the topic of digital media in the classroom are aimed at learners at lower secondary level of general education schools and often only emphasize the media skills to be acquired, but not the possibilities of a learning success-promoting component of the use of digital media [25].

Furthermore, the majority of studies carried out on quiz formats took place in a university setting, in which the effect of the quiz on students' learning performance was researched. These results are a good indicator of the effectiveness of a quiz in the school context, but cannot be explicitly transferred and must be examined in the corresponding context of vocational schools. A high degree of self-regulation and independence as well as the willingness to prepare for the respective content on their own responsibility are expected of students and are the prerequisite for the successful implementation of the quiz. The extent to which this knowledge can be transferred to learners at mainstream schools has not yet been researched in the context of quiz implementation. The effect of game-based learning on the learning success of students at vocational colleges is a research gap, as is the suitability of commercial subjects such as business studies and economics for a quiz.

Generation of Hypothesis

As already shown in the above-mentioned Hattie study [22], the use of media in lessons is particularly effective when learners are given the opportunity to receive feedback and peer relationships are activated. The quiz serves various feedback levels of the Hattie model [26]. On the one hand, it fulfills the function of providing immediate feedback on the task, in this case the quiz question, by declaring the answer as correct or incorrect. However, it is not only the correctness of the task solution that is reflected to the learner in the context of a quiz, but also the learner's own positioning in the learning process in the sense of self-regulation and self-assessment. This enables learners to draw conclusions about their learning needs, i.e. which content has been well internalized and which needs to be further deepened [26]. In addition to the emphasized feedback opportunities in knowledge building for learners, the quiz also offers didactic assistance for teachers in planning the teaching-learning process. Furthermore, Herzig [2] states that media with a short time intensity and a direct stimulus prove to be particularly effective for learning success. This requirement can be considered a given due to the time-limited use in class.

A quiz can also fulfil the function of securing knowledge by consolidating acquired knowledge through repetition and practice as a kind of "drill & practice" program [27]. As

part of the "drill & practice" principle, the learner receives the corresponding solution immediately after answering the question. It has been shown that learning games, which include quizzes, promote learning success significantly better than regular learning opportunities [28].

In a repetitive lesson introduction that picks up on the topics of the previous lesson unit, the quiz offers a promising approach as a reproductive element. This can also be deduced from the study by Haigh [10].

Previous studies have shown a positive correlation between the use of Kahoot as a tool in the teaching/learning context and an increase in the learning success of participating learners (cf. [11], [7], [12], [13], [14], [15]. In the studies listed, improved learner performance was diagnosed as a result of taking the Kahoot quiz format. In addition, other positive effects on learning success such as improved class dynamics [29], increased motivation [30], [31], participation and engagement [32], [33], [34] as well as increased attention [34] through the use of kahoots in the didactic setting.

Wang/Tahir [35] apply Malone's [36] findings regarding intrinsic motivation to the characteristics of kahoots. Kahoot combines the three elements of challenge, fantasy and curiosity. The fantasy character is generated by the temporary transformation of the classroom into a quiz show. The challenge effect is created by the uncertain outcome of the quiz and the variable level of difficulty. Curiosity is created by animated graphics, the audio setting and the general graphic design of Kahoot. In addition, the anonymity of the participants prevents a stressful situation and the fear of losing [35].

Based on the aforementioned features that are achieved through the use of a quiz and on the findings of the studies already conducted, it can be anticipated that a digital quiz has a positive effect on the learning success of learners at vocational schools. On this basis, the following unidirectional hypothesis should be tested.

Hypothesis 1:

Learners in the area of commercial education for whom a kahoot was carried out at the beginning of a lesson within a series of lessons will perform better in learning assessments than learners for whom this was not the case.

Furthermore, in connection with the use of quiz formats in lessons, a distinction can and should be made between the effects on different subjects. The two commercial subjects on which the study is based, "business administration with accounting" and "economics", show fundamental differences due to the objectives formulated in the curriculum. The subject "Economics" builds on the findings and procedures of business administration and also requires learners to reflect critically [37]. Based on Bloom's six-level taxonomy of learning objectives, the operators taken up in the objectives of the fields of action and tasks can be considered in a differentiated manner [38]. The subject "Business Administration with Accounting" has a fundamentally different pattern of requirements, as on the one hand mathematical operators such as document-oriented recording, carrying out bookings, determining and on the other hand operators such as describing, creating, presenting are often used. The latter operators indicate a requirement level in levels 1-3 of Bloom's taxonomy and primarily relate to the understanding and application of knowledge [39]. In contrast, the subject "Economics" often mentions operators such as analyze, evaluate, compare, critically analyze, which are located in the higher levels 4-6 according to Bloom's taxonomy [37]. These requirements in the areas of analysis, synthesis and evaluation correspond to a reflective, controversial and productive development of individual skills in the subject

"Economics". In comparison to "Business Administration with Accounting", the mathematical and reproductive operators take a back seat. In addition, the competencies of knowledge and skills are primarily addressed in various fields of activity in the subject "Business Administration with Accounting" and the competencies of independence and social competence are less affected [39]. In summary, it can be deduced from this that an imaginary division into reproductive and productive skills development can be made between the two subjects.

In the context of the operators, the concept of a quiz format to ensure learning progress can be classified as a task primarily in the lower taxonomy levels 1-3, as the assurance of learning progress or feedback on the learning process primarily addresses the area of knowledge acquisition and understanding. Furthermore, the quiz is limited in terms of open and discursive answer options and only allows for "right-or-wrong" tendencies. In this sense, it can be assumed that a quiz achieves greater learning success in subjects with reproducing and mathematical structures than in subjects with a high critical reflection and action orientation.

Hypothesis 2:

The use of digital quiz formats to ensure learning progress achieves greater success among learners in the subject "Business Administration with Accounting" than in the subject "Economics".

2 RESULTS

2.1 Results for Hypothesis 1

The entire sample (n=243) is to be tested for homogeneity of variance using a type of pre-test based on the learners' previous exam results in percent in order to ensure the validity of a t-test in advance. The two-sample F-test is generally based on the null hypothesis that there is no difference in variance between the samples under consideration. If the test variable F exceeds the critical F value in a one-sided test, the null hypothesis must be rejected [40].

Table 1: Two-sample F-test to check the homogeneity of variance in the pre-test

	<i>Control groups</i>	<i>Experimental groups</i>
Mean	61,904	64,3559
Variance	469,5875	428,7098
Degrees of freedom (df)	124	117
Test statistic (F)	1,0954	
P(F<=f) one-sided	0,3098	
Critical F value for one-sided test	1,3522	

However, the aforementioned null hypothesis for the two-sample F-test cannot be rejected on the basis of the data shown in Table 1, as $F=1.0954 < F_{crit.}=1.3522$. Thus, there is no difference in the variances in the samples considered and variance homogeneity can be assumed in the pre-test.

The situation is similar for the variance comparison for hypothesis 1, in which the results of the entire experimental group with Kahoot are to be compared with those of the entire control group without Kahoot.

Table 2: Two-sample F-test to test the homogeneity of variance for hypothesis 1

	<i>Total experimental group with kahoot</i>	<i>Total experimental group without kahoot</i>
Mean	66,3475	59,6640
Variance	616,8611	607,4023
Degrees of freedom (df)	117	124
Test statistic (F)	1,0156	
P(F≤f) one-sided	0,4656	
Critical F value for one-sided test	1,3502	

As can be seen in Table 2, the selected samples based on the results of the learning status survey at the end of the study period fulfill the required criterion of variance homogeneity, since $F=1.0156 < F_{crit.}=1.3502$.

It is now necessary to analyze the learner results from the learning status survey in a mean value comparison with regard to hypothesis 1 as part of a two-sample t-test. The aim is to reject the null hypothesis, according to which there is no difference between learners with Kahoot and without Kahoot. Taking variance homogeneity and a given normal distribution into account, a two-sample t-test can be carried out assuming equal variances. Since the formulation of hypothesis 1 assumes a directional increase in learning success, the results of the t-test are only considered with regard to one-sided effects.

Table 3: Two-sample t-test assuming equal variances to test hypothesis 1

	<i>Total experimental group with kahoot</i>	<i>Total experimental group without kahoot</i>
Mean	66,3475	59,6640
Variance	616,8611	607,4023
Hypothetical difference in mean values	0	
Degrees of freedom (df)	241	
t-statistics	2,1048	
P(T≤t) one-sided	0,0182	
Critical t-value for one-sided t-test	1,6512	

When evaluating the two-sample t-test, it is essential to consider the p-value. The specified significance level $\alpha=0.05$ is the decisive point of reference here. If there is a p-value of less than 0.05, there is a statistically significant effect, as this indicates statistical significance with a confidence level of more than 95% for the compared mean values [41]. The assumption of $p < 0.05$ means that the null hypothesis, according to which there are no differences, can be rejected. Table 3 shows that the null hypothesis for hypothesis 1 can be rejected and hypothesis 1 can be accepted, as $p=0.0182 < \alpha=0.05$. As a result, the learners in the experimental group who completed a kahoot at the start of the lesson performed significantly better in the learning status survey than the learners without a kahoot.

2.2 Results for Hypothesis 2

To test the second hypothesis that the positive effect of Kahoots for learners is stronger in business administration with accounting than in economics, four two-sample t-tests will be

set up below. Only the learning groups of the commercial vocational colleges form the data basis.

Table 4: Two-sample F-test to test the homogeneity of variance between the results of the control groups and experimental groups at commercial vocational colleges

	<i>Total experimental group without kahoot</i>	<i>Total experimental group with kahoot</i>
Mean	60,7647	68,6311
Variance	604,6768	584,8429
Degrees of freedom (df)	101	102
Test statistic (F)	1,0339	
P(F<=f) one-sided	0,4333	
Critical F-value for one-sided test	1,3881	

Analogous to the testing of hypothesis 1, the experimental and control groups must first be compared in Table 4, but at this point adjusted for the learning groups from the technical vocational college. Since $F=1.0339 < F_{crit.}=1.3881$, variance homogeneity can be assumed for the samples, so that a two-sample t-test is possible assuming equal variances.

Table 5: Two-sample t-test assuming equal variances to test for significant differences between the experimental groups and control groups at commercial vocational colleges

	<i>Total experimental group with kahoot</i>	<i>Total experimental group without kahoot</i>
Mean	68,6311	60,7647
Variance	584,8429	604,6768
Hypothetical difference in mean values	0	
Degrees of freedom (df)	203	
t-statistics	2,3092	
P(T<=t) one-sided	0,0110	
Critical t-value for one-sided t-test	1,6524	

Similar to the results for hypothesis 1, Table 5 shows that learners in the experimental group achieved significantly better results than those in the control group, as $p=0.0110 < \alpha=0.05$. This further confirms that quizzes generally have a positive influence on learners' success in the learning assessment. A general comparison of the learners' results in the subjects of business studies and economics is also carried out.

Table 6: Two-sample F-test to check the homogeneity of variance between the results in business studies and economics

	<i>Economics</i>	<i>Business administration</i>
Mean	60,7216	68,3056
Variance	694,2655	507,5600
Degrees of freedom (df)	96	107
Test statistic (F)	1,3678	
P(F<=f) one-sided	0,0575	
Critical F-value for one-sided test	1,3866	

Since $F=1.3678 < F_{crit.}=1.3866$ applies in Table 6, a two-sample t-test can be carried out under the assumption of equal variances.

Table 7: Two-sample t-test assuming equal variances to test for significant differences between the subjects of business administration and economics

	<i>Business administration</i>	<i>Economics</i>
Mean	68,3056	60,7216
Variance	507,5600	694,2655
Hypothetical difference in mean values	0	
Degrees of freedom (df)	203	
t-statistic	2,2210	
P(T<=t) one-sided	0,0137	
Critical t-value for one-sided t-test	1,6524	

Table 7 shows that $p=0.0137 < \alpha=0.05$ and thus a significant difference can be assumed between the subjects of business studies and economics. This initially means that the results of the learning status surveys were significantly better in business studies than in economics. In order to be able to explain and verify the statistically significant difference between the subjects in the learning level surveys and thus hypothesis 2 with the help of the assumption that learners achieve significantly better results with Kahoot, the control and experimental groups of the two subjects will be considered separately below.

Table 8: Two-sample F-test to test the homogeneity of variance between the control groups in business studies and economics

	<i>Control groups economics</i>	<i>Control groups business administration</i>
Mean	56,7347	64,4906
Variance	672,4490	524,2932
Degrees of freedom (df)	48	52
Test statistic (F)	1,2826	
P(F<=f) one-sided	0,1897	
Critical F-value for one-sided test	1,5960	

Since $F=1.2826 < F_{crit.}=1.5960$ (Table 8), a two-sample t-test can again be carried out assuming equal variances for the control groups.

Table 9: Two-sample t-test assuming equal variances to test for significant differences between the control groups of the two subjects business administration and economics

	<i>Control groups business administration</i>	<i>Control groups economics</i>
Mean	64,4906	56,7347
Variance	524,2932	672,4490
Hypothetical difference in mean values	0	
Degrees of freedom (df)	100	
t-statistic	1,6038	
P(T<=t) one-sided	0,0560	
Critical t-value for one-sided t-test	1,6602	

A statistically significant result of this t-test would mean that the control groups in business studies with accounting achieve significantly better results than the control groups in economics, even without kahoots. However, since $p=0.0560 > \alpha=0.05$, this assumption

cannot be confirmed with the help of Table 9, so that the learners in business studies do not show significantly better results. Despite the high difference in the mean values (mean=64.4906 and mean=56.7647), the assumption therefore remains that the above general statistical significance between the two subjects is due to the use of the kahoots. To finally accept hypothesis 2, the experimental groups of the two subjects should be compared.

Table 10: Two-sample F-test to test the homogeneity of variance between the experimental groups of the two subjects business administration and economics

	<i>Experimental groups economics</i>	<i>Experimental groups business administration</i>
Mean	64,7917	71,9818
Variance	697,8280	472,7960
Degrees of freedom (df)	47	54
Test statistic (F)	1,4760	
P(F<=f) one-sided	0,0836	
Critical F-value for one-sided test	1,5905	

As can be seen in Table 10 by $F=1.4760 < F_{crit}=1.5905$, a two-sample t-test can finally be carried out assuming equal variances for the experimental groups.

Table 11: Two-sample t-test assuming equal variances to test for significant differences between the experimental groups of the two subjects business administration and economics

	<i>Experimental groups business administration</i>	<i>Experimental groups economics</i>
Mean	71,9818	64,7917
Variance	472,7960	697,8280
Hypothetical difference in mean values	0	
Degrees of freedom (df)	101	
t-statistic	1,5147	
P(T<=t) one-sided	0,0665	
Critical t-value for one-sided t-test	1,6601	

Similar to the control groups, the experimental groups in the subject comparison differ significantly in the difference between the mean values (mean=71.9818 and mean=64.7917). However, even in this t-test shown in Table 11, the mean values do not differ statistically significantly from each other, as $p=0.0665 > \alpha=0.05$, so that the conclusion can be drawn that the experimental groups in business administration perform better, but not significantly better, than the experimental groups in economics. In the context of the four two-sample t-tests carried out, the null hypothesis H_0 of hypothesis 2 can therefore not be rejected. Conversely, hypothesis 2 must therefore generally be rejected, as the statistically significant differences of the t-tests initially carried out in the subject comparison cannot ultimately be confirmed by statistical significance between the experimental groups.

3 DISCUSSION

The aim of the research project was to transfer the positive effects of quiz formats in the classroom derived from other studies to vocational schools using the example of Kahoot and

to examine possible subject-related differences. In general, based on the results of the inductive statistics for hypothesis 1, it can be concluded that the use of Kahoots as a reproducible element at the start of the lesson has a positive effect on the performance of learners in the learning success measurement. The experimental groups that completed a kahoot in three consecutive teaching units achieved significantly better results, thus supporting the assumptions formulated in Chapters 1 and 2. The study results of Ares et al. [11], Bawa [7], Esteves et al. [12], Göksün/Gürsoy [13], Toth/Logo/Logo [14] and Tsihouridis/Vavougiou/Ioannidis [15], among others, can therefore also be transferred to the vocational school context. However, the second hypothesis that a quiz achieves higher learning success in subjects with reproducible and mathematical structures (business studies) than in subjects with a high critical reflection and action orientation (economics) could not be proven with statistically significant differences. Although the differences in the mean values of the experimental groups suggest such a tendency, they are not statistically significant. Rather, the high mean differences between the two subjects in Tables 7, 9 and 11 for hypothesis 2 allow the assumption that generally better results were achieved in business administration with accounting than in economics and that these differences cannot be explained solely by the use of the kahoots. Limitatively, it must therefore be noted that the learners in the samples always tend to achieve better results in business studies with accounting, regardless of the kahoots. This should possibly have been analyzed in a two-sample test as part of the pre-test on the basis of the previous exam results in order to anticipate and control such subject-related performance differences at an early stage. However, the rejection of hypothesis 2 on the basis of the data collected may also be due to possible uncontrollable confounding factors. The data collection in the form of the learning status survey took place in the temporal context of the Covid-19 pandemic, so that the influences of distance and alternating teaching at the vocational colleges on the learners' performance should not be underestimated. Furthermore, the differences between the two subjects, some of which are significant, may be attributable to the fields of activity, meaning that differences in performance in this measurement may be distorted by the requirements or levels of difficulty of the teaching topics. The same applies to the quality criterion of objectivity during implementation. Although the attempt to carry out the same teaching units by different teachers at different vocational colleges fulfills the requirement of objectivity, even the smallest communicative differences in teaching behavior could cause deviations at the learner level. It must therefore also be stated that uncontrollable distortions can arise from the teaching behavior and study design.

4 METHODOLOGY

In order to make the positive effects on learning success and retention performance outlined at the beginning of the studies measurable, the data collection planned for this empirical project takes the form of outcome diagnostics, as this can provide information about the learning success of the teaching unit [42].

The initial situation consists of five different vocational colleges. Four of these vocational colleges are commercial vocational colleges and one is a vocational college for technology. In the following, the inductive test procedure considers the population of all participating learners from the five vocational schools in the Aachen city region and the surrounding area. In order to be able to make a reliable representative statement and adequately compare the given statistical units, a deliberate sample selection is generated [43].

The measurement is carried out in six comparable classes of the two-year vocational college in the field of business and administration, which are taught in the subjects of business administration with accounting and economics in the same fields of activity. At the technical vocational college, two classes of the two-year vocational school in the subject area of technology are also considered in the subject of economics. The selection of the classes is based on the didactic analysis of the supervising teachers, as their experience and expertise provide them with the appropriate diagnostic skills to select classes of approximately equal performance. By including the learners' previous exam results as a percentage and in anonymized form, this approach of approximate homogeneity can be supported and offers an approach for the following variance comparisons. An attempt is made to carry out the same series of lessons in the control and experimental groups, which differ only in that quizzes on the content of the previous lesson are carried out at the beginning of the lesson in the experimental group, which is not done in the control group. This modification of the lesson takes place in three thematically consecutive teaching units. At the end of the teaching units, both learning groups (control/experimental group) are given an identical written learning assessment, which is thematically based on the Kahoots question items. The results in the form of the percentage of correct answers in the learning level survey allow conclusions to be drawn about the influence of the quiz on learning success when comparing the control and experimental groups.

Inductive statistics offers the possibility of drawing conclusions from the results of individual or several samples regarding the validity of the population. It is of particular interest to test the previously established hypotheses in the course of a hypothesis test. This is to be applied methodically in the form of t-tests in order to determine whether there is a statistically significant difference between two samples. The sample size in the present study design is $n=243$ for hypothesis 1 and $n=205$ for hypothesis 2. The application of various two-sample t-tests is shown below, as in the course of the previous hypothesis formulations, two samples are to be compared in terms of their mean values and considered with regard to significant differences [43].

The samples to be compared are to be regarded as independent samples in nature, as the values of two groups of learners are compared in each case. Since the t-test for independent samples requires variance homogeneity, the comparability of the two selected samples should firstly be ensured by the fact that all learning groups come from courses of study that aim to acquire a level 4-degree of the German Qualifications Framework [44]. In the course of this, an approximately equal variance can be assumed, which, however, should secondly be statistically tested and confirmed by a two-sample F-test. This variance test is initially carried out on the basis of previous exam results of the learning groups examined as a kind of pre-test. In order to be able to guarantee the criterion of variance homogeneity in the following t-tests as well, a test of variance homogeneity is carried out for each additional t-test in order to guarantee empirically meaningful data. The other conditions for carrying out a t-test for independent samples are normal distribution and interval scaling. Furthermore, a significance level of $\alpha=0.05$ is selected [43].

Central to the use of the t-test is the null hypothesis, according to which the differences in the mean values are due to chance and there are no real differences between the groups. The aim is to reject this null hypothesis and accept the alternative hypothesis [43]. With regard to the tests to be compared, the null hypothesis H_0 for the first hypothesis states that there are no statistically significant differences between the learning groups that use a kahoot in class and those that do not use a kahoot in class. In contrast, the alternative hypothesis H_1 corresponds to the previously established hypothesis 1 and expects a statistically significant difference. In

the following, the mean values of the learning groups (n=243) that carried out a quiz in the classroom for interim learning assurance (experimental group) and those that did not carry out a quiz (control group) are compared and interpreted using a t-test.

With regard to the second hypothesis at hand, the null hypothesis H₀ can be formulated that there is no statistically significant difference in the influence of a quiz on the two contrasting commercial subjects "Business Administration with Accounting" and "Economics". Here, too, the alternative hypothesis H₁ corresponds to hypothesis 2 set out in a previous chapter. In the following, the mean values of the learning groups (n=205) that used a quiz in class are compared in relation to the subjects taught, "business administration with accounting" and "economics", in a total of four t-tests.

5 CONCLUSION

Despite possible limitations, the significant results for hypothesis 1 allow the conclusion that the use of Kahoots as a supplement to the analog teaching process is definitely advisable, as the initial considerations on the findings of Herzig [2] already suggested. At this point, it should only be noted that the integration of Kahoots should be didactically well thought out and justified with regard to both teaching topics and teaching phases. There is a risk that the activating and learning-promoting effect could be undermined if repeated too frequently in successive teaching units, leading to the conclusion that the motivating and self-regulatory effect of Kahoot is primarily dependent on a short, temporal intensity, as already assumed in Chapter 1.

In order to further strengthen the results of the first hypothesis in particular, a future, renewed survey would be conceivable both in terms of reliability and to validate the statements about the target population [41]. Furthermore, the question arises as to which direction further research on digital quiz formats in the classroom can take. In the context of this research project, the Kahoot quiz format was a useful addition to the classroom activities, which was demonstrated by the better results in the learning success survey. Nevertheless, the follow-up question arises as to how these performance gains came about from the learners' perspective: Were they motivational effects due to the inclusion of a digital, game-based format or did the gains result from the repetitive lesson introduction in the form of a quiz? Now that this project has attempted to analyze the effect of Kahoots with regard to a possible subject reference, further conceivable approaches could be found in studies on the effect in different educational courses or in a comparison of the effect on low-performing or high-performing learners. Finally, the focus should be shifted from the learning status surveys at the end of the study period to the individual kahoots. It is possible that both motivational and learning success-specific effects would change if individual quizzes were linked to extrinsic stimuli (e.g. grade bonuses for the three best learners in the quiz) and the focus were thus on the quizzes in a competitive form and not on the learning success assessment.

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Knowledge Obsolescence and Under-Enrolment: Implications for Higher Education Policy and Sustainability

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Abstract

The rapid pace of technological advancement and shifting labour market demands have intensified concerns about knowledge obsolescence in higher education, posing significant challenges to university enrolment and sustainability. This concept paper explored the relationship between outdated curricula, faculty knowledge obsolescence, and declining enrolment trends, particularly in the context of rising tuition costs and the growing preference for alternative educational pathways such as online courses, micro-credentials, and skills-based certifications. Drawing on data from North America and Europe, the study highlighted a decline in traditional undergraduate enrolment, contrasted with a surge in international and online student enrolment. The paper argued that the disconnect between academic content and industry needs has led to student disengagement and skepticism about the value of traditional degrees. Institutional responses, including curriculum reform, technological integration, and lifelong learning initiatives, were examined as potential solutions to mitigate these challenges. Policy recommendations provided directional guidelines that align educational offerings with market requirements, fostering industry-academia collaborations, and addressing demographic shifts to sustain enrolment. The study concluded that proactive adaptation to knowledge renewal and evolving student preferences are essential for higher education institutions to achieve sustainability and remain competitive in an evolving global landscape. Future research was recommended to explore the correlation between faculty knowledge obsolescence and enrolment trends, using quantitative models to inform strategic interventions.

Keywords: knowledge obsolescence, higher education enrolment, curriculum reform, lifelong learning, technological integration, policy implications.

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6 INTRODUCTION

The relationship between knowledge obsolescence in higher education and its impact on university enrolment has emerged as a critical area of study in an era characterized by rapid technological advancement and shifting job market demands. Knowledge obsolescence refers to the decline in relevance and applicability of skills and information acquired during formal education, necessitating continuous updates to curricula and teaching methods to meet the evolving needs of students, emerging entrepreneurs, and employers (Bilimoria & Kim, 2020). As the landscape of available knowledge changes, prospective students increasingly prioritize vocational training and certification programs over traditional degree pathways, prompting universities to reassess their educational offerings to maintain relevance and competitiveness.

This phenomenon has significant implications for university enrolment rates. Research indicates (Dempsey & Smith, 2019) that many students perceive a disconnect between what is taught in universities and the practical skills sought by employers, contributing to declining enrolment figures in traditional higher education institutions. This perception of outdated academic content can lead to student disengagement and diminished interest in pursuing a degree.

The urgency for universities to adopt real-time content updates and innovative educational strategies has intensified, with many educators advocating for the incorporation of lifelong learning as a central component of academic programs (Gallagher & Robinson, 2020). Prominent controversies surrounding this topic include the debate over the value of traditional degrees versus alternative educational pathways, such as online courses and skill-based certifications, as well as the role of universities in preparing graduates for an increasingly dynamic workforce. Critics argue that without a proactive approach to addressing knowledge obsolescence, higher education institutions risk losing their status as primary sources of knowledge and skill development, which could have long-lasting repercussions for both student outcomes and institutional viability.

Ultimately, understanding the relationship between knowledge obsolescence and university enrolment is essential for educational institutions striving to adapt to contemporary challenges. By embracing innovative approaches and ensuring their curricula remain aligned with industry demands, universities can enhance student engagement, improve employability and entrepreneurial outcomes, and sustain enrolment in an increasingly competitive educational landscape.

6.1 Knowledge Obsolescence in Higher Education

The phenomenon of knowledge obsolescence has become increasingly significant in higher education, impacting both the curriculum and the value of a college degree. As technology evolves at a rapid pace, many educational materials, including textbooks and course content, often lag behind current knowledge and practices. This issue is further exacerbated by societal shifts and the changes in industry demands (Bilimora & Kim, 2020). This disconnect leaves students feeling disengaged and frustrated with a consequential impact on learning experiences. (Siphiwe, 2024).

6.2 Enrolment and Higher Education Policy

Using the definition of knowledge obsolescence advanced by Bilimoria & Kim, 2020; a linear model was developed to establish linkages between enrolment, knowledge obsolescence, higher education current responses, and the development of policies that may address the issues in the linear relationship. Figure 1 shows the relationship between enrolment and higher education policy.



Figure 1: Linear model - Enrolment and higher education policy

6.3 Impact on Learning Experiences

Outdated educational materials can profoundly affect students' learning experiences. When learners encounter content that does not align with their lived experiences or current societal contexts, learners may struggle to connect with the material. This disconnect often leads to apathy and disinterest in the subject matter, hindering students' ability to engage fully and grasp essential concepts. Moreover, the reliance on obsolete knowledge can create confusion, leading to misconceptions that impede a deeper understanding of critical subjects (Siphiwe, 2024).

6.4 Shift in Higher Education Paradigms

The shift towards skills-based hiring and the increased demand for competency credentialing have intensified the scrutiny of higher education's relevance. Students and parents are questioning the value of a college degree in employment that increasingly favors practical skills over traditional academic qualifications. The rising tuition costs coupled with the challenges posed by outdated curricula have spurred a reevaluation of the university's role and mission in the modern economy (Anderson, 2024; Dickinson, 2024).

As noted by Hal Varian, chief economist at Google, there is a pressing need for universities to focus more on "how to learn" rather than merely imparting knowledge,

highlighting the importance of adaptability in education to prepare students for a rapidly evolving job market (Anderson, 2024). While the paradigm of “how to learn” might be the directional way forward the rapid pace of technology has inherently brought its challenges to the learning spaces.

6.5 Technological Advancements and Their Challenges

Advancements in technology have offered new possibilities for educational institutions, allowing professors to create and disseminate their course materials more efficiently. However, these developments also present challenges, as universities must navigate the balance between adopting new technologies and ensuring that the content remains relevant and effective ("The State of Higher Ed," 2025)

There is little doubt that technological change has altered instructional delivery. Over the years this change has transitioned from chemical to electronic processes, industrial to a new knowledge age, manual to automated labour, analog to digital, and artificial intelligence to deep learning systems. As the technological revolution accelerates at high speeds, university faculty will have to make related adjustments to instructional delivery format, new ways of student engagement, and educational measurements.

The shift to online learning platforms during the pandemic further underscored the inadequacy of traditional learning environments, prompting institutions to demonstrate their value to in-person students and adapt to modern educational demands (Dickinson, 2024). The fundamental issue is not about the inevitability of change but rather the pace of change and the agility of higher education institutions to respond to these changes. Any shortcomings in response times by institutions may impact university enrolment.

6.6 Impact on University Enrolment

Is there a relationship between knowledge obsolescence and university enrolment? If there is, perhaps an examination of demographic and technology shifts, economic pressures, and evolving student expectations that shape the higher education landscape may provide some indicators. Recent trends (Chaudhry, 2024) indicate a complex interplay of challenges and opportunities that significantly affect enrolment figures across institutions.

Following disruptions caused by the pandemic, undergraduate enrolment at U.S. universities showed a modest increase of 1.2% in recent years, with a notable preference for four-year degree programs, where 45.1% of students are now enrolled (Blankenship & Blankenship, 2024; Chaudhry, 2024). This growth is also reflected in the rising numbers of dual-enrolled high school students, which increased by 10% for the third consecutive year, highlighting a strong interest in gaining early college experience.

The trend of returning to education is further illustrated by a 6.3% increase in freshman enrolment among students aged 21 and older, while a lower (5.3%) for a younger demographic. The higher number of relatively older students suggests that many adults are pursuing further education to reskill or shift careers (Guerra, 2024). The fundamental issue remains; are these reskilling and career shifts a function of the changing work landscape and whether or not the reskilling competency programmes at universities rising to meet these challenges?

6.7 New and Emerging Enrolment Choices

Despite these indicators, the overall landscape is marked by a decline in traditional undergraduate enrolments, with first-time freshman numbers dropping approximately 5% in the 2023-2024 academic year. Public and private nonprofit institutions have reported even steeper declines of 8.5% and 6.5%, respectively, particularly in regions like the US Midwest (*The State of Higher Ed: Enrolment Research Insights, Projections, and Winning Strategies*, 2025)

These changes can be attributed to several factors, including reduced high school graduation rates and a growing skepticism about the value of traditional degree programs amidst rising educational costs (Chaudhry, 2024). The traditional value proposition of a university degree is shifting, as employers increasingly prioritize demonstrated competencies over academic credentials.

While a degree traditionally signaled a commitment to learning and a foundation of knowledge, the accelerated pace of technological change and the changing demands from industry and employers have necessitated a re-evaluation of its significance. Employers are increasingly seeking candidates with specific, in-demand skills such as critical thinking, problem-solving, digital literacy, and adaptability (World Economic Forum, 2020). These skills, often acquired through practical experience, online courses, and certifications, can be more valuable in the modern workplace than a generic degree.

This shift has led to a growing emphasis on competency-based hiring, where employers focus on assessing an individual's skills and abilities through assessments, portfolios, and work samples, rather than solely relying on academic transcripts. This approach recognizes that individuals can acquire valuable skills through various pathways, including self-directed learning, online courses, apprenticeships, and on-the-job training. The question remains – Does the traditional academic dispensation cater to these emerging trends and is this a manifestation of declining enrolment rates?

However, it is crucial to acknowledge that a traditional degree still offers valuable benefits. It provides a structured learning environment, fosters critical thinking and research skills, and cultivates a broader understanding of complex issues. Furthermore, a degree can serve as a valuable credential in certain fields and can enhance an individual's earning potential over the long term (OECD, 2021). The key lies in finding a balance between traditional academic learning and the development of in-demand skills, ensuring that higher education prepares graduates for the realities of the modern workforce while maintaining its commitment to intellectual growth and critical inquiry.

6.8 International and Online Student Enrolment

Key factors have impacted global student enrolment; these include issues of knowledge renewal and obsolescence, the student perceptions of lack of relevance and skill-based learning in universities, the demand for new learning experiences, and the technological advancements in emerging learning spaces.

In the United States, university enrolment declined by 14.4% from 2010 to 2021. The sharpest drop being during the COVID-19 pandemic (NSCRC, 2021). In Canada, enrolment grew by 25% but this increase is largely due to a fairly liberal international student admissions policy. Excluding international student admissions, national student admissions have been relatively flat and expected to decline in the foreseeable future.

Recent shifts in US and Canadian immigration policies have had a significant impact on international student enrolment. In the US, stricter visa regulations and a more restrictive immigration climate have reduced international students from enrolling in higher education institutions in North America. The Institute of International Education (2023) reported a decline in international student enrolment in the US from 2019 to 2020, marking the first decline in over a decade. This decline has been attributed to increased visa application fees, stricter visa interview processes, and a perceived hostile environment for international students (IIE, 2023).

Similarly, recent policy changes in Canada, such as stricter eligibility criteria for study permits and increased scrutiny of international student applications, have also impacted enrolment numbers. While Canada continues to attract many international students, data from Immigration, Refugees and Citizenship Canada (2024) indicates an increase in visa processing times and a higher rejection rate for certain categories of student applications.

These policy changes have created uncertainty and increased processing times for visa applications, potentially discouraging some prospective students from applying (IRCC, 2024). These policy shifts not only affect individual students but also have broader implications for the economic and social fabric of both countries, impacting university revenues, cultural exchange, and the global competitiveness of their higher education systems. Similar enrolment declines in Italy by over 20% (OECD, 2021) have been reported with reasons reflecting demographic and economic challenges. Table 1 below shows university enrolment in the US, Canada, Germany, and Italy. There were declines in the US and Italy, almost flat growth in Canada, and moderate growth in Germany.

Table 1 University Enrolment Trends 2010-2021

Year	U.S.¹ Enrolment (Millions)	Canada² Enrolment (Millions)	Germany³ Enrolment (Millions)	Italy⁴ Enrolment (Millions)
2010	18.1	1.2	2.5	2.0
2011	18.0	1.2	2.6	1.9
2012	17.9	1.3	2.6	1.9
2013	17.8	1.3	2.7	1.8
2014	17.7	1.3	2.7	1.8
2015	17.5	1.3	2.7	1.8
2016	17.3	1.4	2.8	1.7
2017	17.1	1.4	2.8	1.7
2018	16.9	1.4	2.9	1.7
2019	16.6	1.4	2.9	1.7
2020	16.0	1.4	3.0	1.6
2021	15.5	1.5	3.0	1.6

Note: ¹NSCRC, 2021

²ICEF Monitor, 2021

³DAAD, 2021

⁴OECD, 2021

Additionally, the acceptance of online learning formats has become widespread, with enrolment rates for online courses among undergraduates (54.4%) and graduate students (53.5%) reflecting a growing preference for digital education options (Blankenship & Blankenship, 2024). This shift highlights a significant adaptation to the evolving educational landscape, as institutions strive to accommodate diverse student needs and preferences.

6.9 Implications of Knowledge Obsolescence

The ongoing demand for advanced degrees and professional development underscores the importance of higher education in a competitive job market (Blankenship & Blankenship, 2024). However, the decline in traditional enrolment raises concerns about higher education institutions' sustainability, prompting these institutions to adapt their offerings in response to job market demands, particularly in high-growth fields such as computer science and health sciences. Institutions are encouraged to streamline their enrolment processes and diversify their recruitment strategies to align with these trends, aiming to optimize the overall student experience and grow enrolment figures (Guerra, 2024).

Knowledge obsolescence may pose a significant threat to higher education enrolment. As the pace of technological advancement accelerates, the knowledge and skills acquired during a traditional degree program can quickly become outdated, leaving graduates ill-prepared for the demands of the modern workforce (Bilimoria & Kim, 2020). This can lead to a perception among prospective students that a university education is no longer a valuable investment, as they may question the relevance of the knowledge and skills they are acquiring. A study by Dempsey and Smith (2019) found that many students perceive a disconnect between the skills they acquire in higher education and the skills employers seek. This can lead to a decline in student interest in pursuing traditional degree programs.

Furthermore, the increasing availability of other learning pathways, such as online courses, micro-credentials, and industry certifications, provides students with more options for acquiring in-demand skills. These alternative pathways can be more appealing to some students than traditional degree programs, as they offer greater flexibility, faster completion times, and a more direct path to employment. This shift in student preferences can significantly impact university enrolment, as students may opt for these alternative pathways instead of pursuing a traditional degree.

The consequences of knowledge obsolescence for university enrolment can be significant. Declining enrolment rates can lead to reduced tuition revenue, budget cuts, and program closures. Moreover, it can damage the reputation of higher education institutions and erode public trust in their ability to provide students with the necessary skills and knowledge to succeed in the 21st-century workforce. To address these challenges, universities must proactively adapt their curricula, teaching methods, and educational offerings to ensure that they remain relevant and responsive to the evolving needs of students and the job market. How have higher education institutions responded to these paradigm shifts in this new and emerging educational landscape?

7 INSTITUTIONAL RESPONSES TO KNOWLEDGE OBSOLESCENCE

7.1 Importance of Updating Educational Materials

Educational institutions face the challenge of knowledge obsolescence, which significantly impacts their curricula and the relevance of their educational materials.

Updating these resources is crucial for ensuring that students receive high-quality, relevant information that reflects current standards and practices in their respective fields (McNaughton, 2024). The traditional textbook as a major reference point for knowledge may be irrelevant given the time to publication. The half-life of knowledge is approximately three years and may even be shorter in some fields of study e.g., digital technology, machine learning, and artificial intelligence. Regular evaluation and a systematic approach to revising educational materials can help institutions remain competitive and effective in their teaching methods. This process often includes just-in-time content, establishing schedules for periodic reviews, setting evaluation criteria, and soliciting feedback from various stakeholders, including students, faculty, and industry experts.

7.2 Identifying and Addressing Outdated Resources

One of the first steps in responding to knowledge obsolescence is the identification of outdated educational materials. This can be achieved through a critical examination of course content for inaccuracies and obsolete references. Further, perspectives that no longer align with contemporary knowledge and societal norms can be reexamined for relevance and pragmatism. Collaboration among faculty, regular curriculum assessments, and engagement with feedback from students and industry-specific professionals can provide insights into which materials require updating. (*The Case for Curriculum: A Nation at Risk +40*, n.d.).

Once outdated resources are identified, institutions can implement strategies for revision. These may include sourcing newer editions of textbooks or real-time digital content, integrating multimedia resources, and prioritizing diverse and inclusive content selections. Such efforts ensure that learning experiences are both relevant and engaging, better preparing students for success in a rapidly evolving world (*Obsolescence of Higher Education - Review of Economics and Finance*, 2023).

7.3 Curriculum Alignment and Employability

Curriculum reform is a key strategy that institutions can adopt to combat knowledge obsolescence. The curriculum reform agenda must be time-sensitive, industry-relevant, and promote employability and entrepreneurship. While broad consultations are necessary, reforms must not yield an output after prolonged deliberations. Knowledge has become time-sensitive and its relevance is related to the renewal rate. Curriculum reform at best, in this context, must be done in real-time if employers and budding entrepreneurs are to derive the benefits from a reformed curriculum.

How can curriculum reform be aligned with employment and entrepreneurship? The global employment disruption (job creation and elimination) forecast for 2025 to 2030 is estimated at 22% of total jobs. The Future of Jobs Report 2025, indicated new job equivalents are expected to be 14% of the total employment (approximately 170 million jobs) while job displacement/elimination is estimated at eight percent (approximately 78 million jobs). Curriculum reform deliberations must include the issues of both job elimination and addition. Content and competencies related to job addition must be added while those associated with job elimination must be avoided. This measure will narrow the knowledge obsolescence and sustain relevance and enrolment. Some of the growth areas in frontline jobs include construction workers, care economy jobs, counseling professionals, and personal care aides. In technology, the World Economic Forum survey (The Future of Jobs Report 2025, 2025)

suggest job growth in big data specialists, fintech engineers, AI and machine learning specialists, autonomous and electric vehicle specialists, and environmental and renewable energy engineers.

Similarly, jobs that are in decline or facing elimination are clerical and secretarial workers, cashiers, and ticket clerks. On the corporate front, businesses are expected to see huge declines in executive secretaries, postal service clerks, bank tellers, and data entry clerks.

In the 2025-2030 period, it is estimated that 39% of the existing workforce skill set will require upskilling or become obsolete ((The Future of Jobs Report 2025, 2025). The curriculum reform agenda must include a comprehensive assessment and competency gap analysis (see Fig 1) for each job addition with the outcome being a new data curriculum (DACUM) relevant to the industry projections.

A focus on high-quality instructional materials and effective training for educators can significantly improve the academic experience for students. Reform efforts should be comprehensive, addressing both the content delivered and the methods of instruction employed. As educational demands continue to evolve, institutions need to be adaptable and proactive in their approaches to curriculum design, allowing them to meet the needs of new and emerging student personas (Nguyen, 2021).

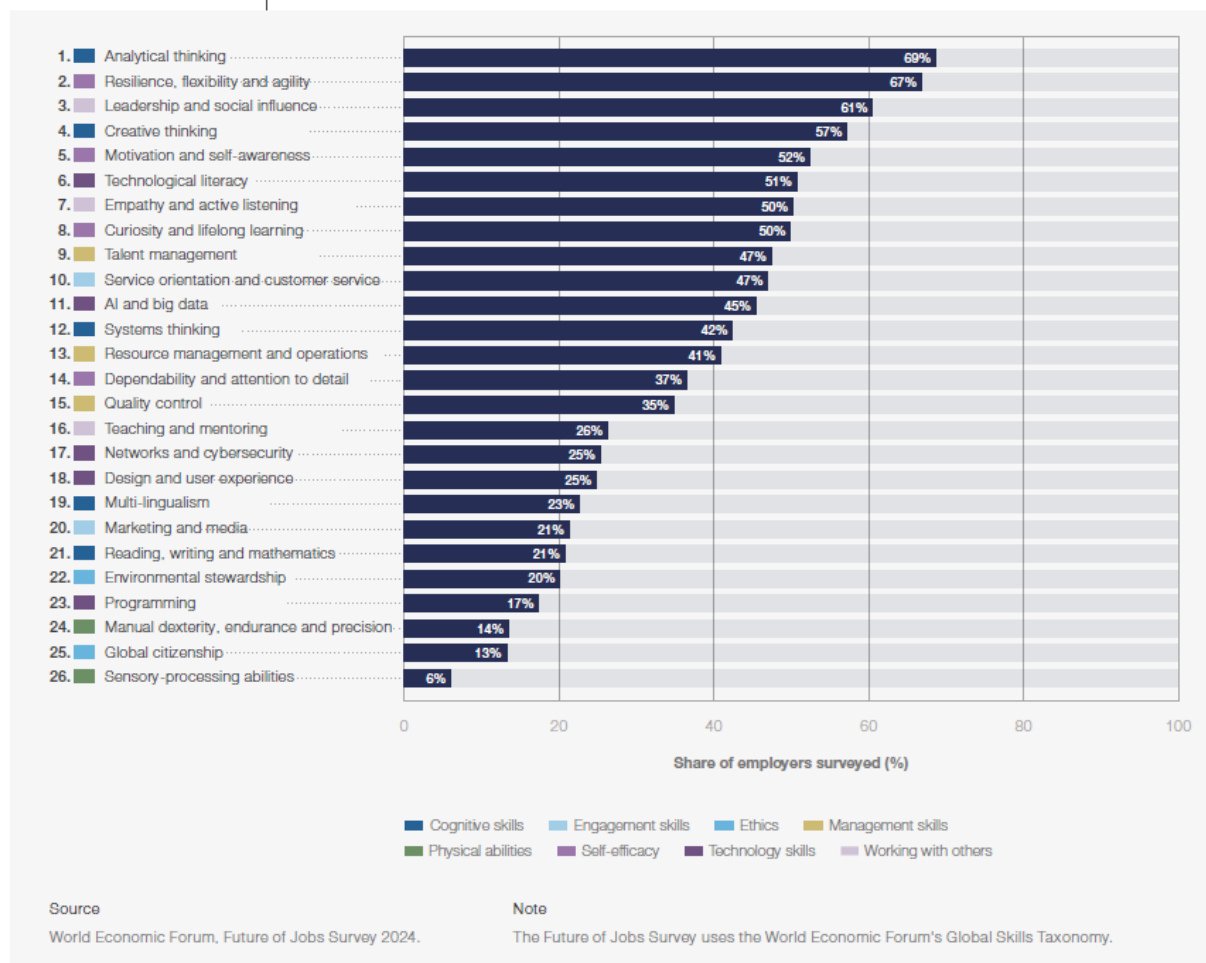


Figure 2: Core Skills in 2025

7.4 Challenges and Perspectives on Change

Despite the recognized need for change, many higher education institutions struggle with inertia and resistance to reform. Factors such as the entrenched nature of traditional educational practices and the challenges of adapting to new pedagogical models hinder progress. Respondents in educational discussions have noted the slow pace of change in academia, indicating a disconnect between the evolving societal landscape and the curriculum offered (Anderson, 2024). Therefore, fostering an environment that encourages innovation and flexibility in curriculum design is essential for addressing knowledge obsolescence effectively (Integrating Discovery-Based Research into the Undergraduate Curriculum, 2015). By remaining vigilant and committed to continuous improvement, educational institutions can ensure that they equip students with the necessary tools and knowledge to thrive in an increasingly complex and dynamic world.

8 POLICY IMPLICATIONS

The landscape of higher education is rapidly changing, driven by changes in technology and shifting societal needs. As institutions become more agile to these changes, several policy implications for the future of university enrolment and knowledge renewal emerge.

8.1 Technological Integration and Student Engagement

The successful integration of technology in higher education requires a multi-polar approach that addresses pedagogical and infrastructural challenges. Policy implications must be agile to the development of a robust digital infrastructure, including reliable internet access, technology resources, and adequate technical support for faculty and students. Technology integration requires significant investment in technology infrastructure within institutions and ensuring greater access for all students, regardless of their socioeconomic or cultural background.

The integration of advanced technologies such as artificial intelligence, predictive analytics, and digital transformation is expected to enhance educational practices and student engagement in the coming years. In 2023, experts predicted a critical need for universities to shift their cybersecurity culture in response to persistent threats, suggesting that institutions must prioritize not only technological advancements but also the safeguarding of student and institutional data (14 Technology Predictions for Higher Education in 2023 – Campus Technology, 2023), (Adapting to Change: The Top Higher Education Trends for 2024, n.d.). This emphasis on secure and effective technology use may play a significant role in shaping student perceptions of higher education, potentially impacting enrolment numbers. Table 2 provides five specific policy guidelines for technology integration and student engagement. See Appendix I for policy details.

Table 12: Policy guidelines: technology integration and student engagement

No	Policy - technology integration and student engagement	Policy Focus
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1	Category: Bring Your Device (BYOD) Policy	Encourage student use of personal devices while providing institutional support.
2	Category: Digital Badges and Micro-credentials Policy	Recognize and reward the development of specific skills and competencies.
3	Category: Personalized Learning Pathways Policy	Focus: Customize learning experiences to individual student needs, pre-knowledge levels and learning styles
4	Category: Data-Driven Decision Making Policy	Focus: Utilize data to improve teaching and learning outcomes.
5	Category: Digital Equity and Inclusion Policy	Focus: Ensure equitable access to technology and digital resources for all students.

Furthermore, policies should encourage and support faculty development in the practical use of educational technology. This may involve providing training on various educational technologies, such as learning management systems, online collaboration tools, and data analytics platforms. Additionally, policies should incentivize the development and adoption of innovative teaching methods that leverage technology to enhance student engagement. Technology integration may include blended learning, online learning, and the use of interactive simulations and virtual reality. By creating a culture of intellectual growth and innovation, and supporting the continuous professional development of faculty, institutions can ensure that technology is effectively integrated into the teaching and learning process.

8.2 Enrolment and Evolving Learning Models

Institutions are increasingly focusing on improving online and hybrid learning models, which cater to a diverse array of learner needs. With the use of flexible educational options, universities can promote accessibility and inclusivity and attract non-traditional students and those who may have been deterred by rigid learning formats.

Apart from a frequent knowledge renewal policy, other factors such as student debt and high tuition can sub-optimize enrolment in higher education institutions. Policy initiatives that address the reduction in student financial burden, flexible admissions policy e.g., skills-based admissions, guaranteed job placement, and business incubation for entrepreneurs can boost enrolment statistics. Table 3 outlines policy initiatives for enhancing enrolment. See Appendix II for policy details.

Table 13: Policy guidelines: learning and enrolment

No	Policy – initiatives for enhanced enrolment	Policy Focus
1	Income-Share Agreements (ISAs) Policy	Reduce the financial burden of higher education and incentivize enrolment.

2	Skills-Based Admissions Policy	Broaden access to higher education beyond traditional academic measures.
3	Guaranteed Job Placement Programs Policy	Increase student confidence and attract prospective students by offering employment guarantees.
4	Micro-Credentialing and Stackable Credentials Policy	Offer flexible and affordable pathways to higher education and enhance employability.
5	Personalized Enrolment Counseling Policy	Provide individualized guidance and support to prospective students.

The commitment to developing dynamic, learner-centric environments is essential in orienting students for the challenges of the next century, thereby potentially boosting enrolment in the long term (2024 Higher Education Trend Watch, n.d.).

8.3 Demographic Shifts and Market Demand

Sustaining growth in student enrolment requires proactive and adaptable policy interventions especially when significant demographic shifts in current and prospective student populations are observed. Some of the key demographic student trends include (a) Aging populations perhaps leading to a smaller pool of traditional university-age students; (b) Increased diversity requiring universities to adopt more inclusive marketing strategies and support services; and (c) Changing family dynamics in family structures and economic backgrounds.

The impact of these demographic shifts may influence students' demand and choice of both programme and institution. Mitigating and adequately responding to evolving market demands requires close collaboration with industry and employers. Policies should incentivize the development of programs in high-demand fields, such as STEM, healthcare, and technology while ensuring that graduates possess the entrepreneurial and essential skills and competencies employers value. Some specific policy guidelines to address the evolving demographic shifts and student market demands are outlined in Table 4 below.

Table 14: Policy guidelines for demographic shifts and student market demands

No	Policy – Demographic Shifting & Market Demands	Policy Focus
1	Higher Education Data Analytics Policy	Establish a centralized system for collecting and analyzing data related to student demographics, enrolment trends, program completion rates,

		graduate outcomes, and labor market demands.
2	Access and Equity Grant Policy	Create need-based grants and scholarships specifically for underrepresented student populations (e.g., low-income students, students with disabilities).
3	Flexible Pathways to Degree Completion Policy	Expand online, hybrid, and blended learning knowledge products to offer greater options for students with work, family, or other commitments.
4	Industry-Academia Collaboration Policy	Establish formal partnerships with employers to identify skills gaps and develop programs that meet industry needs.

As institutions adapt to demographic shifts and declining traditional undergraduate enrolments, higher learning institutions are encouraged to expand offerings in high-demand areas. By aligning educational programs with industry and employer needs, universities can become more attractive to prospective students, ensuring that enrolment remains robust in an increasingly competitive landscape.

8.4 Knowledge Renewal and Lifelong Learning

The notion of lifelong learning is becoming more prevalent, with institutions recognizing the importance of catering to adult learners seeking to upskill or transition into new careers. Lifelong learning not only addresses the knowledge gaps that may exist among students, but life-long learning also caters to faculty knowledge renewal. By offering more programs aimed at continuous education, and self-directed knowledge renewal for faculty, universities can attract a broader demographic, thereby mitigating the impact of declining traditional enrolment figures. This shift not only addresses knowledge obsolescence but also promotes a culture of continuous personal and professional development among faculty and graduates. Table 5 highlights some specific policy guidelines for knowledge renewal and lifelong learning.

Table 15: Policy guidelines for knowledge renewal and life-long learning.

No	Knowledge Renewal and Lifelong Learning Policy	Policy Focus
1	Curriculum Renewal Fund Policy	Allocate dedicated funding for regular curriculum reviews and updates.
2	Industry-Academia Partnerships for Knowledge Exchange Policy	Develop industry-sponsored fellowships and internships for faculty to gain practical experience and stay abreast of industry developments.

3	Micro-credentialing for Faculty Policy	Encourage continuous professional development and knowledge acquisition among faculty.
4	Centers for Innovation in Teaching and Learning Policy	Create dedicated centers to support faculty in adopting innovative teaching methods and integrating new technologies.

9 CONCLUSION AND FUTURE RESEARCH

This concept paper provided preliminary linkages between the factors affecting university enrolment. These factors included economic issues e.g., tuition, technology, skill acquisition, demographic shifts, and changing student personas. Several policy guidelines were suggested to address enrolment, technology integration, knowledge obsolescence, demographic shifts, and life-long learning.

Knowledge renewal and obsolescence among faculty were introduced as a possible factor impacting enrolment. Rising student perceptions about the relevance and value of investment in university education may have contributed to under-enrolment. Prospective students now demand a skills-based approach to higher education and question the observable disconnect between the content received and the skills required from employers (Dempsey and Smith (2019). Knowledge renewal and obsolescence with the slow pace of curriculum reform may have contributed to this dilemma.

Further research is required to establish the nature and strength of the correlations between faculty knowledge renewal and enrolment trends. A multivariable regression model with at least one independent variable being faculty knowledge renewal and the dependent variable being university enrolment might be a recommendation for developing quantitative models.

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Appendix 1: POLICY GUIDELINES FOR TECHNOLOGY INTEGRATION AND STUDENT ENGAGEMENT

Table 16: Policy guideline details for technology integration and student engagement

1. Category: Bring Your Device (BYOD) Policy	
Focus:	Encourage student use of personal devices while providing institutional support.
Policy Details	
a. Mandate that all students have access to a reliable device (laptop, tablet) meeting minimum specifications. b. Offer financial assistance or device rental programs for students who cannot afford their own devices. c. Provide secure and reliable Wi-Fi access across campus. d. Implement robust cybersecurity measures to protect student data. e. Offer workshops and support services for students and faculty on BYOD best practices and troubleshooting.	
2. Category: Digital Badges and Micro-credentials Policy	
Focus:	Recognize and reward the development of specific skills and competencies.
Policy Details	
a. Establish a system for awarding digital badges and micro-credentials to students who demonstrate proficiency in specific skills (e.g., coding, data analysis, critical thinking). b. Allow students to accumulate digital badges and micro-credentials across different courses and institutions. c. Partner with employers to recognize and value these digital credentials in hiring and promotion decisions.	
3. Category: Personalized Learning Pathways Policy	
Focus:	Tailor learning experiences to individual student needs and learning styles
Policy Details	
a. Invest in learning management systems (LMS) that support personalized learning pathways, such as adaptive learning platforms and personalized learning plans. b. Encourage faculty to utilize a variety of teaching methods, including online learning modules, flipped classrooms, and project-based learning. c. Provide students with access to personalized learning resources, such as online tutoring, academic coaching, and study skills workshops.	
4. Category: Data-Driven Decision Making Policy	

Focus: Utilize data to improve teaching and learning outcomes.

Policy Details

- a. Collect and analyze student data (e.g., grades, attendance, engagement data) to identify areas for improvement in teaching and learning.
 - b. Provide faculty with training and support in data analysis and interpretation.
 - c. Use data to inform curricular decisions, resource allocation, and the development of targeted interventions for struggling students.
-

5. Category: Digital Equity and Inclusion Policy

Focus: Ensure equitable access to technology and digital resources for all students.

Policy Details

- a. Provide dedicated support for students with disabilities to ensure they have the necessary assistive technologies and accommodations.
 - b. Address the digital divide by providing low-cost internet access and computer labs for students with limited access to technology.
 - c. Implement training programs to address digital literacy disparities among students and faculty.
-

APPENDIX II: POLICY GUIDELINES FOR ENROLMENT

Table 17: Policy guideline details for enrolment

1. Category: Income-Share Agreements (ISAs) Policy
Focus: Reduce the financial burden of higher education and incentivize enrolment.
Policy Details
a. Offer ISAs as an alternative to traditional student loans. b. ISAs involve agreements where students pay a percentage of their future income for a set period after graduation. c. This reduces upfront costs for students and aligns repayment with future earning potential.
2. Category: Skills-Based Admissions Policy
Focus: Broaden access to higher education beyond traditional academic measures.
Policy Details
a. Implement holistic admissions processes that consider a wider range of factors beyond standardized test scores and GPA. b. Evaluate applicants based on demonstrated skills, such as creativity, problem-solving, leadership, and community engagement. c. Offer pathways to enrolment for students who may not have traditional academic backgrounds but possess valuable skills and experiences.
3. Category: Guaranteed Job Placement Programs Policy
Focus: Increase student confidence and attract prospective students by offering employment guarantees.
Policy Details
a. Establish programs that guarantee employment or internships for graduates within a specific timeframe. b. Partner with employers to develop career pathways and provide students with valuable industry connections. c. Offer intensive career services and support, including resume and cover letter writing workshops, interview preparation, and job placement assistance.

4. Category: Micro-Credentialing and Stackable Credentials Policy

Focus: Offer flexible and affordable pathways to higher education and enhance employability

Policy Details

- a. Develop a system of micro-credentials and stackable credentials that allow students to earn recognized qualifications for specific skills and knowledge.
 - b. Offer a range of micro-credentials that can be combined to form pathways towards a degree or a recognized professional qualification.
 - c. Make micro-credentials accessible and affordable to a wider range of students, including those who may not be able to pursue a full degree program.
-

5. Category: Personalized Enrolment Counselling Policy

Focus: Provide individualized guidance and support to prospective students

Policy Details

- a. Implement personalized enrolment counseling services that match prospective students with the programs and institutions that best fit their individual needs and goals.
 - b. Utilize data analytics to identify and address the unique needs and preferences of prospective students.
 - c. Provide comprehensive information and support throughout the application and enrolment process.
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Adding Meta Data to Documents for E-Learning: A Tool Evaluation

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ABSTRACT

Modern Web 3.0 learning environments require a solution for making all related documents, which may be stored and accessible through various systems, findable in a semantic way. This paper deals with the requirements of such a solution, which are based on a project from the University of Applied Sciences Technikum Wien and evaluates which of the existing software solutions on the market meets the needs, while only ready-to-use software and components are considered. Features and functionalities of four software solutions (Microsoft SharePoint, W3C Annotea, Ontopia Knowledge Suite and Caringo CASTor) are compared with the requirements. Possible usage scenarios provide hints and general thoughts for putting the project's concept into practice. An evaluation of all the software solutions considered shows clearly the advantages and disadvantages of them. It turns out that no considered software solution meets the needs perfectly, but this paper illustrates the best usage for e-learning purposes.

KEYWORDS: E-learning, Topic maps, Annotation, Semantic technologies

11 INTRODUCTION

Considering the development of e-learning platforms in universities or similar institutes and the need for a knowledge-driven solution for browsing e-learning content stored in various systems, a modern Web 3.0 learning environment is required. The University of Applied Sciences (UAS) Technikum Wien tries to find an approach to meet the needs of such an environment using semantic technologies (project “eLearning 3.0”). One important part of this project is to find a solution for making all related documents, which may be stored and accessible through various systems, findable in a semantic way. This includes dealing with metadata as well as adding annotations to documents and many other requirements. The approach is called “eThek” (mixture of “e-learning” and “Mediathek” which means “digital library”) and the main goal of this paper is to evaluate which of the existing software solutions on the market meets the needs.

In the past few years, a lot of studies and research were done regarding e-learning software solutions or technology approaches for supporting e-learning requirements. Considering the need for an abstract knowledge model which can be lapped over existing resources, the concept of Topic Maps is mentioned a lot. Topic Maps is a standard for representing knowledge, with an emphasis on the ability to find information. They provide an external meta-structure in the form of a dynamic, semantically based hypertext. Most of the previous studies dealt with the combination of topic maps with classical hypertext-based or concept-based e-learning content such as wiki pages [28]. Providing access to document-based content as learning resources through a topic map driven solution was hardly considered. In this case, the TM4L project [27], which offers Topic Map-based digital libraries, seems to offer a promising approach but is considered by the authors as being in a very early phase of developing.

Besides the idea of a simple Topic Map solution other software solutions like file servers or a combination of them also may be of interest to fulfill the requirements of the eThek platform. Therefore, various software systems were evaluated in this research. One of the main goals of this paper was to find software which provides the most approximate solution and promises as less additional development needs as possible. Therefore, simple engines, stand-alone components or software which is not ready to use, are out of scope. Finally, four software solutions were chosen to be compared within this paper: Microsoft SharePoint, W3C Annotea, Ontopia and Caringo CASTor.

Chapter 2 provides a closer look at the eThek requirements which will be part of the further assessment in chapter 3. After the description regarding components, architecture, and basic functionalities of each of the chosen software, an evaluation follows how the software meets the needs. Every subchapter closes with a possible usage scenario regarding the requirements. An evaluation of all the software solutions considered and an outlook for further projects can be found in the conclusion. For better understanding it is recommended that the reader has basic knowledge about topic maps and related technologies such as XML.

12 REQUIREMENTS

The eThek is defined as a central web application for universities for storing documents that can be accessed by multiple users over a network. Documents stored in eThek include written documents, like course materials, scientific papers and presentations but also multimedia files like videos or music.

Annotation data. It should be possible to add annotations to documents stored in eThek. These annotations should be stored in a central database to allow access for multiple users. Information that must be stored with annotation includes date, username, a title, a rating and the path to the document. The creation of additional data fields for annotations should also be possible. Furthermore, it is important that access to annotations can be restricted.

Import / Export of objects and their annotations in XML. An import/export function for documents and annotations stored in eThek is required, preferably through XML-documents.

Search. The search functionality of eThek must allow searching for documents, within documents and for annotations.

User and Access management. The eThek should be able to integrate existing directory information services over LDAP.

Central document storage. Central document storage is required for all kinds of learning materials and documents in various formats (Microsoft Office, PDF, video, audio, etc.).

Central annotation storage. Annotations should be stored in a way that makes them easily accessible for administrators or authors.

License and restrictions. The preferable license model is open source or a free license for educational institutions.

Support and maintenance. It is important that there is support available for the underlying software of the eThek and that continuous maintenance and further development is ensured.

13 SUGGESTED TOOLS AND TECHNOLOGIES

As mentioned in the introduction, only software solutions were considered, which are ready to use and promise as few additional developments need as possible. Regarding Topic Map concepts, mainly the list of tools from topicmaps.com (a site dedicated to promoting the use of topic maps) [29] was used for the research. The Ontopia Knowledge suite turns out to be the most mature software solution. In addition, three more software solutions are evaluated: Microsoft SharePoint, which provides integrated services to support almost all required features, W3C Annotea, a project which comes directly from the World Wide Web Consortium and is part of the Semantic Web efforts, and Caringo CASTor, a file server solution providing functionalities to store a huge amount of unstructured data.

13.1 Microsoft SharePoint

SharePoint is a Web application platform developed by Microsoft. The current stable release is of the year 2013 and is known for intranet content management and document management. Although, the current version has much more to offer than only content and document management and has some significantly broader capabilities. The new version of SharePoint offers intranet portals, document & file management, collaboration, social networks, extranets, websites, enterprise search, and business intelligence. It also has system integration, process integration, and workflow automation capabilities. Another thing to be mentioned is that the information given in this paper partly comes directly from the Microsoft SharePoint Solution Specialist Mr. Richard Bosse. Therefore, some information cannot be referred to in the literature link, because it was part of the interview process. The interview text is available on demand. Like the other Microsoft products, SharePoint has a Microsoft Office-like interface, and it is closely integrated with the Office suite and is easy to understand also by non-technical users. [1] Furthermore, SharePoint also incorporates a

complete development stack based on web technologies and standards-based APIs. As an application platform, SharePoint provides central management, governance, and security controls for implementation of these requirements. [2] The SharePoint platform integrates directly into IIS (Internet Information Services) - enabling bulk management, scaling, and provisioning of servers, as is required by the UAS Technikum Wien. Figure 1 shows the logical architecture of SharePoint

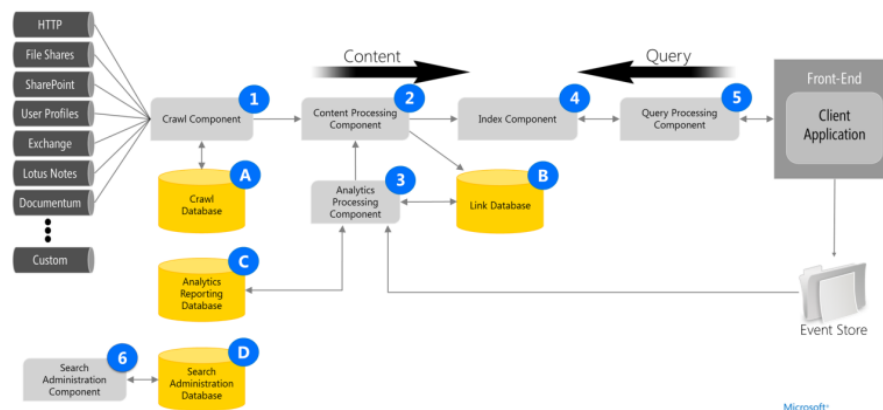


Figure 3: Share Point Architecture [2]

This high-level overview of the new search logical architecture shows all the components of the new search engine. All the content sources are placed on the left side of the picture that are going to be picked up by the new crawl component (1). The crawl component is going to get track of what it needs to crawl and whether it was successful in the crawl database (A). It hands off the content it crawls to the new content processing component - CPC (2). In the CPC SharePoint breaks down what was crawled into the individual pieces of data that will get stored in the index. It also writes to the link database (B) to track all the different anchor content it has crawled and then pushes the data to the index component (4). The index component is what handles the process of creating the physical index, as well as responding to queries. The queries are delivered by the query processing component (5). It takes the individual queries from a client application and figures out the one-to-many queries that are required to execute upon that and then aggregates the results and sends it back to the client. Periodically a timer job will run and perform analytics on the SharePoint content. This includes what content has been accessed through different query results, as well as what content has been accessed by users just clicking in and around different SharePoint sites. It pulls in data from the links database for additional relevance data and stores the reports in the analytics reporting database (C); it also pushes a small amount of analytical data back to the content process component so that it can be included in the index. The search component (6) is what's responsible for keeping it all up and running and healthy, and it stores its configuration in the search admin database (D). [3]

Annotation data. Annotations can be defined individually by any user or admin, uploading a file. It is also possible for UAS Technikum Wien to create their own taxonomy.

Import / Export of objects and their annotations in XML. It is possible to add metadata and store it together with the documents. The documents are stored centrally, and the annotations can be document based. Moreover, it also supports different data formats, such as videos, pictures, links, etc.

The search function is also applicable for the file content and file names. Also, searching for Meta information is possible. However, it is not a standard feature to import/export objects

with annotations in XML, but possible with the help of some migration tools e.g., Microsoft Excel.

Search. SharePoint makes it possible for the admin to define data fields for the manual annotations, such as username, date, datalink, title, and rating and fields for free text. Moreover, it is also possible for the user to use automated annotation, using keywords to search for the documents.

User and Access management. SharePoint offers the possibility to define different roles for the users, like student, teacher, admin, etc. Going one step ahead, SharePoint offers the functionality to administrate user groups (annotation groups) with the help of Active Directory and supporting LDAP. The following Figure 2 shows a preview of the admin area managing users' properties, profiles, sub-types, audiences, permissions, policies and much more:



Figure 4 SharePoint User Management

Central document storage. Another plus point is the central data storage and user capacity, which is huge and offers enough scalability and space for the users and their stored documents. It can be expanded on demand.

Besides using SharePoint only for data storage, it can also offer the additional functionality of personal or Team Websites. Figure 3 gives an example about the SharePoint site collection. A Farm is a collection of physical SharePoint servers that serve the content to users. Generally, such a Farm can be structured and build using different types of topologies.

- Farm: collection of SharePoint Web Applications
- Web Application: collection of SharePoint sites
- Site Collection: Formed by a single root site (Top-Level site) and a collection of sub-sites.
- Sub-Site: collection of pages, lists, libraries, and other content the user wants to make available through the browser. [4]

SharePoint FARM

- **Web Application 1**
 - **Site Collection 1.1**
 - Top Level Site
 - Sub-sites
 - Site 1
 - Lists
 - Libraries
 - Other content
 - Site N
 - **Site Collection 1.2**
 - **Site Collection N**
- **Web Application N**
 - ...

Figure 5 SharePoint FARM

Central annotation storage. Considering annotation storage, SharePoint offers a central place to store the annotations. The following Figure 4 gives an example of the possible implementation and taxonomy hierarchy:

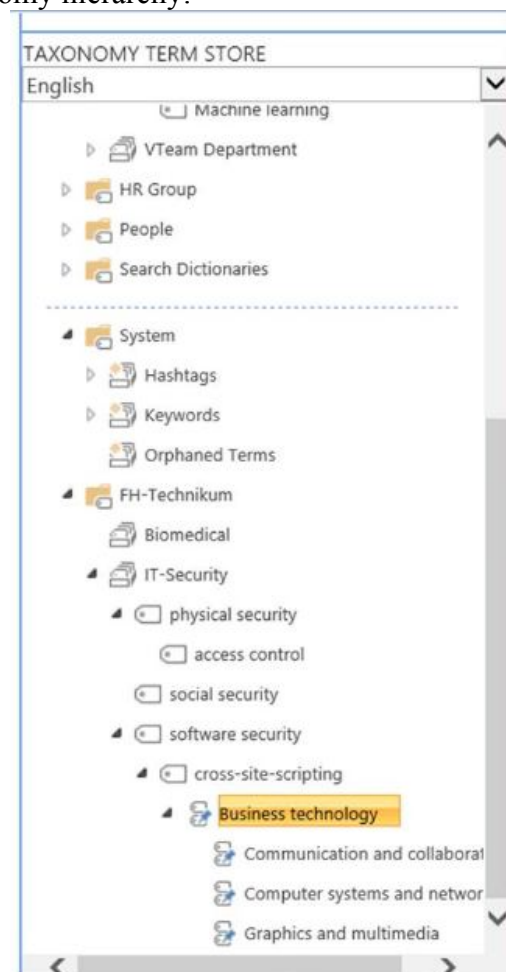


Figure 6 SharePoint Taxonomy

License and restrictions. SharePoint is not an open-source product. But for UAS Technikum Wien, Microsoft has a special academic offer for students and is almost free which just needs to be applied, providing a cloud service edition as part of their Office 365 platform.

Support and maintenance. Considering the support service of Microsoft, one can rely on them. Having a lot of Service Partners, they offer a 24-hour support, which is granted online or via telephone. In urgent cases, it is also possible to call a SharePoint specialist to fix the problem.

Possible usage scenario and evaluation. The Microsoft SharePoint platform provides all the basic needs and ready to use infrastructure needed for several file formats. Furthermore, additional Add-Ons such as better portraying of the Annotations as a Topic Map Format can be bought additionally. The Taxonomy is given, but the way of portraying it might not feed the needs of UAS Technikum Wien, as the Annotations cannot be displayed graphically in a topic map format.

Having a look at scalability, data storage, Business Intelligence, and User capacity, one does not have to worry. Additionally, the Support Function in case of Errors is also provided. On top of that, using this Cloud Service the User does not have to worry about the security and stored data in the cloud. The data stored is in Europe and applies to the Safe Harbor contract. Overall, the software covers most of the necessary functions needed for eThek. With a few additional applications for the annotations and topic map navigation.

13.2 W3C Annotea

Annotea is a W3C project that enhances collaboration via shared metadata-based Web annotations, bookmarks, and their combination. Figure 5 presents the architecture of Annotea. We have various stores for RDF metadata. Metadata can be stored locally or on one or more annotation servers. And we have a user interface that provides different views on the web resources.

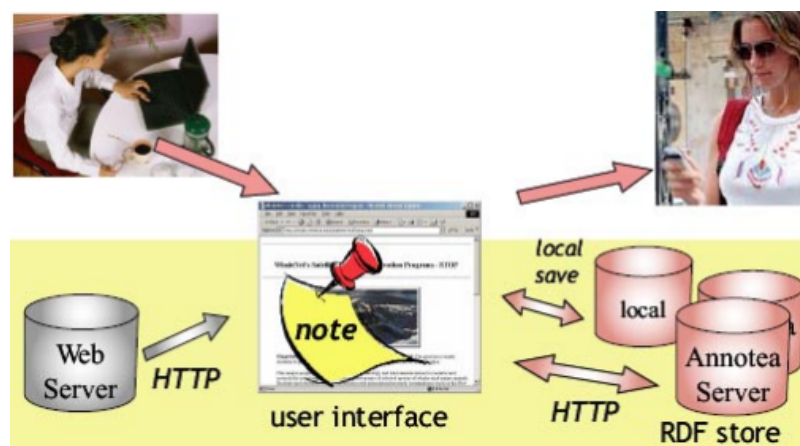


Figure 7 Annotea architecture [33]

Annotation data. Annotations can be comments, notes, explanations or external remarks and are stored as Annotea objects. They can be attached to web documents or a selected part of the document. Annotations are described using the RDF [30] schema and are located in the document by using XPointer [31].

Annotea objects have a URI, containing RDF metadata and a property referring to some other web resource. For instance, annotations can annotate another web page using the property

“annotates”. Additionally, Annotea objects include a core set of properties for describing web resource. For instance, annotations have a “creator” property for describing the creator of the object [34].

Import / Export of objects and their annotations in XML. Annotea can only be used for web documents which can be identified by URI. The annotations are assigned to that URI and are stored in annotation servers using the RDF schema. There is no export functionality but the server uses MYSQL and ODBC so it should be possible to develop an export functionality [34].

Search. The presentation of the annotations, including the search functionality, can be done using a web browser. Every time the user browses a document, the browser queries the defined annotation server, requesting the annotation metadata that is associated with the document’s URI. Annotea does not include a search functionality for annotations, therefore the user cannot search for specific annotations. In fact, annotations will only be displayed after opening the document’s URI [34].

User and Access management. The Annotea project does not include user management.

Central document storage. Documents and resources are associated with a unique URI and can be stored on a webserver.

Central annotation storage. The annotations attached to a document are stored locally or in one or more annotation servers and can be loaded after the user gets the document. The user can select which form of these metadata stores he or she wants to retrieve the Annotea objects. Users can also select the store for writing new Annotea objects. As shown in the HTTP protocol is used for the interaction between the clients and the annotation server.

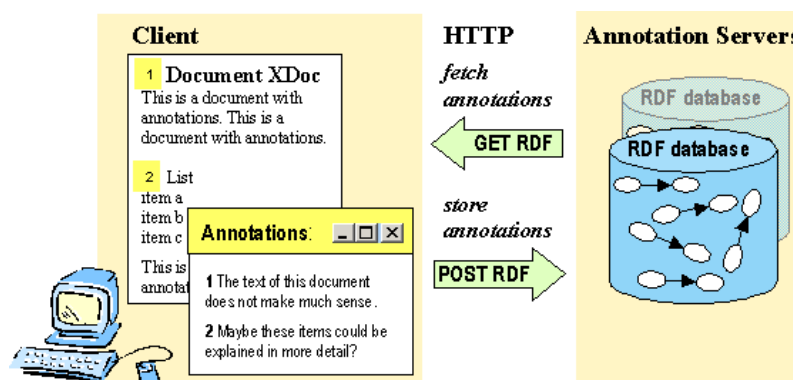


Figure 8 Annotation storage and usage [34]

License and restrictions. Annotea uses the W3C standards when possible and is a full open-source project [35].

Support and maintenance. The last official update for Annotea was published in October 2005 [35].

Due the fact that Annotea is not actively maintained any more it can only provide some conceptual ideas for the eThek project. Furthermore, the source code could be used to develop its own software solution for eThek. There are several related projects with implementations for annotation servers and clients which could be evaluated in additional projects [32].

13.3 Ontopia

The Ontopia product is an open-source project, created by the Ontopia community. It was first released in 2001 and in November 2012 version 5.2.2 was available. A little number of commercial projects are known to use Ontopia. The product provides a set of tools for building applications driven by topic maps, such as Web portals and knowledge-based intranets and it is used for content management systems as well as for enterprise application integration. [11]

Ontopia consists of the following components known as Ontopia Knowledge Suite:

- Ontopia Topic Maps engine (full-text integration, schema tools, query engine)
- DB2TM (database conversion)
- Ontopia Navigator framework
- Ontopia Web editor framework
- Ontopia RDBMS Backend Connector
- Ontopoly Topic Maps editor
- Ontopia Omnigator (Topic Maps browser)
- Ontopia Vizigator (visualize and navigate topic maps)
- Figure 7 shows how the components work together.

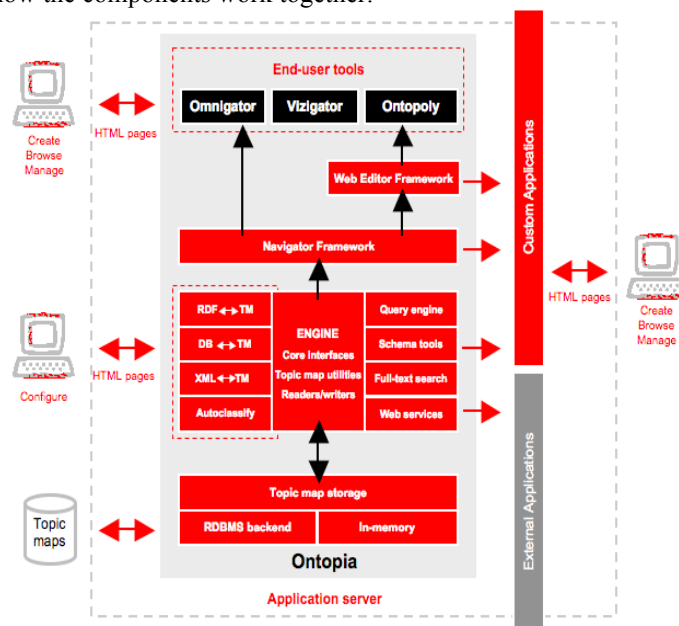


Figure 9 Ontopia Knowledge Suite [12].

The Topic Maps engine is the core component of Ontopia's Knowledge Suite which stores and maintains the topic maps. Essentially it contains a set of Java APIs providing services for accessing and modifying topic maps, as well as importing, exporting and converting services. Tolog (query language for topic maps) is used for query execution and full-text search is performed. The engine can store topic maps in relational databases or keep them in memory. In both cases the API to the engine stays the same. [13]

Using DB2TM ("database to topic maps") module relational data can be automatically converted to Topic Maps data. A simple XML file is used to describe the mapping. The module also provides synchronizing to keep the topic map up to date as changes occur in the database. [14]

The RDBMS Backend Connector adds relational database persistence support to the Ontopia Topic Maps engine while the persistence is transparent for the user of Topic Map interfaces. [15]

With the Navigator Framework it is possible to create individual topic map-based websites. It mainly provides a set of tag libraries and produces no HTML itself in order to have complete control over the layout and structure of the desired web application. It is based on J2EE (Java 2 Enterprise Edition) platform and uses JSP (Java Server Pages) technology which is easy to learn and efficient in use. [16] The Web Editor Framework is an extension of the Navigator Framework. It is based on JSP technology and provides extensive libraries of actions for developing web applications where the users can modify the contents of a topic map using a forms-based interface. [18]

Ontopia offers three end user-tools for editing topic maps based on Ontologies (Ontopoly), for browsing and debugging (Omnigator) and to visualize and navigate through topic maps (Vizigator).

Ontopoly is written as a client/server application and is accessible within Ontopia – as a client you use the web browser while the server application (which is built with the Navigator and Web Editor Framework) is a web server bundled with the distribution. It provides a web interface to design Topic Maps ontologies as well as to populate them with instance data. It is divided into the ontology editor and the instance editor. An administration interface makes it possible to add metadata to the topic map (description, version number, etc.), validate it and provide functions for importing and exporting from and to various interchange systems. [18] The Omnigator (“omnivorous navigator”) application (client/server) is the main Topic Map navigator for loading and browsing topic maps and is built using components of the Ontopia Knowledge Suite (f.e. Navigator Framework). Although it is provided as an end-user tool, the purpose of the application is more like debugging for (topic map) developers. It is intended as a teaching aid, to help understanding Topic Map concepts. [19]

While the Omnigator uses a text-based interface the Ontopia Vizigator provides an additional method of topic map navigation through a graphical interface. It consists of three components which are dependent on each other: the designer’s configuration tool (VizDesktop), Java applet for adding visualization to web applications (VizLet) and a Plugin for combining text-based view and graphical-based view within the Omnigator (VizPlugin). Vizigator naturally bases on TouchGraph which is an open-source toolkit for graph visualization (Sourceforge). VizDesktop (desktop application), can be seen as the entry point to the entire Vizigator. With VizDesktop designers can determine whether and/or how various topic types and associations will be graphically displayed. All the configurations that are done with VizDesktop (filter settings, shapes, sizes, colours, fonts, etc.) are stored at the server and then loaded from the other components when they are used. Thus, VizLet provides almost the same visualization functionality as VizDesktop, except that the menu bar is unavailable, and it always operates in topic view (while VizDesktop also shows ontologies). It is a Java Applet (reusable applet component) which is intended to add topic map visualization to any web application using Ontopia. VizPlugin is an Omnigator Plugin that provides graphical visual navigation of topic maps and uses VizLet to support this visualization directly in the browser. [20]

Annotation data. Regarding the given requirements, topic maps can be used for structuring and saving document properties and metadata in the desired way. While the data structure is provided by ontology, the topics within the topic maps depict the documents containing the predefined fields from the ontology. Besides topic types, names, associations, roles and so on, occurrences can be added which mark the document properties. Various data types are provided (String, URI, Date, Datetime, Number, as well as HTML content and images).

In addition, Ontopia provides an automatic classification module which helps creating a topic map (or simply classifying the content) by offering extracted keywords from a given file, which could be an XML, HTML, PDF, Microsoft Word or Microsoft Powerpoint document in English and Norwegian language. Regarding Ontopia's product description [21] additional file formats and languages can be plugged in easily.

Unfortunately, adding metadata (annotations) to documents is hardly possible with the given functionalities – no solution was found to add files to the topic maps and neither for browsing them in the graphical view. It can be assumed that Ontopia was designed much more to combine with content management systems for web content solutions than to use topic maps together with document management systems.

Import / Export of objects and their annotations in XML. Non-Ontopoly topic maps (maps from an external source) can be imported and will automatically convert according to the most approximating topic map in the system. Additional user support may be needed.

Ontopia uses the ontology topic maps as system topic maps which are needed for understanding and interpreting topic maps within the system in the right way. Exporting topic map instances usually work without the underlying ontology, but system topic maps must remain. [18]

Omnigator allows loading an RDF model and browse it as it were a topic map, and exports it in XTM syntax. Also export a topic map as an RDF model is supported as well as merging features. [19] XML support is provided for converting in every direction.

Search. Searching within the system is mainly provided by the Ontopia Omnigator which is responsible for navigation. The Full-text Search Plugin allows doing simple full-text searches when a full-text index has been created first. Combined with the Omnigator's browsing interface it makes the task of locating information much simpler, because jumping directly to a specific topic is possible. Unfortunately, this works only for topic maps data, not for searching within (external) documents. [19] Furthermore, the graphical visualization of topic maps is not suitable for navigation because it doesn't work for all kinds of data.

User and Access management. If building an application which doesn't use directory information stored elsewhere (or uses no authentication at all) is considered, Ontopia provides an application that can be used to administrate topic maps containing users, roles and privileges. Written using the Web Editor Framework it provides user vocabulary understandable by JAAS (Java Authentication and Authorization Service) which authenticate the users against the information in the topic map. [22]

Central document storage. Document storage and management functionalities (regarding external documents beside topic maps, e-learning documents) are not provided by Ontopia.

Central annotation storage. Considering topic maps as pool for all given annotations, Ontopia provides mechanisms for saving them in a relational database (DB2TM, RDBMS) or as files on a server which then marks the central annotation storage. However, a file server or database technologies are not provided by Ontopia Knowledge Suite. But the product supports various databases like Oracle 8 or newer, Microsoft SQL Server 2005 or newer, PostgreSQL 7.4 or newer, MySQL 5.0 or newer, and h2 version 1.1 or newer. [13]

License and restrictions. Ontopia is 100 % Java and runs on any operating system which has Java 1.5. It is a fully open-source product hosted by Google Code. [23] Beside the Apache License 2.0 policies no restrictions regarding number of users and annotations (topics and topic maps) are known. [10]

Support and maintenance. So far known, commercial support is provided by a few companies in Norway, Japan and Holland, which is offered by them mainly as consultant services. [24] Thus, support for individual projects can hardly be considered as it is typical for using open-

source software. As a result, the maintenance workload depends on the designed application's architecture and the way, topic maps are used in it.

Possible usage scenario and evaluation. The Ontopia community describes the Ontopia Knowledge Suite as the world's most feature-complete Topic Maps product. [25] This might be true, but it is far away from offering a fully integrated service application. Ontopia can be seen as a "box of bricks". A lot of development work is needed in order to reach the individual project goals. A solution for adding the metadata (annotations stored as topic maps) to the documents through any kind of document management tooling must be found, database technology must be evaluated, designed, implemented and continuously maintained and a front-end application must be created which may adopt an existing user management solution. In turn, the product's components are very well documented (developer's guides, user manuals) and can be marked as high integrate-able (end-user tools like Ontopoly, Java technology). Therefore, reusing some of the tools and functionalities (especially for creating, storing and maintaining topic maps) may be considered when putting an e-learning concept into practice.

13.4 Caringo CASTor

Caringo CASTor is a proprietary Object Storage Software developed by Caringo, Inc; based in the USA. It is used for storing huge amounts of unstructured data. The minimum hardware requirements are an x86 server with at least 1 GB RAM, a hard drive and Gigabit Ethernet. Multiple Servers can be combined with a cluster [5].

Each document that is stored in Caringo gets a Universally Unique Identifier (UUID) that can be used as a reference to the document in a database, an application or another document. Application integration is possible over an HTTP-interface with the Simple Content Storage Protocol (SCSP) [6].

Several modules can be used to provide additional functions and services like indexing or additional data protection. The Caringo CASTor Content File Server (CFS) allows the creation of interfaces to other applications for file transfers with protocols like CIFS, NFS, FTP and WebDAV [7].

Potential customers can apply for a test account through the homepage [8]. For evaluating Caringo CASTor for eThek the authors applied for a test account. Unfortunately, this test account was not activated by Caringo. Since no other reliable information on CASTor could be obtained by the authors, the information presented in this chapter is entirely based on the information provided by Caringo on their homepage.

Annotation data. CASTor provides default metadata for stored documents. According to the FAQs [6] it is possible to add additional Metadata fields. Therefore, it should be possible to add annotations as metadata.

Import / Export of objects and their annotations in XML. Information on Import/Export functionality for metadata could not be obtained.

Search. The Indexer module for CASTor provides "real time indexing" and "ad-hoc searches of content within CASTor by name or metadata [10].

User and Access management

The CASTor Content File Server module supports integration with Active Directory and Access Control Lists [9]. The requirements for eThek are therefore fulfilled.

Central document and annotation storage. CASTor can be used to store documents and metadata like annotations in a central storage platform and would therefore fulfill this requirement [6].

License and restrictions. CASTor is proprietary software. License information is not freely available for potential customers.

Support and maintenance. Since CASTor is proprietary software, support is provided by Caringo. Caringo provides support 24/7. A knowledge base is also available. Customers can gain access to additional functions like creating trouble tickets and downloads after logging in [11].

Possible usage scenario and evaluation. The Caringo Object Storage Platform provides basic infrastructure for storing documents. Additional modules that should be considered for the eThek are the Content File Server for additional interfaces to other applications and the Indexer for search functionality.

The Caringo Object Storage Platform could be used to store all documents for the eLearning 3.0 platform. Additional software would be necessary to provide functionality for annotations and topic map navigation.

Therefore, the software only covers part of the necessary functions for eThek, and additional applications and programming would be necessary for annotations, topic map navigation and document access. Figure 8 shows a possible system landscape.

Caringo CASTor is used in combination with the Indexer-Module for storing documents in the eThek. The Content File Server (CFS) is used as an interface for the Learning Management System (LMS) Moodle that is currently used at the UAS Technikum Wien. Moodle uses CASTor as document storage and provides the user with access to the documents. To be able to integrate Moodle and CASTor would require additional programming.

For annotations another application would have to be used to provide the necessary functionality for eThek, like topic map navigation. A possible choice could be Ontopia. However, additional programming would be necessary to integrate it with Moodle and CASTor. Another possibility would be to develop new annotation-software according to the requirements.

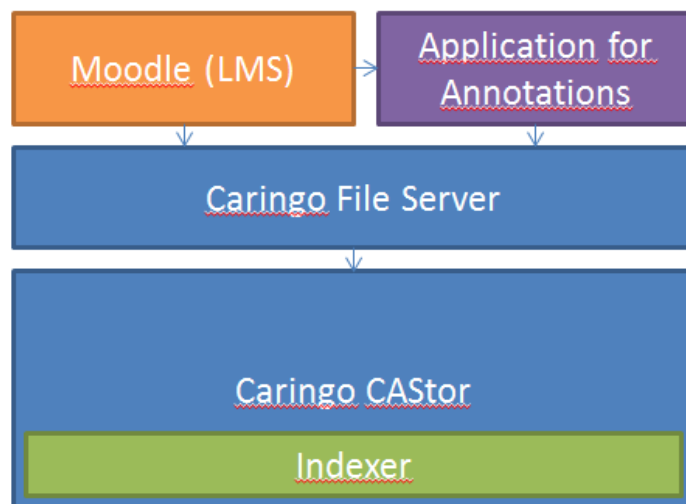


Figure 10 Usage Scenario for Caringo Castor in eThek **Error! Reference source not found.**

Since no test account for Caringo CASTor and the Content File Server could be obtained for this evaluation, all information regarding Caringo CASTor in this paper is from the official Caringo homepage and marketing materials, since no reliable independent sources could be found.

The software uses a proprietary licence. Information on licensing and pricing are only provided after request.

Additional evaluation, additional information about pricing and the license model and a test account are necessary if the Caringo CAStor Object Storage Platform is considered as a viable option for the eThek. However, as it uses a proprietary license and does not fulfill important requirements for the eThek like topic map navigation and annotations it can only be used in combination with other applications. The Content File Server should facilitate integration with other software.

14 CONCLUSION

Table 1 gives an overview of the evaluation described in the previous chapters. The values can be understood as follows:

- (+) Positive; The Software provides all essential services and functionalities. Only implementation and configuration work are needed.
- (~) Caution; the solution provides only approaches where additional programming is required.
- (–) Negative; the solution doesn't provide services or functionalities to support the required features at all.
- (?) Unknown; the necessary information for evaluating a solution regarding the requirement could not be obtained.

Table 18. Tool evaluation

	MS SharePoint	W3C Annotea	Ontopia	Caringo CAStor
Annotation data	~	+	+	~
Import / Export	~	~	+	?
Search	+	-	~	+
User and Access Management	+	-	~	+
Document storage	+	~	-	+
Annotation storage	~	~	+	~
License / Restrictions	+	+	+	-
Support / Maintenance	+	-	-	+

After the evaluation of the selected products, it may be asserted that none of the products is able to meet all requirements on the eThek project. The probed products hold various strengths and weaknesses, which may be looked at from different points of view. While Microsoft is providing a, even though for the concept of eThek not complete, but for itself

functioning and solid version, the other three products require substantial effort to be programmed, and accordingly a combination of different approaches to meet the respective demands.

Whilst Annotea, respectively Ontopia are less suited for productive use on grounds of scarce support, Sharepoint and Caringo are continuously being enhanced and improved. Annotea and Ontopia are both being operated under the OpenSource license and are hence able to provide valuable assistance in terms of independent development of the eThek project as opposed to the other two products. Further strengths of the commercial products Sharepoint and Ontopia lie in the range of searching and of an existent User Management.

Based on the conducted evaluation and the results, as displayed in Table 1 Microsoft Sharepoint complies with most placed requirements and furthermore provides the possibility of a flexible use and an extension to the software. Additional strengths of Sharepoint as opposed to other tested solutions would be constituted by the centralized document storage, the commerce with a variety of file types, and the employment of a software solution that will also be actively enhanced and maintained in future times.

In case the University of Applied Sciences Technikum Wien is considering an in-house development, both softwares Annotea and Ontopia would be of relevance. Whereas in case a preferably complete and solid solution shall be employed, Microsoft Sharepoint would depict the program of choice. Because Sharepoint was not conceptualized as sheer annotation software though, it does not offer out of the box a possibility for development of Topic Maps. In that case an evaluation of how Sharepoint could be amplified with annotation functionality as well as Topic Maps would be necessary.

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**LeSA: Applying a Computer Vision-based AI Approach
To Monitoring Sustained Attention
In Online Learning**

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ABSTRACT

As online learning continues to expand, its flexibility in time and location supports individual learning differences and lifelong learning, contributing to sustainable social and economic development. However, online learners require greater self-discipline and responsibility due to limited interaction and reduced instructor oversight, making it difficult to monitor engagement and adapt teaching strategies. One of the most significant challenges in this environment is sustaining student attention, which is essential for effective learning. A lack of sustained attention can lead to decreased motivation and higher dropout rates, impacting overall learning outcomes.

This study explores the use of computer vision-based AI to analyze behavioral patterns that indicate sustained attention in online learning. By tracking key behavioral indicators, including gaze direction, facial expressions, blinking patterns, and eye closure frequency, this approach provides valuable insights into student engagement. The Learner Sustained Attention (LeSA) model was developed and evaluated using four machine learning algorithms to determine the most effective method for identifying attention patterns.

Findings indicate that integrating computer vision-based AI into online education provides a scalable and data-driven solution for real-time attention monitoring. The Random Forest model demonstrated the highest accuracy (84.07%), effectively identifying behavioral patterns associated with sustained attention. These insights can support instructors in adapting teaching methods, enhancing student engagement, and reducing dropout rates. This study contributes to the ongoing innovation in educational technology, reinforcing the role of AI-driven behavioral tracking in improving learning experiences and instructional effectiveness in online education.

KEYWORDS: Online Learning, Computer Vision, Sustained Attention, Artificial Intelligence, Educational Innovation, Behavioral Patterns, Engagement Tracking, Learning Analytics

15 INTRODUCTION

The digital transformation has significantly reshaped education, making learning more flexible, accessible, and adaptable to individual needs (Wichuda, 1999). Online learning has emerged as a key driver in promoting lifelong learning and sustainable development (Torres, 2011; Vieira, 2019), enabling learners to engage with educational content regardless of time and location. However, despite these advantages, maintaining student engagement and attention remains a critical challenge, particularly due to the lack of real-time observation and interaction between instructors and learners (Guo et al., 2015; Rothkrantz, 2017). Addressing this challenge requires innovative strategies that ensure students remain focused and engaged, ultimately enhancing their learning experiences and outcomes. Previous research has explored three primary approaches to tackling this issue (Hakimi et al., 2024):

The Instructional Strategies Approach focuses on improving engagement and motivation by implementing student-centered learning methods such as project-based learning, interactive activities, and collaborative tasks (Achuthan et al., 2024; Balalle, 2024; Jiang & Cheong, 2024; Marland & Store, 1993; Samandar, 2024). These approaches foster active participation and reduce dropout rates by making online learning more interactive and personalized.

The Content Delivery Approach ensures that learning materials are structured, engaging, and aligned with students' learning styles. Poor content organization can lead to cognitive overload, frustration, and disengagement. Effective delivery includes clear learning objectives, modular content, multimedia integration, gamification, and interactive learning tools, all of which enhance student engagement and knowledge retention (Afzal et al., 2024; Khasawneh et al., 2023; Muhammad, 2024; Sadanala et al., n.d.).

The Monitoring Learners' Behavior Approach leverages data-driven interventions and AI-powered student monitoring to analyze learning behaviors and apply timely interventions. AI models can track facial expressions (Cha & Kim, 2015; Dewan et al., 2018; D'Mello et al., 2012; Hutt et al., 2017; Murali et al., 2021; Sun et al., 2019; Zeng et al., 2019), gaze behavior (Bedenlier et al., 2021; Hutt et al., 2017; Murali et al., 2021; Yang et al., 2015), head posture (Ahuja et al., 2021; Murali et al., 2021; Raca & Dillenbourg, 2015), and physiological responses such as brain waves (Hassib et al., 2017; Kosmyna & Maes, 2019) and galvanic skin response (GSR) (Al Machot et al., 2018; Di Lascio et al., 2018). These insights provide real-time feedback, enabling instructors to better understand student engagement levels and implement adaptive interventions.

Building upon these approaches, this study introduces LeSA (Learner Sustained Attention), an AI-powered solution utilizing computer vision techniques to analyze students' sustained attention in online learning. By extracting behavioral patterns such as gaze tracking, facial expressions, and blinking patterns, the proposed model offers a practical tool for monitoring engagement and enhancing instructional strategies.

Research Objectives

1. To investigate online learners' behavioral patterns using computer vision techniques and their impact on sustained attention levels.
2. To analyze the relationship between these behavioral features and students' engagement in online learning environments.
3. To evaluate the effectiveness of AI-powered attention monitoring tools in supporting instructors to enhance student engagement and improve instructional strategies in online education.

16 RESEARCH METHODOLOGY

This research follows a research and development approach using mixed methods design with the following steps:

16.1 Data Collection

A dataset was collected from 25 student participants, consisting of 20 males and 5 females, all Asian teenagers aged between 15–20 years old, with 2 participants wearing glasses. Prior to data collection, all participants were informed about research ethics and provided consent for data collection.

Each participant recorded two 20-minutes video sessions using their own devices to reflect real-world diversity in online environments. The sessions included:

- **Active online activities** that participants found engaging and enjoyable, where they were naturally. Such as using social media, playing online games, and streaming movies.
- **Passive online activities** that were perceived as less engaging and more likely to cause distraction or reduced attention, such as attending online lectures, reading e-books, and listening to monotonous podcasts.

Each video was required to capture upper-body movements, facial expressions, and gaze direction to facilitate behavioral analysis.

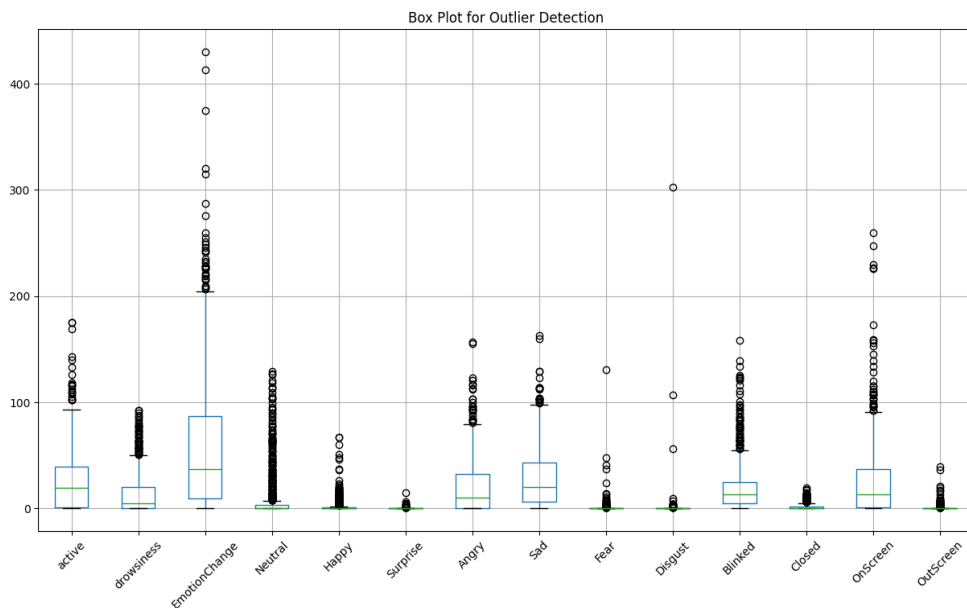


Figure 1: Example of the dataset

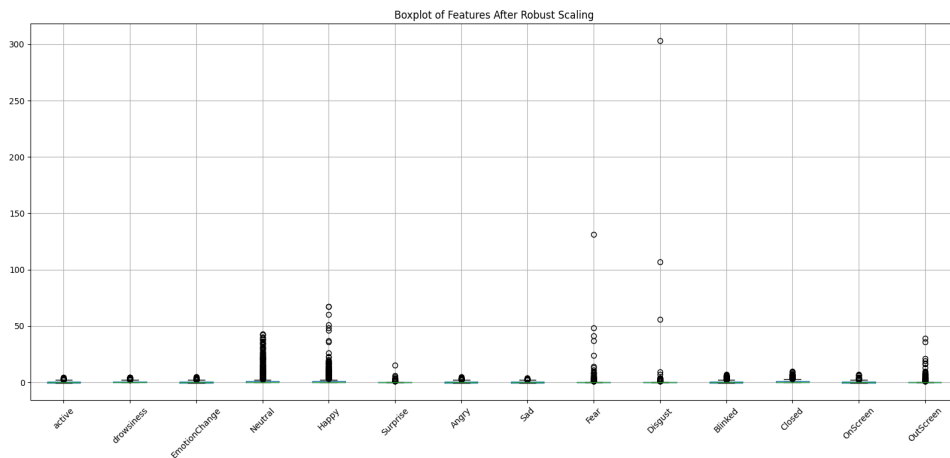
After three days, participants reviewed their own videos (without being informed of the session type) and self-assessed their sustained attention levels for each minute, categorizing them into high, moderate, low, or no attention. Meanwhile, three online learning experts independently assessed the same videos, using a randomized order to prevent assessment bias. The final sustained attention level for each video segment was determined using the following rules:

1. If all assessments matched (from three experts and from participants), that level was assigned.
2. If there was disagreement, only the mode value from the three expert assessments was used.
3. If no mode value was found, the participant's self-assessment was included to determine the mode value.
4. If no mode value still could not be determined, the data was discarded.

Meanwhile, a computer vision-based AI model was used to extract 14 behavioral features from the record videos: blink rate per minute, frequency of eye closure, frequency of looking at the screen, frequency of looking away from the screen, frequency of active facial expressions, frequency of drowsy facial expressions, frequency of angry facial expressions, frequency of sad facial expressions, frequency of disgusted facial expressions, frequency of happy facial expressions, frequency of surprise facial expressions, frequency of neutral facial expressions, frequency of fear facial expressions, and frequency of emotional facial expression changes. These 14 behavioral features were then combined with the categorized sustained attention levels to analyze behavioral patterns affecting sustained attention in online learning environment. Dataset contains 1000 records. After removing records with missing values and duplicates, robust scaling was applied to handle inconsistencies in the data, ensuring that outliers remained within an acceptable range without distorting the analysis. The final dataset contains 764 records.



(a) Dataset before applied robust scaling



(b) Dataset after applied robust scaling

Figure 2: Dataset before and after handling outliers with robust scaling.

16.2 Feature Selection and Feature Engineering

To identify behavioral features relevant to sustained attention levels, correlation analysis was conducted. Features which have a correlation coefficient of 0.3 or higher were selected for further analysis. Based on this criterion, six behavioral features were chosen for training the AI model:

1. Frequency of active facial expressions.
2. Frequency of emotional facial expression changes.
3. Blink rate per minute.
4. Frequency of looking at the screen.
5. Frequency of looking away from the screen.
6. Frequency of eye closure.

The selected featured exhibited linear relationships with sustained attention levels, making them suitable for training a supervised AI model for effective prediction. To address potential training inefficiencies caused by limited dataset and class imbalance, the Synthetic Minority Over-sampling Technique (SMOTE) was applied to resample the data. The dataset was then 976 records, with 337 records in each category. The dataset was split to an 80% training set (780 records) and a 20% test set (196 records) for model evaluation.

16.3 Model Training

Six machine learning algorithms were selected to train AI models, categorized based on their computation complexity and ability to handle different data relationships:

Lightweight models: Suitable for linear relationships data and requiring minimal computation resources including Support Vector Machine (SVM), and Logistic Regression.

Medium-weight models: Capable of handling non-linear relationships with moderate computational resources: Random Forest

Heavyweight models: Designed for high accuracy and complex relationships, requiring higher computational resources: Gradient Boost, XGBoost, and LightBGM.

The AI models were trained in two rounds: First round, AI models were trained using default parameters, with 10-fold, 20-fold, and 30-fold cross validation to ensure robust performance.

Table 19 Default Parameters Used in First Round Training.

AI Model	parameter
SVM	probability=True, random_state=42, Kernel= RBF
Logistic Regression	max_iter=1000, random_state=42, Solver= lbfgs
Random Forrest	random_state=42, n_estimators=100, max_depth=None
Gradient Boost	random_state=42, learning_rate=0.1, n_estimators=100, max_depth=3
XGBoost	use_label_encoder=False, eval_metric=mlogloss, random_state=42, n_estimators=100
LightBGM	random_state=42, num_leaves=no define, learning_rate = 0.1

After evaluating the first round of training, 20-fold cross validation demonstrates the best balance between bias and variance. Consequently, for the second round all AI models were fine-tuned using RandomizationSearchCV, retrained with optimized hyperparameters, and their performances were compared.

Table 2 Fine-Tuned Parameter Used in Second Round Training.

AI Model	parameter
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SVM	kernel=rbf, gamma=1, C=10
Logistic Regression	solver=lbfgs, penalty=l2, max_iter= 100, C=0.1
Random Forrest	n_estimators= 200, min_samples_split= 2, min_samples_leaf=1, max_depth=None
Gradient Boost	n_estimators=200, max_depth=7, learning_rate=0.2
XGBoost	subsample=0.8, n_estimators=100, max_depth=7, learning_rate=0.2
LightBGM	num_leaves=50, n_estimators=300, max_depth= -1, learning_rate= 0.2

16.4 Model Evaluation

To evaluate the performance of the AI models, a confusion matrix was used to measure accuracy metrics:

Accuracy measures the overall correctness of a model by calculating the percentage of correctly predicted instances out of all predictions. Higher accuracy generally indicates better performance; however, it can be misleading in imbalanced datasets where one class dominates. **Precision** quantifies how many of the predicted positive cases are actually correct, with higher precision meaning fewer false positives, making the model more reliable when false positives need to be minimized.

Recall (Sensitivity or True Positive Rate) assesses how well the model identifies actual positive cases, measuring the proportion of true positives correctly predicted. A high recall indicates that the model effectively detects most positive cases but may increase false positives.

F1-score is the harmonic means of precision and recall, balancing both metrics to provide a more comprehensive evaluation when there is an imbalance between false positives and false negatives. A high F1-score suggests that the model maintains an optimal trade-off between precision and recall.

Receiver Operating Characteristic - Area Under the Curve (ROC-AUC) evaluates a model's ability to distinguish between different classes by plotting the True Positive Rate (Recall) against the False Positive Rate at various classification thresholds. The AUC score quantifies the model's performance, where a value of 1.0 indicates perfect classification, 0.5 suggests random guessing, and below 0.5 means the model performs worse than random chance. A higher AUC indicates better class separation, making ROC-AUC particularly useful for evaluating probabilistic models and assessing their discriminatory power across different classification thresholds.

Additionally, given the real-world application in online learning environments, **computation time (latency)** was measured to evaluate how long each model took to predict new data. All models were compared across these metrics to determine the most situation model for monitoring sustained attention in online leaning.

17 RESULTS

This section presents research results according to research objectives.

17.1 Investigating Online Learners' Behavioral Patterns Using Computer Vision Techniques and Their Impact on Sustained Attention Levels.

To investigate the behavioral patterns of online learners and their impact on sustained attention levels, 14 behavioral features were extracted using computer vision-based methods. Each feature was analyzed to determine its relationship with sustained attention.

Behavioral Feature Analysis: An initial correlation analysis was conducted to assess the relationship between each behavioral feature and sustained attention level. The results

indicated that all 14 features influenced sustained attention to some degree, however, only six features exhibited a statistically significant correlation (≥ 0.3) with sustained attention level. These six key behavioral features were selected for further study:

1. Frequency of active facial expressions: Facial movement, such as raising eyebrows, smiling, or reacting expressively, was positively correlated with sustained attention. Learners who frequently display active facial expression tended to remain more engaged in the learning sessions.

2. Frequency of emotional facial expression changes: Frequent shifts between different emotional expressions indicate fluctuating attention levels. Learners who rapidly changed facial expressions showed lower sustained attention, possibly due to distractions or shifting emotional states.

3. Blink rate per minute: Engaged learners blinked between 15-30 times per minute. A higher blink rate was associated with lower sustained attention, as increased blinking may indicate fatigue, disengagement, or cognitive overload.

4. Frequency of looking at the screen: Direct eye contact with the screen was a strong indicator of sustained attention. Learners who consistently maintained screen focus exhibited higher attention levels.

5. Frequency of looking away from the screen: In contrast to looking at the screen, frequent eye movement away from the screen was negatively correlated with sustained attention. A higher off-screen gaze frequency suggested distraction or reduced cognitive engagement.

6. Frequency of eye closure: Prolonged eye closures were linked to fatigue, reduced alertness, and lower sustained attention. Learners who frequently closed their eyes during the session were more likely to experience attention lapses.

Interpretation of Behavioral Patterns: The findings suggest that learners who exhibited active facial expressions, maintained eye contact with the screen, and had a moderate blink rate were more likely to sustain their attention during online learning. Conversely, those who frequently looked away from the screen, rapidly changed facial expressions, or closed their eyes experienced reduced attention spans.

These results highlight the importance of visual sustained attention cues in online learning environments. The extracted behavioral patterns provide valuable insights for instructors, allowing them to identify disengaged learners in real time and adjust instructional strategies accordingly.

Table 3 Learners' Behavioral Pattern Represent Sustained Attention.

Sustained Attention level	Learners' Behavioral Pattern
Tend to high level	1. Exhibited active facial expressions. 2. Maintained eye contact with the screen. 3. Had a moderate blink rate.
Tend to low level	1. Frequently looked away from the screen. 2. Rapidly changed facial expressions. 3. Closed their eyes

17.2 Analyzing the Relationship Between Behavioral Features and Sustained Attention

To examine the relationship between behavioral features and sustained attention, Pearson correlation analysis was conducted. The correlation coefficient (r-value) was used to measure

the strength and direction of each relationship, with statistical significance assessed using p-values.

Figure 3 presents the correlation heatmap, illustrating the relationships between the 14 behavioral features and sustained attention levels. The intensity of the color represents the strength and direction of correlation, with darker shades indicating stronger correlations.

The analysis revealed that six key features exhibited statistically significant correlations (≥ 0.3) with sustained attention levels. Table 4 presents the correlation results for the selected six behavioral features.

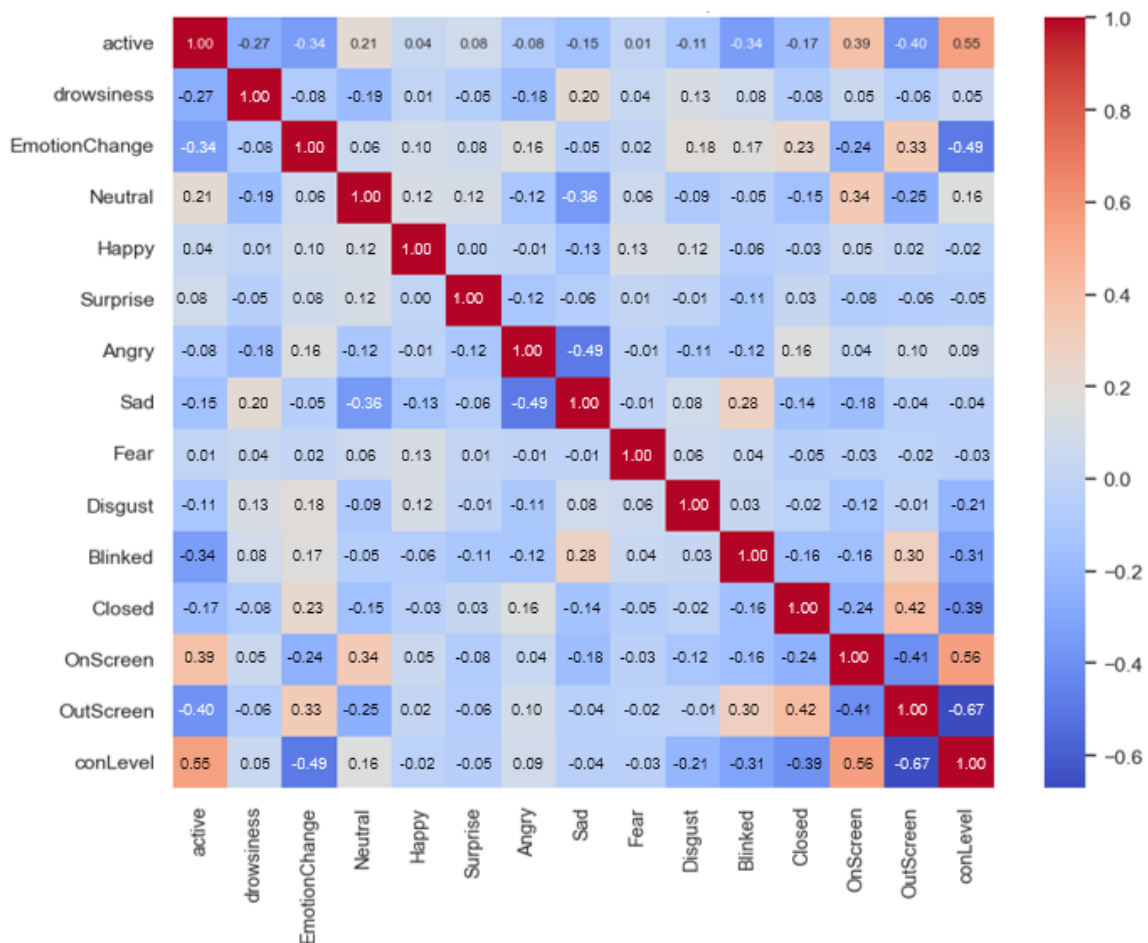


Figure 3: Correlation Heatmap of Behavioral Features and Sustained Attention Levels.

Table 4 The Correlation Results for The Selected Six Behavioral Features.

Behavioral Feature	Correlation Coefficient (r)	Statistical Significance (p-value)	Relationship with Sustained Attention
Frequency of looking at the screen	0.56	< 0.05	Strong Positive
Frequency of active facial expressions	0.55	< 0.05	Moderate Positive
Blink rate per minute	-0.31	< 0.01	Weak Negative
Frequency of eye closure	-0.39	< 0.01	Moderate Negative

Frequency of emotional facial expression changes	-0.49	< 0.05	Moderate Negative
Frequency of looking away from the screen	-0.67	< 0.01	Strong Negative

The correlation analysis highlights key behavioral indicators associated with sustained attention in online learning environments.

Positive Correlations (Indicators of High Sustained Attention)

- Looking at the screen ($r = 0.67, p < 0.01$): Strongly associated with higher sustained attention, confirming that visual focus is a key determinant of attention retention.
- Active facial expressions ($r = 0.55, p < 0.05$): Moderately associated with higher sustained attention. Learners who frequently engage in expressive reactions (e.g., smiling, raising eyebrows) tend to remain engaged in learning sessions.

Negative Correlations (Indicators of Low Sustained Attention)

- Looking away from the screen ($r = -0.67, p < 0.01$): Strongly associated with lower sustained attention, suggesting that frequent off-screen gazes indicate distraction.
- Emotional facial expression changes ($r = -0.49, p < 0.05$): Moderately associated with lower sustained attention. Learners who frequently shift emotions during learning sessions tend to lower sustained attention, likely due to external distractions or cognitive overload.
- Eye closure ($r = -0.39, p < 0.01$): Moderately associated with reduced attention levels, possibly due to fatigue or disengagement.
- Blink rate ($r = -0.31, p < 0.05$): Weakly associated with lower sustained attention. While a moderate blink rate is normal, an excessive blink rate suggests lower sustained attention, likely due to mental fatigue or loss of focus.

Further analysis indicates that the relationship between the selected behavioral features and sustained attention levels exhibit linearity. This suggests that changes in these behavioral features have a direct and proportional effect on sustained levels. Figure 4 illustrates these linear relationships between key features and sustained attention.

These findings highlight the importance of behavioral monitoring in online education, as tracking visual focus and facial engagement can provide real-time indicators of attention retention.

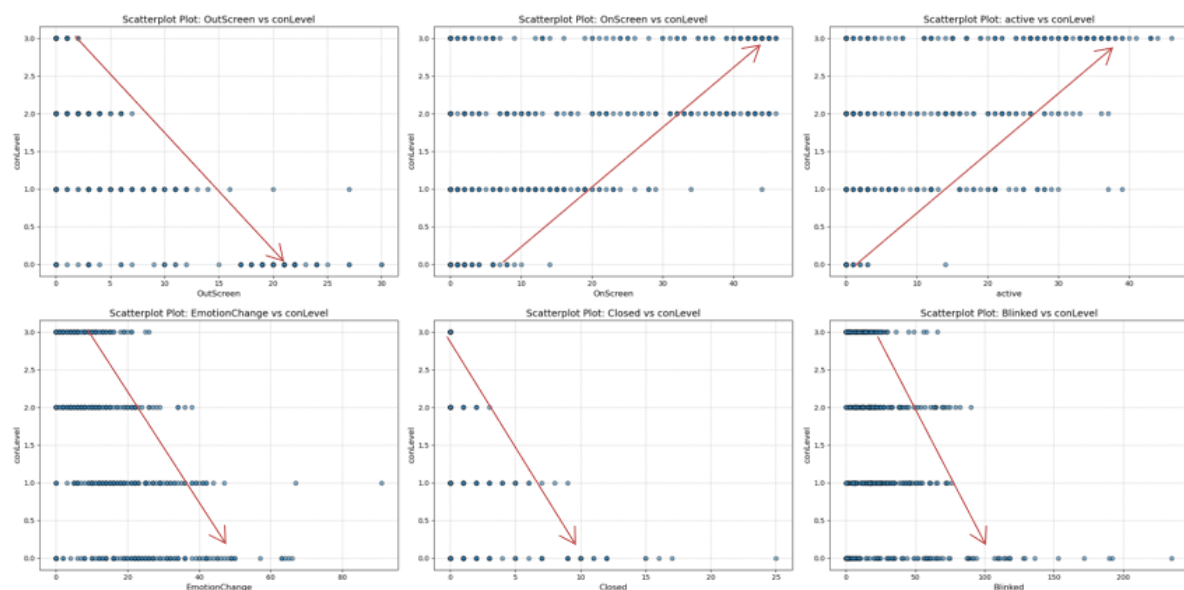


Figure 4: Linear Relationship of Selected Features with Sustained Attention.

17.3 AI Model Performance Evaluation for Sustained Attention Monitoring

To assess the effectiveness of AI models in monitoring sustained attention, multiple machine learning algorithms were trained and evaluated. The evaluation metrics included: Accuracy, Precision, Recall, F1-score, ROC-AUC, and Latency. Table 5 summarizes the performance of the six AI models evaluated in this study.

Table 5 Performance Comparison of AI Models for Sustained Attention Prediction

AI Model	Accuracy	Precision	Recall	F1-score	ROC-AUC	Latency
SVM	71.48%	0.71	0.69	0.70	0.83	230 mS
Logistic Regression	62.96%	0.61	0.63	0.62	0.77	10 mS
Random Forest	84.07%	0.83	0.84	0.83	0.86	760 mS
Gradient Boosting	83.70%	0.83	0.84	0.83	0.85	6.12 S
XGBoost	82.22%	0.82	0.82	0.82	0.86	310 mS
LightGBM	83.70%	0.83	0.84	0.83	0.85	660 mS

The Random Forest model achieved the highest accuracy (84.07%) and the best overall performance with an F1-score of 0.83 and a ROC-AUC of 0.86, making it the most effective model for predicting sustained attention in online learning. However, its latency (760 mS) is slightly higher than SVM (230 mS), Logistic Regression (10 mS), XGBoost (310 mS), and LightGBM (660 mS), which is an important factor for real-time applications.

Although Gradient Boosting exhibited high accuracy and strong overall performance, it had the highest computational time (6120 mS), making it unsuitable for real-time tracking.

SVM and Logistic Regression performed moderately well and required significantly less computation time; however, their accuracy was lower than other models, limiting their effectiveness for sustained attention prediction.

XGBoost and LightGBM demonstrated competitive performance, achieving high accuracy and F1-scores while maintaining lower latency than Gradient Boosting. However, both models require higher computational costs than Random Forest, making them less efficient for large-scale online learning applications. Figure 5 illustrates the comparative performance of all models across different evaluation metrics.

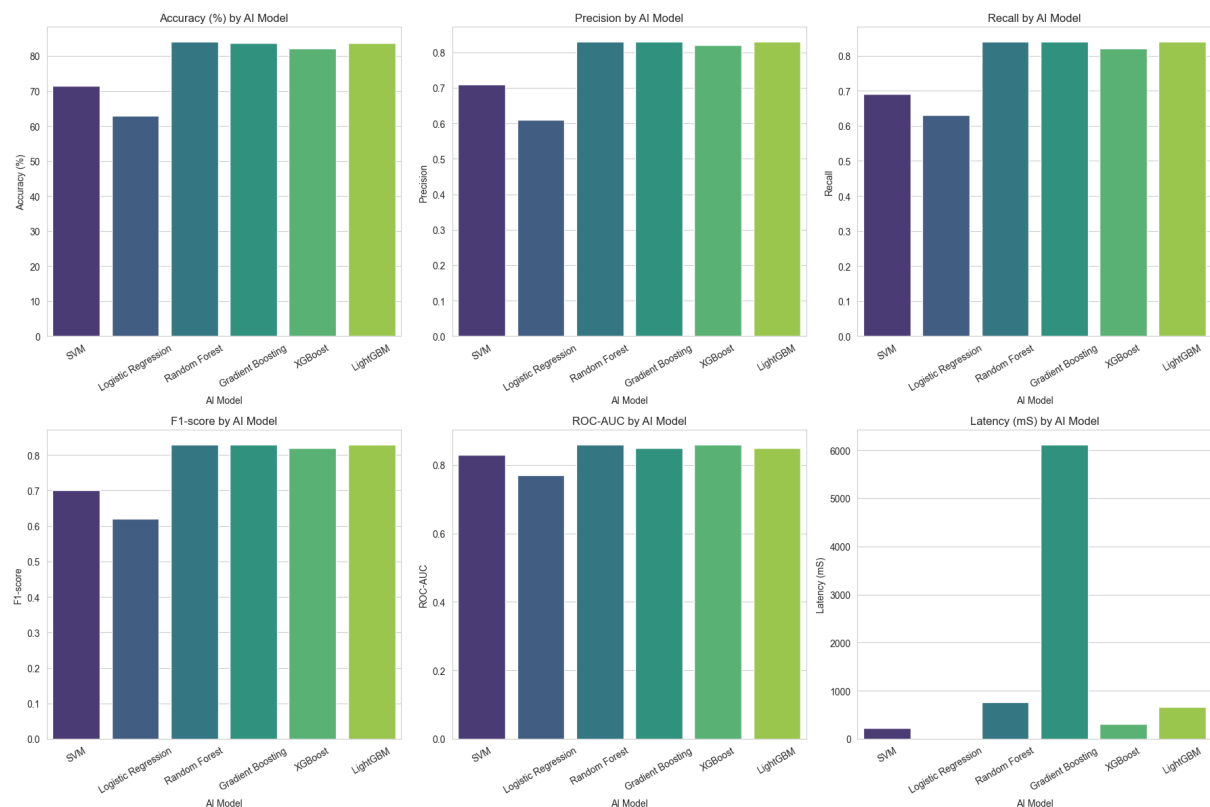


Figure 5 The Comparative Performance of AI Models.

For real-time monitoring in online learning, balancing model accuracy and computational efficiency is essential, if required high accuracy, Random Forest, Gradient Boost or LightGBM may be the best options. If low computational latency is required XGBoost provides a good balance of accuracy and faster processing. If simplicity and low resource usage are needed, Logistic Regression and SVM are the good choice but less accurate.

18 CONCLUSION AND DISCUSSION

This study demonstrates that Computer Vision-based AI can effectively monitor students' sustained attention in online learning environments. By identifying key behavioral patterns, it validates the effectiveness of AI-driven attention tracking, offering a scalable, automated approach to engagement monitoring.

Through correlation analysis, the study reveals that sustained attention is significantly influenced by visual and facial behavioral cues. The six key behavioral features identified are: **High sustained attention** is associated with frequent screen focus, active facial expressions, and a balanced blink rate.

Low sustained attention is linked to frequent looking away from the screen, excessive emotional expression changes, frequent eye closure, and a high blink rate.

Similar to Miao et al. (2024), who integrated multimodal data for real-time attention detection, this study reinforces the importance of leveraging multiple behavioral cues for accurate attention assessment. The findings highlight that combining gaze tracking, facial expressions, and movement analysis enhances the effectiveness of Computer Vision-based AI models in monitoring concentration. Likewise, Zhou et al. (2024) emphasized that non-verbal cues play a crucial role in understanding student learning processes, further supporting the role of

Computer Vision-based AI models in adaptive learning environments and personalized engagement monitoring.

Additionally, this study validates Computer Vision-based AI models as a non-intrusive and scalable solution for automated attention monitoring. The proposed Learner Sustained Attention (LeSA) AI model, powered by Random Forest, achieved the highest accuracy (84.07%), demonstrating its effectiveness in predicting sustained attention levels. Unlike traditional manual observation, self-reported surveys, or wearable sensors, the Computer Vision-based approach enables real-time, automated tracking using only a webcam, making it a practical tool for online learning.

This study aligns with Ma et al. (2022), who explored the use of Computer Vision in analyzing student engagement, confusion, gaze following, emotional expressions, and head movement, demonstrating its effectiveness in supporting online teaching. Similarly, Alruwais & Zakariah (2024) highlighted that AI-driven computer vision enables real-time student behavior recognition, allowing instructors to tailor learning experiences and ultimately improve engagement, learning outcomes, and instructional support. By analyzing behavioral patterns such as gaze direction, facial expressions, and attention shifts, Computer Vision-based AI provides real-time insights that enhance personalized learning experiences and engagement monitoring in both individual and collaborative learning settings.

As educational technology continues to evolve, AI-driven behavioral tracking offers an opportunity to redefine online learning experiences. This study demonstrates that Computer Vision-based AI models can provide real-time insights into student attention, improving engagement monitoring and retention strategies. The findings contribute to an expanding field of research on AI in education, offering a scalable, objective, and automated solution for tracking sustained attention in online learning environments.

Although this study provides strong evidence for Computer Vision-based attention tracking, several limitations must be acknowledged. Environmental factors, such as lighting conditions and webcam quality, can impact the accuracy of facial feature extraction, potentially affecting real-time tracking. Generalization challenges also exist, as real-world applications may require adaptive AI models that continuously learn from individual variations in student behavior, despite the dataset being balanced using SMOTE. Additionally, the AI model has yet to be tested in fully operational online learning environments, requiring future validation in real-world classrooms to assess its practical effectiveness and integration with existing learning platforms.

Future research should focus on deploying the AI model in live online learning environments to evaluate its practical effectiveness in monitoring sustained attention. Conducting live classroom trials would help validate the model's ability to provide real-time feedback and support adaptive teaching strategies. Additionally, further exploration of multi-modal behavioral analysis, integrating keystroke dynamics, speech tone, and body posture, could improve prediction accuracy by capturing a broader range of engagement indicators.

Incorporating adaptive AI systems that dynamically adjust attention thresholds based on individual learning styles could further enhance engagement tracking, making AI-powered learning analytics more personalized and responsive. By addressing these areas, future advancements in Computer Vision-based AI can continue to revolutionize online education, making learning environments more adaptive, data-driven, and student-centered.

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**Enabling Ideas For The Future.
Bridging Creative Projects, Innovation, And The Arts**
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ABSTRACT

Based on the analysis of current entrepreneurship support in Germany, a team at the Campus for Applied Research at the Technical University of Applied Sciences Würzburg-Schweinfurt has developed a new approach. The “Bridging Studies: Future Ideas and Project Implementation” started successfully in the winter semester of 2024 and is unique in this form in Germany. The Bridging Studies enable regular enrolment at the university and are particularly suitable for bridging qualification and life stages, for example between a Bachelor's and Master's degree or after completing a Master's degree. The Bridging Studies focus on the real implementation of an individual passion project. Each student brings his or her own idea to the program, which is supported for one or two semesters.

In this way, we want to reach projects that already have start-up ambitions as well as those that do not yet identify themselves as start-up projects but have the potential to do so. In particular, we also address students of the humanities and social sciences, as well as artistic projects that have so far remained largely unseen in entrepreneurship support. In courses on topics such as personal development, project management, business modeling, communication and science management, students work on their own ideas.

On the one hand, this article aims to enrich the overarching discussion for a target-oriented entrepreneurship qualification with a new approach and, at the same time, raise the question of the transferability of the model to other forms of study, teaching and examination.

KEYWORDS: Entrepreneurship qualification, project management, innovation, creativity, studies

INTRODUCTION

The seventeen binding sustainability goals of the United Nations came into force in 2016. They are intended to guarantee fundamental improvements in areas such as energy, education, health, and global warming by 2030. Innovation and entrepreneurship are particularly important aspects within this context: the development of new solutions for contemporary challenges should make it possible to achieve these goals. [1]

However, the feasibility of the same remains up for debate: entrepreneurship in particular is highly dependent on wide-ranging support in the start-up phase, which should include awareness-raising and qualification programs in addition to financial support. [2] The EXIST-Potentiale-Projects, which have been one of the most important funding programs for entrepreneurship and innovation in the heart of Europe, however, are now coming to an end. Innovative project ideas from all disciplines are therefore at risk of no longer being pursued in the future.

New approaches are needed in order to achieve sustainable support for creative concepts and projects. The new study format “Bridging Studies: Future Ideas and Project Implementation” at the Technical University of Applied Sciences Würzburg-Schweinfurt offers said approach. We focus on project-based learning, the promotion of intrinsic motivation, the inclusion of project ideas from all specialist disciplines, close project support, communication, and scientific expertise using tried and tested methods. Above all, the program proactively integrates the perspectives and innovative potential that students from the humanities and arts have to offer.

KEY LEARNINGS

The basis for the development of the Bridging Studies was an intensive analysis of current startup promotion - both within the university and throughout Germany. Qualitative observations at our university were brought into dialog with the categories known from the literature and our own conclusions were derived from this.

In the past, the expiring entrepreneurship support programs had various “blind spots” that need to be corrected with new approaches. They often only focused on a small section of potentially promising projects and examined these predominantly from an entrepreneurial and societal perspective, rather than from an individual psychological perspective. However, in startups and entrepreneurship, the focus should also be on personalities, personal drive, and purpose, as intrinsic motivation to pursue a 'passion project' often takes center stage. [3]

It was particularly noticeable that humanities and social studies as well as arts programs often felt insufficiently addressed by existing programs. [4] This circumstance is all the more remarkable when realizing that it is precisely these study programs that have the concept of creativity, a key concept of innovation in theory and practice at heart. Innovative approaches to complex questions, answers, and solutions would be expected within this realm precisely because students of humanities are trained to think in terms of ambivalences and ambiguities and do not exclusively favor the most expected and probable answers.

Students from the humanities, cultural, and social sciences are not only excluded from start-up scholarships but often remain underrepresented in events within the innovation ecosystems. In this context, the typical “start-up wording” is repeatedly emphasized, which tends to have a deterrent effect on some scientific disciplines. [5] The redesign of an interdisciplinary and inclusive study concept must inevitably take these linguistic aspects into account.

Considering that there is a wide variety of subject-specific perspectives that need to be integrated, a new program must offer a balance between providing open-mindedness in terms of individual design. However, it also needs structure to provide students with “guidelines” for organizing their work. In the past, it was observed that the individual courses in the funding programs were often not properly aligned with each other, which resulted in losing important synergy effects between the courses. In entrepreneurship education in particular, emphasis should be placed on content that builds on each other in a structured manner with practical relevance. [6]

It has recently become clear that startup grants (such as EXIST from the Federal Ministry of Economics and Climate Protection of the Federal Republic of Germany) often offer little incentive for those interested in starting a business: High requirements from the level of innovation, orientation towards common good and diversity, combined with a complex application process and little flexibility, have produced only a few teams eligible for funding in recent years.

THE CONCEPT OF THE BRIDGING STUDIES

Based on these findings, the entrepreneurship team at the Technical University of Applied Sciences Würzburg-Schweinfurt developed a new concept last year that is intended to address all scientific disciplines while bringing them into dialog. At the same time, it aims to establish innovative start-up projects as well as public-welfare-oriented start-ups in the long run.

The “Bridging Studies: Future Ideas and Project Implementation” was offered for the first time in the winter semester of 2024/2025 as an independent module program (in accordance with the Bavarian Higher Education Innovation Act). The program will not lead to a scientific degree but enables regular enrolment at the Technical University of Applied Sciences Würzburg-Schweinfurt.

The concept takes a different approach to many existing innovation programs: In the initial phase, start-up ideas are not generated or supported. Instead, the focus will lie on individual student projects. Each student brings their own “passion project”, which they will work on intensively for one or two semesters, focusing on its organizational structure. In doing so, students can earn up to 30 ETCS points, which can be credited to subsequent degree programs. The program is particularly suitable in phases between qualification and life stages, for example between Abitur and Bachelor’s degree, Bachelor’s and Master’s degree, Master’s and career entry, or Master’s and doctorate. It is also appealing to prospective students before formally starting an undergraduate degree course. On the one hand, it “bridges” gaps in the curriculum vitae, and, on the other, it promotes the acquisition, application, and transfer of new skills.

The supported projects can have an economic, social, creative, or scientific focus. This explicitly includes and addresses the humanities, cultural studies, and arts. In addition, the program makes it possible to identify projects that do not yet perceive themselves as start-up initiatives. Raising awareness and building competence in entrepreneurial and societal issues is an integral part of the curriculum.

Education-theoretical foundations

On a pedagogical level, our study concept is based on the constructivist paradigm: [7] We assume that our study concept primarily enables students to work out and further develop

their own projects, personalities, and world designs. The students remain the experts in their own projects. The skills acquired in the Bridging course enable students to find new perspectives on their work and provide them with tools that are suitable for working on various project ideas, in areas such as creativity techniques, project management, and communication.

Methodologically, the course is based on a project-based learning approach, which emphasizes practical work. At the same time, however, meta-competencies are also learned using specific examples. This makes it possible to transfer these skills to other issues at a later date.

Intrinsic Motivation

Individual projects are always the starting point in Bridging Studies. We are convinced that the intrinsic motivation to work on a project close to one's heart is a much greater incentive than the prospect of possible funding options in the future.

A separate course on “Personality and Society” addresses this intrinsic motivation separately and promotes it further. Theoretical knowledge such as systemic thinking and communication skills as well as start-up tools such as “business model” and “business plan” are taught, but never as an end in themselves, but always in their application in relation to the student's own project.

Close project support

Based on the students' individual projects, the Bridging Studies offer close project support: students work practically on their projects in all courses. The link here is the seminar “Implementing and documenting projects”, in which a self-developed milestone plan is implemented, evaluated, and realigned to current conditions in an agile manner. The basis for assessment is always the organizational competence and the application of the methods learned, not the actual content of the projects, which can be designed in different ways.

Communication

We consider communication to be a central learning strategy, but also the core of entrepreneurial thinking and action. It is therefore all the more surprising that often too little attention is paid to communicative skills in entrepreneurial contexts. Accordingly, we have not only firmly anchored the “Media and Communication” module as course content. We have also established numerous forms of examination as a meta-competence. As part of the “Implementing and documenting projects” seminar, students should form peer groups for regular exchange, work with agile methods such as Lego Scrum in the “Designing and managing projects” seminar, conduct interviews with founders and network partners in the “Founding@THWS” seminar and present their projects at a final conference. Communication thus serves not only as a means of acquiring new knowledge but also as a means of networking with each other and within the network, as well as an actively trained soft skill for presentation situations, group work, and everyday encounters.

Scientific know-how

Exams within the Bridging Studies “Future Ideas and Project Implementation” do not test theoretical knowledge, however, we attach great importance to contextualizing the knowledge imparted in our courses in their respective subjects and traditions of thought. As a result, we are moving closer to a holistic pedagogical ideal. The applied methods include systemic tools such as the “hero’s journey”, methods of agile project management, design thinking, and gamified (planning) game elements. In addition, we integrate the interdisciplinary know-how of experts from different disciplines in key areas such as business modeling, copyright law, taxes, and financing.

PERSPECTIVES

Entrepreneurship education at universities often suffers from the fact that many promising start-up projects are not realized after the qualification phase. There are many reasons for this, ranging from a lack of funding options and insufficient entrepreneurial skills to a lack of networks. We, therefore, consider it essential to firmly integrate possible follow-up prospects into the concept of the Bridging Studies. Precisely because the Bridging Studies serves as an orientation phase between qualification and life stages, it is important to address this aspect beyond the work done within this program.

Since we are dealing with an extremely heterogeneous group, these follow-up options have to be correspondingly diverse. Innovation-based, high-tech-focused start-ups can receive further support through the “ZENTRIA” certificate program (in partnership with the University of Würzburg, the Technical University Würzburg-Schweinfurt and the Technical University Aschaffenburg) or be considered for the EXIST start-up grant. Female founders are eligible to take part in the qualification program “EXIST Women”, including a scholarship. The general start-up advice service at THWS is open to all THWS students and alumni. In addition, the network (e.g. start-up centers, Chamber of Industry and Commerce) is already actively involved during the Bridging Studies. Those interested in pursuing a doctorate are given personal contact persons by the THWS Doctoral Center, which is also located on the Applied Research Campus. It is also possible to take up further studies at the THWS or any other national or international university with credit for the ECTS points earned.

OBJECTIVES

The Bridging Studies „Future Ideas and Project Implementation” pursues didactic, project-related, and social objectives.

Didactic Objectives

The didactic objectives of the Bridging Studies are primarily aimed at training so-called meta-competencies that can be used in a variety of application situations. These include practical and problem-solving skills, as well as implementation skills since all projects are accompanied through various stages and are transferred into a concrete implementation phase. The ideas in the Bridging Studies do not remain on paper but are directly worked on for one or two semesters. The promotion of organizational and management skills is particularly important here, as milestone plans are developed and implemented, but also must be adjusted to changing conditions in an agile manner. The self-organization and “help for

self-help” required in many contexts are also implemented in a very practical way into one's own project and should be emphasized separately here. A key competence in all questions pertaining to organization, problem-solving, and implementation is also communication, which - as already mentioned - is promoted in many ways during the course. Overall, the didactic objectives of the Bridging Studies strengthen transfer skills especially, as basic knowledge and skills from areas such as communication, organization and management can be transferred to different areas.

Project based goals

We pursue various goals based on project support. First and foremost, our core concern is to support students in implementing their projects. The Bridging Studies aims to set itself apart from other qualification programs by working on the projects in one or two semesters. Moreover, the examinations are always based on partial aspects of the student's own project. In particular, we would like to encourage students of the humanities, social sciences, and cultural studies to carry out their projects. In addition, we hope to identify start-up projects that do not yet see themselves as such at this stage. After completing the Bridging Studies, we would like to offer all projects possible follow-up options - from general start-up advice to start-up grants.

Social objectives

We believe that a broad qualification program such as the Bridging Studies is a fundamental component for the holistic promotion of creativity, innovation, and social progress. By bringing together different disciplines in a project-based degree program, we promote exchange between scientific disciplines. Furthermore, our didactic goals train meta-skills such as creativity, communication, and problem solving, which should enable our students to think and act creatively and sustainably beyond their own project work. Lastly, we immediately identify innovation-based start-up ideas in the Bridging Studies, which we can then transfer directly to corresponding funding programs. Social problems, as defined in the United Nations Sustainable Development Goals, are specifically addressed in this program and brought into dialog with students' own project ideas.

DISCUSSION

The program was very well within the first semester and led to 27 registrations without the need to exhaust all possible deadlines. Our assumption that this concept would also reach students who had not previously felt addressed by other funding and qualification options proved to be correct in that a variety of different project ideas with start-up potential are represented, from artistic projects (e.g. creative processing of current social discourse) to social concerns (e.g. cooperatively organized supply structures) to technological start-up ideas (e.g. app to improve healthcare). Around two-thirds of the participants are female, which is well above the average representation in many other entrepreneurship initiatives. Overall, the question arises as to what extent the basic assumptions of the Bridging Studies could also be promising for other educational purposes: Artificial intelligence is increasingly challenging traditional forms of teaching and learning. As a result, the definition and significance of “knowledge” will have to be discussed anew in the future. Our partial answer to this is to train transfer and meta-skills in particular and thus enable students to deal

competently with the resources available to them, to question them at the same time and to use them sensibly and purposefully for the (further) development of project-based work.

CONCLUSION

The Bridging Studies “Future Ideas and Project Implementation” at the Technical University of Applied Sciences Würzburg-Schweinfurt offers a new approach to entrepreneurship support that includes a variety of scientific disciplines. It also promotes practical project implementation and enables students to respond to the challenges of our time in a creative, solution-oriented, and implementation-oriented manner.

We are confident that these initial promising results will enable us to expand the Bridging Studies even further in the coming years and thus make a valuable contribution to entrepreneurship education.

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Using AI Transcription-Translation Tools to Improve Speaking Skills for the IELTS Test

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Abstract

This paper aims to share classroom practices for using the transcription-translation platform TurboScribe in conjunction with the latest Chat GPT-4o AI model to help students practice for the speaking component of the IELTS test. The participants are first-year undergraduate students in the International Studies Department at a private university in Western Japan. One year of study abroad is mandatory for these students, so they need to take the IELTS test to qualify for programs in North America, Europe, Southeast Asia, and Australia. The students' transcripts have been analyzed to check how they incorporated the advice received from the AI into their speaking practice. Students' perceptions and thoughts about using the AI, as well as the successes and challenges encountered during classroom instruction, are discussed.

Key Words: Artificial Intelligence (AI), ChatGPT, L2 speaking development, translation-transcription, feedback, IELTS test

Introduction

I. Program Overview

The mission of the International Studies department where this case study took place is to send all enrolled students for one year of study abroad. All the overseas affiliated institutions accepting these students use the IELTS test as a benchmark for acceptance. The cut-off score for acceptance is a band score of 5.5. As such, preparatory courses for the four skills tested on the IELTS, Listening, Speaking, Reading, and Writing, are required courses for first-year students. The speaking component of the IELTS test is taught in a year-long dedicated Speaking & Writing course with a maximum enrollment of fourteen students per class. The motivation for this study was to propose a guide for best teaching practices that would help these students to improve their IELTS speaking scores necessary for study abroad.

II. The Role of Transcription-Translation Tools in Fostering Speaking Practice

In spite of many years of English as a Foreign Language (EFL) study, many students struggle with production in L2 (Akhter et al., 2021; Kargar Behbahani et al., 2024, Leeming et al., 2024). For Japanese learners in particular, the heavy focus on grammar studies (Sakui, 2004) and the general tendency to sit quietly in lecture style, non-interactive courses, have led to a lack of active participation and engagement in the EFL classroom (Harumi, 2011; Kim, 2024). Therefore, it is important to offer tools to EFL students that will help them to visualize their speaking output, to train them to recognize errors and self-correct, and to provide feedback that is easy for them to understand and incorporate in future output. AI-powered tools that can help achieve these aims are now widely available to both students and educators, but studies on how CALL affects speaking efficacy are just beginning to emerge (Dong et al., 2022), as the use of AI technology is becoming more and more popular in language teaching (Dennis, 2024).

Transcription tools have been considered a great aid to help students improve both accuracy and fluency which are among the scoring criteria for the speaking component of the IELTS test. The IELTS speaking test consists of three parts: Part I is a basic interview about personal preferences and opinions on general topics; Part II is a one to two minutes monologue about a particular suggested topic with one minute of preparation; Part III requires generalized answers to more abstract themes based on the topic from Part II.

Research has shown that students can make significant gains in speaking ability by learning to spot and correct errors in transcribed speech in the short-term (Mennim, 2003; Stillwell et al., 2010) as well as in the long-term (Mennim, 2007). According to Stones (2013), transcription task cycles “[involving] practice test, transcription, student correction, teacher correction, and retrieval of the original test...showed that students’ approaches to correction varied widely from single corrections to complete reformulations, and that students were able to make gains with a variety of forms, appearing more likely to use their own corrections than those of the teacher.” Lynch (2007) has also shown that students’ perceptions of the process of using transcribed speech to analyze their speaking have been generally positive. A study carried out on Japanese learners of English by Hirai and Kovalyova (2024) has shown that speech-to-text applications demonstrate great pedagogical potential.

Methodology

I. AI Translation-Transcription Tools

The transcription platform selected for the IELTS Speaking & Writing course is TurboScribe, a Whisper powered AI that offers video and audio translation and transcription. The site allows three free transcriptions of up to 90 minutes per day and unlimited transcription-translation for paying subscribers. The resulting transcriptions can be downloaded and shared as PDF, DOCX, captions and subtitles (SRT/VTT), CSV, and TXT. Chat GPT-4o AI is linked to TurboScribe, so the transcripts can be directly analyzed through the same site. Instructors purchased paid accounts, while students only registered for free accounts.

II. Training for Students

To help students become accustomed to utilizing the TurboScribe and ChatGPT AI, training was provided. Students were shown how to make recordings on their devices and how to upload them to TurboScribe. Then they were taught how to download the transcribed text to Word documents which were printed. Instructor-created error-correction guides were introduced to explain how to spot common mistakes within the transcribed text and how to self-correct. The initial guides were simple, but they became more complex as students learned new test-taking techniques, formulaic language, and vocabulary. The instructor demonstrated how to use the error-correction guide through pair-work activities.

III. Transcription-Task Cycles

Speaking practice for the IELTS test was conducted in the following manner: after a new IELTS topic and techniques were introduced, students were given a set of Part I, II, and III questions on that topic for practice. Students were instructed to record their answers to the questions and transcribe the recorded speech using TurboScribe. They were provided with error-correction guides and asked to analyze and self-correct their speech. These assignments were carried out in class or assigned as homework. The self-corrected transcripts were then submitted to the instructor for feedback.

Before receiving instructor feedback, students were asked to feed their corrected transcription to ChatGPT and ask advice from the AI. The following suggested prompts were used for this purpose:

“How can I improve this answer for Part (I, II, or III) of the IELTS Speaking Test?”
“How can I improve this answer for Part (I, II, or III) of the IELTS Speaking Test in order to receive a 6.0 score?”

The second prompt was used after students had taken the IELTS for the first time and had an idea of their band score. Students would then compare their self-corrected transcripts with the suggestions offered by ChatGPT. Finally, the students received the self-corrected transcripts with instructor feedback and had three sources of feedback from which to prepare for their speaking tests (See Figure1).

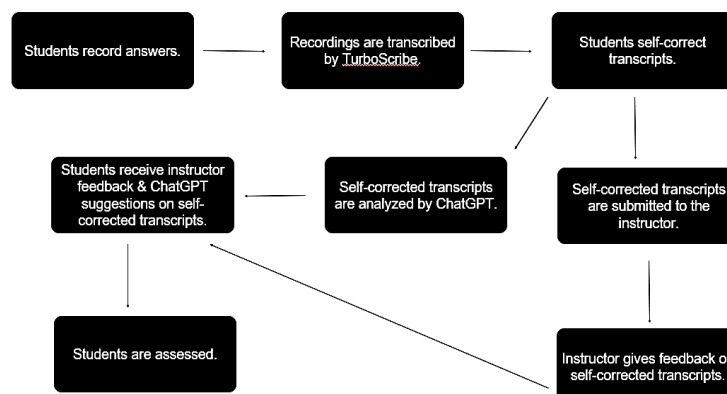


Figure 11. The transcription-task cycle.

For lower-intermediate students, Part III of the IELTS Speaking test was the most challenging. They often had trouble formulating their answers even when they could understand and answer the questions in L1. For these students, the TurboScribe translation function was employed (See Figure 2). They would first answer the question in Japanese, then transcribe their answers from Japanese to English. TurboScribe can translate speech recorded in one language to another language before transcription. After studying the translated transcript, they were asked to make a second recording in English and follow the same steps as the regular transcription-cycle. It is important to give students enough time to analyze the translated transcription to note vocabulary and details. However, they should not be allowed to memorize the answers: they must attempt to answer the question in a similar manner, using their own words and suggestions from the feedback.

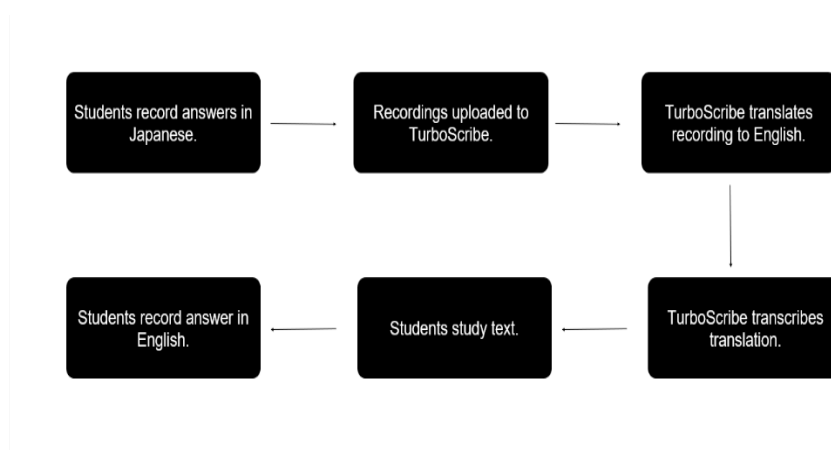


Figure 12. Transcription-task cycle for students answering Part III questions in Japanese.

After a transcription-task cycle, students were assessed using a mix of the same questions from the original set as well as similar questions that they had not seen before.

IV. Assessments

Speaking assessments were carried out after each transcription-task cycle. To avoid memorization of answers, students were assessed immediately after receiving the instructor-feedback. They were allowed a short period of time to study the instructor-feedback and ask questions before the test. Then all students took the speaking test simultaneously by recording their answers to the instructor's questions on their devices. The tests aimed to simulate the IELTS Speaking Test: there were Part I, II, and III questions and the time limits were observed. The recordings were subsequently shared with the instructor through Google Docs. TurboScribe was used to transcribe, the text and was scored and shared with students along with the transcriptions.

Discussion

I. Students' Perceptions

The intervention was carried out in two Speaking & Writing classes: Advanced and Lower Intermediate. A total number of 24 female students participated, 12 in each class. At the end of the academic year, students were surveyed to gauge their perceptions (See Appendix for a list of survey questions). The survey questions and options were provided in both Japanese and English.

Most students agreed that TurboScribe, the error-correction guide, and the instructor's feedback were easy to use and understand (See Figures 3, 4, and 5). However, only 55% of the students said that ChatGPT suggestions were easy to use and understand (See Figure 6). Not surprisingly, the students who found ChatGPT challenging were in the Lower Intermediate group. A closer look at the transcriptions altered by ChatGPT revealed that the suggestions used lower frequency vocabulary, longer sentences with more complex grammatical structures that were probably harder for this group to understand and use for improving their answers. One possible solution that needs to be further explored is how to word the prompts so that lower-level students can also benefit from the ChatGPT advice.

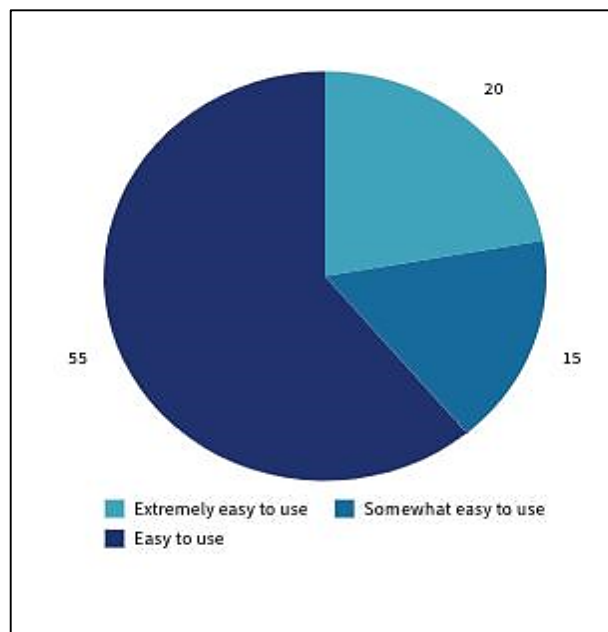
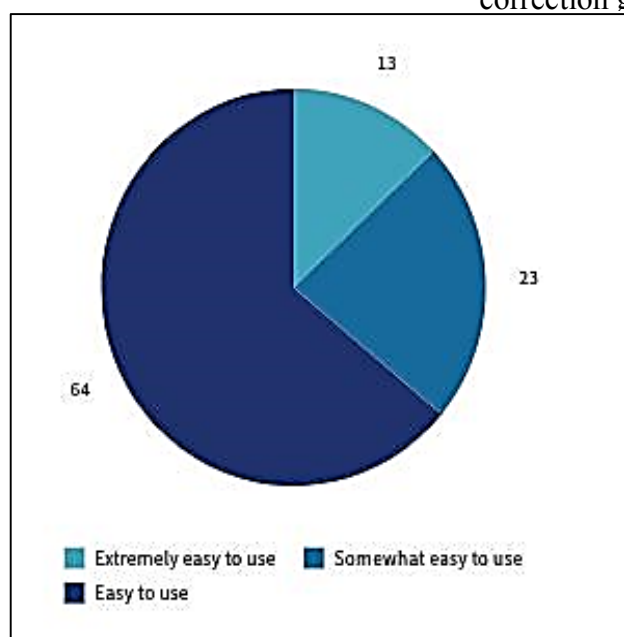


Figure 13. Students' perceptions of TurboScribe (percentages). Figure 14. Students' perception of the error-correction guide (percentages).



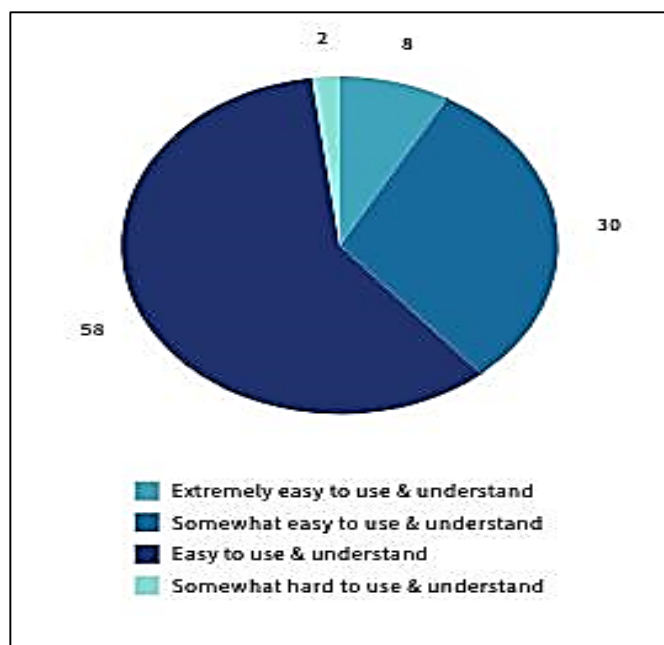


Figure 15. Students' perceptions of instructor feedback(percentages).

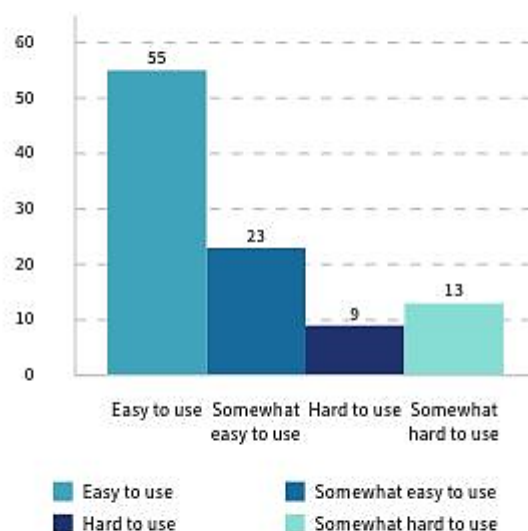


Figure 16. Students' perceptions of ChatGPT (percentages).

Most students seemed satisfied with the AI-supported speaking practice and 64% had made gains of 0.5 to 1 point for their IELTS speaking scores (See Figure 7). These IELTS skills classes are offered once a week and many students have inquired about additional support. Although the university provides an IELTS summer camp for first-year students, many cannot attend due to financial constraints. The department has also arranged for IELTS tutors who can schedule one-on-one free of charge 20-minute sessions, but students often cannot make appointments because of scheduling conflicts with other courses and part-time jobs. It is very likely that the students appreciated the lack of fees and the accessibility of these AI platforms.

Despite this, only 35% said that they were likely to continue to use TurboScribe in the future. This is most likely because after this year none of the students will be taking the IELTS test again, and they no longer need practice. Fifty percent of students said they will continue to use ChatGPT to improve their speaking practice. Most of the positive responses came from the Advanced group. It seems that a lot of these students have been using ChatGPT for grammar study for other courses and they have become accustomed to relying on it.

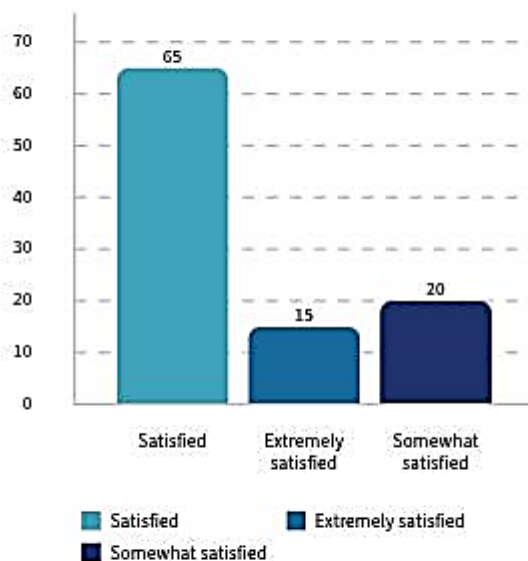


Figure 17. Students' levels of satisfaction with AI-supported speaking practice (percentages).

II. Instructor's Impressions

Listening to audio recordings is very helpful for assessing pronunciation and intonation and it also helps to more easily pinpoint individuals' strengths and weaknesses and tailor advice for improvement. It also saves a lot of class time that can be used for other tasks; instead of using 90 minutes (the standard time for a lesson at this university) to conduct one-on-one speaking tests, an IELTS style assessment with simultaneous group recordings can take just 15 to 20 minutes.

Assessing transcribed speech saves time while ensuring scoring accuracy and fairness. It can also be a good way to collect data and gauge if students are improving over time, what kind of mistakes are repeated, and whether students can successfully incorporate feedback from self-corrections, AI suggestions, and instructor feedback. This data is currently being collected, and results will be disseminated at a future date.

Limitations

Although TurboScribe has been very useful for both learners and instructors, it has some limitations in terms of technological, financial, and academic honesty issues. In terms of technological limitations, there have been issues with the TurboScribe platform claiming that students have used up their daily quota of free translations, even though they

had just registered for the first time ever. This could be due to the fact that since they were all signing up simultaneously from different terminals in the same classroom, the TurboScribe platform might have recognized the IP address and assumed that all the accounts were bots attempting to abuse the system by creating multiple accounts for the same user. To avoid encountering this issue, students should be asked to register from home and do most of the transcription assignments for homework.

A second technological obstacle has been overlapping, inaccurate recordings. For example, if the students are simultaneously recording and sitting in close proximity to each other, it is possible that a fellow student's voice might be picked up by the recorder and transcribed as the device owner's voice. Then the transcription might become jumbled. This has happened when students have made their recordings directly through TurboScribe on a computer or tablet. Although TurboScribe claims that it has a special background noise filtering technology, this still occurs. To avoid encountering this problem, it's a good idea to ask students to sit farther apart from each other and to use their mobile phones to make recordings using a separate recording application on their phone. The recording can then be uploaded to TurboScribe for transcription.

In terms of potential financial issues, it could be costly to register for an unlimited transcription account for instructors who are not subsidized for educational technology expenditures by their institutions. Although the students can use the free TurboScribe accounts for homework assignments, despite the limit of three free 90 minute per day transcriptions, this is not feasible for instructors who need to transcribe a whole class worth of recordings for an assessment.

There are also issues of academic honesty that could potentially arise. Some students have tried to bypass the self-correction stage by asking ChatGPT directly for suggestions and submitting these as their own attempts. Fortunately, it is fairly obvious if intermediate students are cheating in this manner, because the advice from ChatGPT is clearly beyond what they would be able to produce on their own. One way to avoid this problem is to have students print the transcripts in class and monitor while they self-correct. Instructors could also keep copies of shared recordings from students on Google Drive and these can be used to verify suspicious assignments by requiring the student to self-correct during class and compare it with the suspicious assignment.

This case study was conducted with two small groups of students and the data on successful revisions and speaking accuracy and fluency progress needs to be analyzed further before making any recommendations for this practice.

Conclusion

TurboScribe can be a very useful pedagogical and self-study tool despite its limitations. Transcriptions of recordings for speaking tests can make assessments more accurate and save class time that can be dedicated to other tasks. Students seem to view AI-supported transcription in a positive light and can easily adapt to using it both at home and in the classroom to enhance their speaking practice for the IELTS test. Most students' scores for the Speaking component of the IELTS have increased, but without further analysis it cannot be determined if this is due to this intervention. Future studies need to investigate how students actually incorporate the corrections into their speech and which corrections are more useful and accessible: self-corrections, instructor or AI feedback.

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Appendix

Survey Questions

1. Was TurboScribe easy to use?
Extremely easy to use
Easy to use
Somewhat easy to use
Somewhat hard to use
Hard to use
Very hard to use
2. Were the error-correction guides easy to use and understand?
Extremely easy to use and understand
Easy to use and understand
Somewhat easy to use and understand
Somewhat hard to use and understand
Hard to use and understand
Very hard to use and understand
3. Were the ChatGPT suggestions easy to use and understand?
Extremely easy to use and understand
Easy to use and understand
Somewhat easy to use and understand
Somewhat hard to use and understand
Hard to use and understand
Very hard to use and understand
4. Was the instructor's feedback easy to use and understand?
Extremely easy to use and understand
Easy to use and understand
Somewhat easy to use and understand
Somewhat hard to use and understand
Hard to use and understand
Very hard to use and understand
5. How satisfied do you feel with your AI-supported practice for the Speaking tests?
Extremely satisfied
Satisfied
Somewhat satisfied
Somewhat dissatisfied
Dissatisfied
Extremely dissatisfied
6. Has your IELTS speaking score improved? By how much?
Yes No Current score: _____ Previous score: _____
7. Would you like to continue using TurboScribe to practice speaking English?
Yes No

8. Would you like to continue using ChatGPT to ask for advice on your speaking practice?
Yes No

THE STUDY HABITS AND METACOGNITION
LEVEL OF BEED STUDENTS

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ABSTRACT

Study habits are a contributing factor in shaping metacognitive awareness among BEED students. This quantitative correlational study, determined the significant relationship between the levels of study habits and metacognitive awareness among BEED students. This made used of purposive sampling of 72 BEED students in UM Tagum College. A survey questionnaire on study habits and metacognitive awareness adapted from Branford University published in the book of Maria Rita D. Lucas and Brenda B. Corpuz were used. The results revealed that there is a significant positive relationship between study habits and metacognitive awareness among BEED students. The results further revealed that as students' study habits improve, their metacognitive awareness also increases. Henceforth, this study recommends to consider revising the curriculum to emphasize the development of metacognitive awareness alongside study habits which is believe to further promote the academic success of students across the country.

Keywords: BEED students, Philippines, Study habits, Metacognition.
SDG Indicator: #4 Quality Education

INTRODUCTION

The quality of education is demonstrated by students' academic achievement, which is influenced by their study habits and attitudes toward learning. Absenteeism and time spent on completing homework affects educational outcomes. Students' motivation to learn is affected by the extent how parents pay attention to their children educational needs. In addition, less-equipped school and less qualified teachers of their fields demotivate the students to learn. (Priya & Dkhar, 2015; Goodlowe-Scott, 2017; Ajileye, 2021). Moreover, Shank (2024) reported that time and the value of a degree were also influential to students' success.

Study habits serve as a mediator in the relationship between self-esteem, self-control, and academic achievement. Self-esteem when integrated to teamwork training is hinting enriching interactions at university to offer students lifelong competencies for future success (Hua, 2022; De Prada, Mareque & Pino-Juste, 2024). Additionally, self-control is one of the most essential and beneficial life skills significant contributing to individuals' academic success (Pala, & Başbüyük, 2023).

Metacognitive awareness positively predicted the study habits in university students (Mussarat & Rashid, 2018). Metacognition is the driving force behind self-regulated learning (Winne, 2022). The author continued that the object level, learners actively seek information and select learning tactics and strategies they predict will enhance their knowledge. Simultaneously, at the meta level, learners collect and analyze data about their learning experiences to draw conclusions. However, without training and tools on which the self-regulating learners rely, school curriculum and its program are naïve and scruffy.

This study is urgent as it explores how study habits and metacognitive awareness affect academic achievement. With issues like absenteeism, inadequate homework, and lack of support undermining educational outcomes (Priya & Dkhar, 2015; Goodlowe-Schott, 2017; Ajileye, 2021), and poorly equipped school and unqualified teachers further demotivating students (Shank, 2024), understanding these factors can help improve student guidance and support, enhancing academic performance in diverse learning settings.

The significance of this study lies in its potential to enhance educational practices by providing insights into effective study habits and metacognitive strategies, thereby benefiting students, teachers, school heads, and DepEd official in their efforts to improve academic outcomes and learning environment.

For *students*, the study helps them identify effective study habits and metacognitive strategies, leading to improve academic performance and personal growth.

For *teachers*, the insights from the study enable teachers to refine their teaching methods and support strategies, enhancing their effectiveness in the classroom.

For *School Heads*, to use the findings to inform decisions on resource allocation and curriculum development, creating a better learning environment.

For *DepEd Officials*, the research provides evidence-based recommendations for enhancing educational practices and policies, contributing to improved quality of education.

This research explores the study habits and metacognitive awareness of the BEED students. Thus, the following research questions are answered after the data were analyzed and interpreted:

1. To determine the level of the study habits among BEED students in terms of:
 - 1.1 motivation;
 - 1.2 working with others; utilizing resources and feedback; and
 - 1.3 note-taking and reading?
2. To ascertain the level of metacognitive awareness among BEED students in terms of:
 - 2.1 organizing and planning their works'
 - 2.2 managing school work stress; and
 - 2.3 preparing and assignment/project?
3. To determine if there is a significant relationship between the level of the study habits and the level of metacognitive awareness among BEED students?

Hypothesis

The null hypothesis of the study was tested at 0.05 level of significance with its statement *there is no significant relationship between study habits and metacognitive awareness of BEED students.*

METHOD

This study investigates the level of study habits and metacognitive awareness among BEED students. The methodology encompasses participants, materials and instruments, and design and procedures.

Participants

The respondents were Bachelor of Elementary Education (BEED) students from the University of Mindanao Tagum City (UMTC). A simple random sampling techniques was employed to select a minimum of 100 respondents, as mandated by the Research and Publication Center of UM Tagum.

Table 1

Distribution of the Respondents

Year Level	Number of Respondents
2 nd	27
3 rd	37
4 th	8
Total	72

However, since this study was conducted during summer of 2024, the 72 respondents were considered. Eligibility criteria included being currently enrolled at UM Tagum College and being a BEED student. This approach represents a complete enumeration of the target group.

Material/Instruments

The study utilized materials adapted from Bradford University, specifically from the book *Facilitating Learning: A Metacognitive Process* by Maria Rita D. Lucas and Brenda B. Corpus. The structured questionnaire explored BEED students' study habits and metacognitive awareness. It assessed study habits in terms of motivation, collaboration, use of resources and feedback, and note-taking and reading skills. On the other hand, metacognitive awareness was evaluated based on organizing and planning work, managing school work stress, and preparing assignments/projects.

To interpret *motivation levels*, a parameter limit was applied.

Range of Mean	Descriptive Value	Interpretation
55-80	High	This means that the respondent does not appear to have many problems in getting down to work and keeping to it.

35-50	Moderate	This means that the respondent sometimes gets down to work but can be distracted; might not always be certain why he/she has work. He/She probably could benefit from learning some techniques that help him/her to get down to work more consistently and keep at it.
30-Below	Low	This signifies that the respondent really does have problem in getting down to work. Unless he/she develops skills in this area, he/she is likely to have many unsatisfactory experiences as a student throughout his/her life. He/She needs to take action.

To interpret the level of *working with others; utilizing resources and feedback*.

Range of Mean	Descriptive Value	Interpretation
55-85	High	This means that the respondent makes full use of resources available, listen well and take an active part in seminars.
35-50	Moderate	This means that the respondent probably collects resources, but he/she needs to ask himself/herself how he/she is going to use them more effectively.
35-Below	Low	This means that there are important resources around him/her that he/she is ignoring. He/She may not be hearing much of what is being said. He/She needs to know what resources are available, and he/she needs to find out where they are and what they have to offer. He/She needs to take action.

To interpret the level of *note-taking and reading*.

Range of Mean	Descriptive Value	Interpretation
75-110	High	This means that the respondent prepares well and read efficiently, learning as he/she goes. He/She wastes little time reading irrelevant material.
45-70	Moderate	This means that the respondent's reading and note-taking skills are adequate, but could be improved.

40-Below	Low	This means that the respondent's notes are likely to be of little use to him/her, if they exist at all. He/she spends a lot of time reading or sitting in but comes home with very little. He/She needs to become more selective in what he/she reads or writes down. He/She needs to take action.
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To interpret the level of *organizing and planning* the respondent's work.

Range of Mean	Descriptive Value	Interpretation
70-100	High	This means that the respondent is well-organized and plans ahead for his/her work.
40-65	Moderate	This means that the respondent is not as well-organized as he/she could be. His/Her time management might benefit from a closer analysis.
35-Below	Low	This means that the respondent has little organization, probably deal with things as they happen, constantly doing things at the last minute, often not getting work completed. He/She needs to take action.

To interpret the level of *managing school work stress*.

Range of Mean	Descriptive Value	Interpretation
65-80	High	This means that although the respondent sometimes gets stressed and worried; he/she has the skills of knowing how to minimize problems and look after himself/herself.
40-65	Moderate	This means that the respondent handles his/her anxieties and concerns moderately well but could develop skills to manage them more effectively.
35-Below	Low	This means that the respondent is likely to get over-whelmed with his/her problems which will make him/her much less effective as a student. He/She needs to acquire the skills of managing stress more effectively.

To interpret the level of *preparing an assignment/project*.

Range of Mean	Descriptive Value	Interpretation
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70-100	High	This means that although the respondent's essay is well thought out, researched and clearly written.
40-65	Moderate	This means that the respondent has room for improvement although he/she demonstrates some skills
35-Below	Low	This means that the respondent probably wonders why his/her essay always get such low marks. Resources and support are available to help him/her improve his/her essay writing skills. The respondents need to take action now.

Design and Procedures

This study employed a quantitative, non-experimental research design using the correlational technique. This method is appropriate when the objective is to describe the status of a situation as it exists at the time of the study and to explore possible relationships between variable. In correlational research, data is collected to determine whether a relationship exists between two or more quantifiable variables (Gay, 2019).

A correlational research design is employed to explore the relationship between two or more variables, aiming to determine whether a relationship exists and to what extent the variables are related. In this method, the researcher collect data from a sample and analyze it using statistical tools such as correlational coefficients to measure the strength and direction of the relationship between variables (Hassan, 2024). This design does not imply causality but identifies association between study habits and metacognitive awareness of the BEED students.

In a correlational study on study habits and metacognitive awareness, Pearson's correlation identifies the relationship between these variables (Hassan, 2024). Mean measures the levels of study habits and metacognitive awareness, while Pearson's correlation coefficient (r) determines the strength and significance of their connections.

Moreover, the research followed these steps: First, permission was sought from the Program Head to conduct the study. A request letter was then submitted to the Dean of UM Tagum College to obtain approval for conducting the research and distributing instruments to the selected respondents. After the approval has received, the research distributed survey questionnaire based from random sampling method and then gathered the data.

RESULTS AND DISCUSSION

This section presents the analyzed data and findings of the study. The results are organized under the following subheadings: the level of the study habits among BEED students, the level of metacognitive awareness among BEED students, and the significant relationship between study habits and metacognitive awareness. The data is summarized in tables for clarity and ease of interpretation.

Level of Study Habits

Table 2, Level of Study Habits of BEED Students, presents the indicators along with their corresponding *Mean*, *Standard Deviation* and *Descriptive Value*. *Motivation* has a mean score of 52.86 (SD=12.47) or moderate. *Working with others*, and *Note-taking and reading* with its mean scores 54.21 (SD=14.77) or moderate and 79.45 (SD=16.95) or high, respectively.

Table 2

Level of Study Habits Among BEED Students

Indicators	Mean	SD	Descriptive Equivalent
Motivation	52.86	12.47	Moderate
Working with others; Utilizing resources and feedback	54.21	12.77	Moderate
Note-taking and reading	79.45	16.95	High
Total	186.52	11.27	High

Among the three indicators under study habits, *note-taking and reading* has the highest mean of 79.45 (SD=16.95) or high. This means that the respondents prepare well and read efficiently, learning as they go. This also means that they waste little time reading irrelevant materials. Chen, Zhang, and Qian (2023) confirm that attentive readers are more effective and efficient in task completion, employing questions-oriented and navigation-assistant strategies, while inattentive readers often rely on guessing or prior knowledge. Moreover, they highlight the importance of understanding these differences to improve reading strategies and meet reader needs.

Working with others; Utilizing resources and feedback has a mean score of 54.21 (SD=12.77) or moderate. This means that the respondents probably collect resources but they need to ask themselves how they are going to use them more effectively. However, the mean score of 54.21 is slightly below the high threshold. This suggests that the respondents are likely proficient in collaborating and utilizing resources but might benefit from small improvements in their approach to maximize effectiveness.

The result reflected above relates to the study of Liao et al. (2024) who construed that average efficiency in educational resource utilization suggesting a potential for improvement. They further confirm that to assess how efficiently educational resources are used vary among regions. Regional differences are noted, with Southern Europe leading in efficiency and technology, while other regions show varying levels of effectiveness in utilizing educational resources.

Motivation, which has the lowest mean among indicators, gained a mean score of 52.86 (SD=12.47) or moderate. This means that sometimes the respondents get down to work but they can be distracted. They might not always be certain why they have to work. Though motivation has the lowest mean score of 52.86, it falls just below the high descriptive equivalent. This also means that they are motivated and committed to their tasks but may occasionally experience distraction or a lack of clarity about their goals. They are close to being consistently self-motivated but might benefit from refining their work habits or motivation techniques to reach a higher level of consistency.

Beño and Gaganova (2024) posit that flexible working practices reveal that working without stringent limits around working areas, agendas, and agreement is possible. Flexibility is defined as having flexible work schedules for better managing works and personal lives. However, the individual's choice as to when, where and how they engage in the working process matters. Motivated individuals are destructured too. To avoid destruction, individuals need to decide and manage their school work schedules and family responsibilities.

Nonetheless, *the level of study habits among BEED students* has a total mean score of 186.52 (SD=11.27) or high. This means that the total score of 186.52 is likely a cumulative score across the three indicators: *motivation, working with others; utilizing resources and feedback*, and *note-taking and reading*. The summation suggests that the individuals' study habits are likely a mix of high and moderate performance across these areas. This further indicates that while there may be strengths in certain areas, there could still be room for improvement in others, but generally, the respondents demonstrate good study habits. In connection with the results of its strength and weaknesses, Sharma and Kumar (2023) hinted that there exists a moderate positive relationship between study habits and the school environment.

Level of Metacognitive Awareness

Table 3, Level of Metacognitive Awareness Among BEED Students, presents the indicators along with their corresponding *Mean, Standard Deviation and Descriptive Value*. *Organizing and Planning* has a mean score of 74.93 (SD=15.43) or high. Managing School

Work Stress with a mean score of 40.86 (SD=20.00) or moderate; and Preparing an Assignment/Project with a mean score of 75.37 (SD=16.38) or high.

Preparing an assignment/project has the highest mean score of 75.37 (SD=16.38) or moderate. This means that the essays of the respondents are well thought out, researched and clearly written. Kitilà and Bekele (2023) explained that writing enhances learning by allowing students to apply syntax and vocabulary, in improving language mastery. Research shows that integrated skills instruction is more effective than isolated skill teaching for writing. Studies by Widdowson, Skehan, and Storch demonstrate that using integrated skills boosts student outcomes and makes writing instruction more engaging.

Among the three indicators, Organizing and planning with a mean score of 74.93 (SD=15.43) or high has the second highest mean score. This means that the respondents plan ahead for their works. This means further that the respondents are self-regulated learners. Liu, Liu, and Yang (2024) explained that self-regulated learning involves psychological processes that help learners actively manage cognitive, behavioral, and emotional functions to achieve academic goals. It includes proactive behaviors like goal-setting, motivation, and strategy use for overcoming obstacles.

Table 3
Level of Metacognitive Awareness Among BEED Students

Indicators	Mean	SD	Descriptive Value
Organizing and Planning	74.93	15.43	High
Managing School Work Stress	40.86	20.00	Moderate
Preparing an Assignment/Project	75.37	16.38	High
Total	191.16	12.45	High

Managing school work stress with a mean score of 40.86 (SD=20) or moderate is the last indicator to discuss under metacognitive awareness. The moderate descriptive equivalent means that the respondents handle their anxieties and concerns moderately well but could develop skills to manage them more effectively. Freeman (2020) cited Jessica Lina at David Lawrence Center in Collier that for those individuals having hard time adjusting to school after being away for so long (like the experience of COVID-19 pandemic) early identification and intervention is important.

The author above continued that according to Frances Duverge, emotional and behavioral signs include increased irritability, inability to focus on activities and changes in eating habits. However, linking them with brief therapeutic services can help to establish

coping skills and should be an option at the first signs of a concern. In addition, allowing them the opportunity to express their emotions and guiding them through it will ease the transition. Much more, they need to set aside some time to disconnect from technology together; build up the duration each day and give the individuals or each other reinforcement for success.

Nevertheless, *the level of metacognitive awareness among BEED students* has a total mean score of 191.16 (SD=12.45) or high. Metacognitive scores tend to be cumulative across various factors. This suggests strong abilities in planning monitoring and evaluating learning processes. Seema and Padmanabha (2024) described individuals with high metacognitive awareness as demonstrating strong self-awareness in learning. They effectively manage learning strategies, actively adjust their approaches when necessary, and are likely skilled in planning goals, monitoring progress, and reflecting on outcomes to make improvements.

To recapitulate, *the level of study habits among BEED students* has a total mean score of 186.52 (SD=11.27) or high. At the same time, *the level of metacognitive awareness among BEED students* has a total mean score of 191.16 (SD=12.45) or high. The total mean score of 186.52 likely reflects a cumulative result across *motivation, working with others and; utilizing resources and feedback, and note-taking*. This suggests a mix and moderate performance, indicating strength in some areas with room for improvement in others, but overall good study habits. Ehsan and Sultana (2020) confirm that effective study habits positively influence academic performance.

On the other hand, the total mean score of 191.16 on *the level of metacognitive awareness* would be an asset in academic settings, as it suggests a proactive and adaptive approach challenges and new information. Davis et al. (2024) confirms that adaptability is constant, learned through active effort, shaped by organizational culture, and linked to wellbeing.

Mussarat and Rashid (2018) posit that metacognitive awareness positively influences study habits and it is also positively related to teaching styles. To determine if the results from other studies are applicable to BEED students, it is essential to test whether the patterns observed in those studies particularly study habits and metacognitive awareness are also evident within the context of BEED students. This approach helps assess the generalizability of these findings and their relevance to different educational settings and student population.

Relationship Between Study Habits and Metacognitive Awareness

Table 4, *Relationship Between Study Habits and Metacognitive Awareness* reflected the two variables: *Study Habits* and *Metacognitive Awareness* with its r-value 0.768*, r-squared 0.5898, and p-value 0.001. This means that the null hypothesis which states that there is no significant relationship between variables is rejected. Further, it means that there is a significant positive relationship between Study Habits and Metacognitive awareness among BEED Students.

Table 4
Relationship Between Study Habits and Metacognitive Awareness

Variables	r-value	r-squared	p-value	Description
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Study Habits	0.768*	0.5898	<0.001>	Reject Ho
Metacognitive Awareness				

p<0.05>

The p-value is less than 0.05, which means that the null hypothesis is rejected, confirming that there is a statistically significant relationship between study habits and metacognitive awareness. The findings show a robust positive correlation between study habits and metacognitive awareness among BEED students. With an *r*-value of 0.768, an *r*-square value of 0.5898, and a p-value of 0.001, the study establishes that metacognitive awareness significantly influences students' study habits. These results suggest the potential for targeted educational interventions that enhance metacognitive skills, ultimately fostering better academic performance.

The potential for targeted educational intervention relates to the study of Chen et al. (2024). The authors examine the impact of a professional development (PD) program for early childhood teachers focused on metacognition-driven, place-based science teaching. Conducted in rural Idaho, it involved preschool and kindergarten teachers and children. The results showed significant improvements in children's self-regulated learning and teachers' science teaching skills. The study also found that hands-on science activities support children's learning across various subjects and development areas.

The *Pearson correlation coefficient*, *r*-value (0.768) shows a strong positive relationship between study habits and metacognitive awareness. Learn Statistic Easily (2024) posted that +1 denotes a perfect positive linear correlation, where variables move precisely in tandem. For example, an *r* value close to +1 suggest that an increase in one variable will likely be accompanied by an increase in the other to a similar extent. This means that as students' study habits improve, their metacognitive awareness also increases. Specifically, BEED students who exhibit strong motivation, collaborate effectively with others, use resources and feedback efficiently, and take organized notes are more likely to demonstrate high metacognitive awareness, including better planning, stress management, and preparation for assignments.

At the same time, Learn Statistic Easily (2024) also posted that the coefficient of determination suggests that approximately 58.98 % of the variance in metacognitive awareness can be explained by study habits. This significance percentage indicates that study habits are a more contributing factors in shaping metacognitive awareness among students. The remaining variance could be due to other factors, such as personal characteristics, external influences, or cognitive abilities not captured in the study.

This study anchored on the theory adopted in the study of Mussarat and Rashid (2018) as presented in the third paragraph in the *introduction* of this study. The authors confirms that metacognitive awareness positively influences study habits in university students. Winne (2022) added that at the object level, learners seek information and strategies to improve knowledge, while at the meta level, they analyze learning experience. However, without proper training and tools, school curricula remain ineffective.

To recount, John Flavell coined the term metacognition, describing it is *thinking about thinking or learning how to learn*. According to Flavell (1979,1987), metacognition consists of

both metacognitive knowledge and metacognitive regulation. Metacognitive knowledge includes awareness of one's cognitive processes and the ability to control them, which Flavell categorized into person variables, task variables, and strategy variables (Lucas & Corpuz, 2007).

The authors above continued that Flavell's framework highlights how students' awareness and control over their learning processes impact academic performance. When study habits align with metacognitive strategies, learners manage tasks better, select effective strategies, and adapt to challenges. For example, students aware of their strengths and weaknesses (person variables) can choose effective study methods (strategy variables) and adjust based on task difficulty (task variables). This emphasizes the importance of fostering metacognitive awareness to improve study habits and academic success.

CONCLUSION AND RECOMMENDATION

This study investigated the relationship between study habits and metacognitive awareness among BEED students. This section summarizes the key findings and provides recommendations for enhancing study habit practices and metacognitive awareness.

Conclusions

This study addressed the research questions or hypothesis posed at the beginning of the study, indicating whether they were supported or refuted.

1. The *level of the study habits among BEED students* has a total mean score of 186.52 (SD=11.27) or high. The result shows that while the respondents start their work, they often face distractions and need better focus techniques. Although they gather resources, there is room for improvement in using them effectively. However, they excel in preparation and reading efficiently, focusing on relevant material. Enhancing focus and strategic resource use could boost academic performance.
2. The *level of metacognitive awareness among BEED students* has a total mean score of 191.16 (SD=12.45) or high. The result indicates that the respondents demonstrate strong organizational skills and effective planning. Their essays are well-researched, clearly written, and thoughtfully developed. While they manage anxieties and concerns reasonably well, there is potential for further improvement in developing more effective strategies for managing these challenges.
3. The relationship between study habits and metacognitive awareness with its *r*-value 0.768*, *r*-squared 0.5898, and *p*-value 0.001 rejects the null hypothesis which states that *there is no significant relationship between study habits and metacognitive awareness*; that there is a significant positive relationship between study habits and metacognitive awareness among BEED students. As students' study habits improve, their metacognitive awareness also increases. Study habits are a more contributing factors in shaping metacognitive awareness among students.

The results and findings of the study supports the study of Mussarat and Rashid (2018) that metacognitive awareness positively predicted the study habits of 400 university students in Islamabad and Rawalpindi.

Recommendations:

Base on the findings of this study, several recommendations can be made to help students enhance their study habits and metacognitive awareness. These suggestions aim to foster improves academic performance and personal development.

1. To enhance focus and reduce distractions, students should be trained in time management and concentration techniques, such as the Pomodoro method or mindfulness exercises, to improve their ability to stay on task. Teachers can incorporate workshops or lessons on effective resources utilization, guiding students on how to gather, evaluate, and apply academic materials more strategically to improve their study habits.
2. To further enhance their metacognitive awareness, students should engage in reflective practices, such as writing journal or self-assessment, to better identify areas of improvement in managing anxieties and enhancing their planning and organizational skills. Teachers can offer guidance on advanced metacognitive strategies, such as self-monitoring techniques or stress management workshops, helping students to refine their planning and organization while managing their emotional well-being more effectively.
3. School heads and administrators should offer workshops or seminars focused on both effective study habits and metacognitive strategies. These programs will provide students with the tools to enhance their learning processes, fostering an environment that supports academic growth. DepEd Officials may consider revising the curriculum to emphasize the development of metacognitive awareness alongside study habit. Implementing these practices in educational polities can further promote the academic success of students across the country.

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**Learning from Three Decades of Motivational Education:
New Possibilities Revealed Beyond the Sustained Efforts Supporting Learner
Growth**

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Abstract

This study examines the processes of trial and error in enhancing learner motivation and the evolution of educational perspectives on teaching experience. Focusing on strategies for fostering learners' intrinsic motivation in English education and intercultural communication instruction, this study explores their relationship with three key elements of intrinsic motivation in Self-Determination Theory (SDT): competence, autonomy, and relatedness. The challenges encountered, conflicts navigated, and insights gained throughout this process are analyzed in detail using specific examples. Furthermore, the impact of intercultural exchange on learner motivation is examined, emphasizing its significance. This study provides insights into effective motivation strategies for educators in educational settings and highlights essential factors for their professional growth.

Keywords: Teacher motivation Intrinsic motivation, Competence, Autonomy, Relatedness, Intercultural communication

1. Introduction

In recent years, interest in motivating learners has increased in the educational field. In particular, promoting intrinsic motivation is crucial for creating an effective learning environment (Deci & Ryan, 2000). Within the field of educational psychology, Self-Determination Theory (SDT) has identified three fundamental psychological needs—**competence, autonomy, and relatedness**—as key factors that enable learners to continue learning autonomously (Deci & Ryan, 1985, 2000).

However, in actual educational settings, simply applying theoretical frameworks does not always yield sufficient results. Learner motivation is influenced by various factors, including the educational environment, sociocultural context, and instructional methods. In addition, effective teaching strategies for low-motivation learners remain an ongoing challenge.

This study examined the author's 30 years of teaching experience to explore strategies for enhancing learner motivation. In particular, it examines how to support learners' competence, autonomy, and relatedness through the lens of Self-Determination Theory.

The foundation of this research is the author's early educator experience. Teaching was not a deliberate career choice but rather a result of circumstances. Entering the classroom without sufficient preparation and facing an imminent breakdown of classroom order, the author was compelled to take immediate action. Initially, he experimented with existing motivation theories and methods; however, the expected outcomes were not achieved, leading instead to a sense of powerlessness. Nevertheless, through a process of trial and error, he developed a deeper understanding of the mechanisms underlying learner motivation and gradually discovered more effective teaching strategies.

This paper first outlines the theoretical framework of motivation based on Self-Determination Theory. The study then examines the author's teaching practice in three stages: enhancing competence, fostering autonomy, and strengthening relatedness. Subsequently, it explores specific instructional strategies for promoting motivation followed by a discussion on the influence of intercultural exchange on learner motivation.

This research provides a case study of educational practices for low motivation learners and highlights the role of motivation in the professional development of educators. This study is expected to offer insights for educators seeking to implement more effective instructional approaches.

2. Phase I: Psychological Need for Enhancing Intrinsic Motivation (1) Competence

The public high school where the author was first assigned after completing graduate school had the lowest academic performance among the region. The educational methods acquired at university proved ineffective in this environment, as students exhibited little to no interest in lessons. In this regard, classroom behaviors such as eating, drinking, listening to music, and reading manga were common, and it was evident that the teacher's guidance did not reach these students. Additionally, many students failed to recognize the significance of learning, had become accustomed to low grades, and received minimal expectations from both parents and teachers. Consequently, an environment conducive to fostering motivation for learning was not in place.

These students were clearly forced to learn under conditions of extrinsic motivation or amotivation. Faced with the challenge of engaging students who demonstrated little interest in learning, the author frequently experienced a profound sense of powerlessness. Furthermore, in addition to the difficulties associated with classroom management, the mental burden of working on holidays because of responsibilities in sports club activities further compounded the challenges, leading the author to even contemplate resigning from

the teaching profession. However, recognizing the inherent responsibility in this role, the author began actively seeking ways to improve teaching strategies.

As part of this effort, the author explored theories and practical approaches related to motivation, thoroughly reviewed academic literature, and actively participated in educational conferences held in distant locations. However, many existing studies have primarily focused on students with high motivation, making them largely inapplicable to the context faced by the author. It was under these circumstances that the author encountered the work of Hungarian foreign language education scholar Zoltán Dörnyei (Dörnyei, 1990. 1994a. 1994b)). His research provided detailed descriptions of motivation strategies for students with low motivation, leading the author to consider these strategies as potential solutions.

The primary goal was to help students who were in a state of learned helplessness (Seligman, 1975) realize that they had the capability to improve their English proficiency. To achieve this, the author experimented with various motivation techniques, many of which prioritized building trust-based relationships with students through dialog rather than focusing solely on English instruction. This approach required significant time and effort because the process of fostering motivation required sustained engagement and repeated interventions.

Through continuous trial and error, notable progress was made after five years of practice. Five years later, within the same school, the author implemented instructional strategies that effectively enhanced students' motivation to learn, resulting in greater engagement and active participation in lessons. This practice was presented at an academic conference and was published in a scholarly journal (Seki, 1999). The research presentation became a turning point, opening new opportunities in educational research and ultimately leading to the author's transition to a junior college teaching position.

3. Phase II: Psychological Need for Enhancing Intrinsic Motivation (2) Autonomy

After transitioning to a literature major college teaching position, the author initially believed that his practical exploration of learner motivation in high school settings had reached a milestone. However, by observing college students, he identified a distinct set of motivation-related challenges. The college where he was employed was highly regarded within the region, and its students demonstrated relatively high academic proficiency. However, many students exhibited a passive learning attitude, displaying a strong tendency to engage only in tasks explicitly assigned by instructors.

To further investigate this issue, the author conducted a learning awareness survey among the students (Seki, 2000). The results revealed that a significant proportion of students felt that they had not achieved learning outcomes commensurate with their abilities. Many respondents also expressed dissatisfaction with the instructional methods and the overall learning environment. In particular, numerous students attributed their lack of practical skill acquisition to issues with teaching methodologies and classroom conditions, frequently citing class sizes as excessively large. However, very few students engaged in self-directed learning beyond assignments mandated by instructors, highlighting a pronounced lack of autonomous learning behavior. This finding aligns with Self-Determination Theory (SDT), specifically the concept of "autonomy" as a fundamental psychological need for intrinsic motivation (Deci & Ryan, 2000).

To address these challenges, the author implemented curricular reforms intended to foster students' self-directed learning abilities. Specifically, he emphasized the principle that "knowledge and skills can only be acquired through voluntary engagement and repeated practice; sufficient competence cannot be developed solely through externally directed

learning." Based on this perspective, he introduced instructional strategies designed to promote autonomous learning. A key aspect of this reform was the integration of learning strategy training within the curriculum, which enabled students to develop sustainable learning habits beyond the classroom and engage in self-regulated learning.

In practical terms, the author incorporated self-regulated learning principles into instruction, guiding students to take initiative in their learning through processes such as goal setting, learning plan formulation, progress monitoring, and self-evaluation. Furthermore, to support autonomous learning, he facilitated the development of a Computer-Assisted Language Learning (CALL) environment, which was considered advanced at the time. Additionally, he established an extracurricular learning support system, providing students with academic guidance beyond formal coursework. To further clarify the learning objectives, the author introduced the TOEIC exam—the first exam for the region—encouraging students to take the test and providing structured guidance on study methods to improve their scores.

Having sustained these educational initiatives for five years, students' engagement in independent learning increased significantly, leading to measurable improvements in academic performance and English proficiency across multiple indicators (Seki, 2006). These achievements have attracted considerable attention and have led to opportunities for the author to deliver lectures throughout Japan. Furthermore, to widely disseminate insights on motivational instructional strategies, he translated Zoltán Dörnyei's *Motivational Strategies in the Language Classroom (2001)* into Japanese, added his own motivational teaching practices, and published it in Japan.

4. Phase III: Stagnation of Motivation and Reconsideration of Challenges

The author assumed a position as an associate professor at a prestigious social sciences university in Tokyo, bringing with him the motivational teaching practices and successes achieved at educational institutions in northern Japan. Through years of experience, he accumulated practical insights into motivating learners and believed that he had established effective instructional methods applicable to a broad spectrum of students, ranging from high school learners with low motivation to university students with high academic abilities. However, upon transitioning to a new educational environment, he encountered an unexpected challenge—his previously effective motivational approaches did not yield the anticipated results.

Despite employing the same instructional strategies that have been proven successful in past educational settings, there was little noticeable change in the learning attitudes and responses of students in Tokyo. Although there were no significant issues regarding the comprehension of course content or completion of assignments, students displayed minimal engagement in learning, and no discernible improvement in intrinsic motivation was observed. This phenomenon did not manifest as explicit failure or resistance; rather, it emerged as a state of neutrality, where learning neither flourished nor deteriorated. Even when the author taught with enthusiasm, the student responses remained lukewarm, highlighting the ineffectiveness of conventional motivational strategies in this particular academic context.

Until this point, the author had found joy in stimulating students' enthusiasm for learning. However, the stark reality that none of his motivational techniques had any meaningful impact was profoundly unsettling. This sense of bewilderment and discouragement was further exacerbated by his own culture shock—the transition from northern Japan to Tokyo was not merely a geographical shift but also a psychological and professional adjustment that

significantly intensified the emotional burden. Confronted with the realization that the pedagogical methods he had refined through years of trial and error no longer applied to this new cohort of students, the author's confidence in his teaching abilities began to waver.

Moreover, perhaps influenced by the university's focus on social sciences, the author perceived those students exhibited limited interest in language itself. Many of the Tokyo students in this study approached the mandatory university English courses with vague motivations, such as the potential advantage for job hunting or the general convenience of knowing English, which, in a country like Japan where they can live comfortably using only Japanese, did not translate into a genuine commitment to learning.

Under these circumstances, the author was compelled to fundamentally reconsider the applicability of motivational theories in this educational environment. However, the inability to foster students' autonomous engagement in learning persisted. Gradually, the author lost confidence in his teaching methods, and this period of stagnation and uncertainty lasted for approximately five years—one of the most challenging phases in his career as an educator.

5. Phase IV: Reexamining the Role of Relatedness in Language Learning

5-1. Reexamining Relatedness in Language Learning

A pivotal moment in the author's teaching career occurred when he had the opportunity to accompany students on overseas training programs for several years as part of a liberal arts education program. The training program lasted approximately two weeks, and Nepal was selected as the destination. This decision was based on the country's educational significance, as it provided various critical themes—such as poverty, multi-ethnic coexistence, and intercultural communication—that were deemed essential for Japanese students to explore and understand.

During the program, students gained valuable insights and were deeply impacted by interactions with local communities. However, alongside their enthusiasm and newfound perspectives, they also experienced immense frustration due to their inability to effectively communicate. Some students were quite overwhelmed by this challenge. They shed tears and could not express their thoughts adequately. In witnessing this scene, the author was instantly reminded of his own experiences when he was 15 years old, recognizing the emotional struggles his students were experiencing.

At the age of 15, the author participated in an international exchange and homestay program in Indonesia, sponsored by the Japanese government. This experience was transformative because it sparked a profound interest in intercultural exchange. However, it also exposed the author's lack of knowledge about foreign cultures and his near-total inability to communicate in English, which resulted in a strong sense of powerlessness and frustration. This formative experience motivated him to engage in English language-learning, eventually equipping him to collaborate with diverse cultural backgrounds. Having seen his students face similar emotional challenges, the author gained a renewed understanding of the importance of relatedness in language learning.

Up to this point, the author had primarily considered interpersonal relationships within the classroom, focusing on teacher-student interactions, peer relationships, and connections between students and their families. However, he did not deeply examine the concept of relatedness in language learning, particularly in the sense of connecting with people who speak the target language.

According to Self-Determination Theory (SDT), relatedness is a fundamental component of intrinsic motivation and plays a crucial role in human learning and development

(Baumeister & Leary, 1995). This principle is particularly significant in language acquisition, where building meaningful connections with others serves as a powerful driver of motivation.

In Japan, where nearly all information is available in Japanese, learners have limited opportunities to engage in authentic language use. Consequently, many students struggle to develop a concrete purpose for learning English, often resulting in low intrinsic motivation.

Within the framework of Goal-Setting Theory, research suggests that clear and specific goals significantly enhance learner motivation (Locke & Latham, 2002). However, for many Japanese students, such goal-setting opportunities are scarce, as English education is primarily focused on exam preparation rather than fostering intercultural connections.

Following their participation in the training program, many students demonstrated an increased interest in learning English and engaging with global issues—a shift that occurred independently of external motivators. Rather than merely responding to grades or teacher expectations, the students began to discover their intrinsic reasons for studying English and learning about different cultures.

When autonomy, competence, and relatedness—the three core components of Self-Determination Theory—are effectively nurtured, learners develop strong intrinsic motivation (Deci & Ryan, 2000). Many students who participated in the training program later became fluent English speakers and were actively engaged in international communication and collaboration.

Through this experience, the author reached a decisive realization:

"When learners establish meaningful relationships with the people behind the language, learning ceases to be merely an academic obligation and transforms into a powerful tool for personal and professional engagement. The true essence of learning lies in relatedness."

Following this turning point, the author's educational philosophy evolved from focusing solely on language skill acquisition to emphasizing the role of language in fostering interpersonal relationships across cultures. This transformation significantly influenced learner motivation and ultimately led to a fundamental reexamination of the purpose and impact of language education.

5-2. Aiming to Understand "Relatedness"

The author himself had never lived in a culture outside Japan, and due to economic constraints, he had limited opportunities for long-term stays abroad. As a result, although he had theoretical knowledge of relatedness in intercultural learning, his practical understanding remained insufficient. Recognizing that effective guidance on relatedness requires lived experience, he felt a strong need to explore firsthand how relatedness is constructed in different cultural settings.

Motivated by this realization, the author left Japan for two years, living in Thailand and Nepal, where he had the opportunity to engage in educational practice in cross-cultural environments. In both countries, he was actively involved in developing and implementing international exchange programs, primarily for university students. Through these experiences, he gained a practical understanding of the significance of relatedness in education.

The experience in Nepal, a highly multi-ethnic society, was particularly eye-opening. Through interactions with Nepalese students, he observed that their attitudes toward cross-cultural understanding and acceptance of diversity were strikingly different from those of Japanese students.

In Japan, where opportunities to engage with different cultures are relatively limited, cultural barriers to building relationships are often perceived as significant obstacles.

Conversely, Nepalese students, having grown up in a multi-ethnic society, were naturally accustomed to coexisting with people of diverse backgrounds, and this profoundly influenced their values and interpersonal relationships.

By directly experiencing these cultural differences, the author gained a deeper understanding of how relatedness functions in language learning and educational activities. Moreover, these experiences not only deepened his cross-cultural understanding but also prompted him to redefine the concept of relatedness within educational practice.

Ultimately, this profound realization had a lasting impact on the author's educational philosophy, leading to the development of a teaching methodology that places a strong emphasis on cross-cultural exchange as a central component of learning.

6. Phase V: Interaction Practice with Diverse Others

Teachers who had a deep understanding of the three key elements of intrinsic motivation in Self-Determination Theory (SDT)—autonomy, competence, and relatedness—tended to exhibit two distinct approaches in their educational practice. The first was the continuous implementation of international exchange programs based on prior efforts, and the second was an increasing focus on cultural differences and intercultural learning.

6-1. The Continuation and Evolution of International Exchange Programs

The international exchange program that the author has been engaged in represents the culmination of the educational practices described thus far. It incorporates elements designed to satisfy three core components of intrinsic motivation—competence, autonomy, and relatedness. Students who participate earnestly in this program have opportunities to engage in self-reflection and deepen their learning through interactions with diverse others.

Convinced that such educational practices yield meaningful learning outcomes, the author's primary focus shifted toward refining the program itself. Consequently, the same methodological framework was repeatedly implemented in international exchange programs, and the initiative has been conducted more than 30 times.

However, through continuous implementation, it became evident that even when procedures and structures remained unchanged, the development and impact of the program significantly varied depending on the individuals involved. Even when identical activities were conducted in the same locations, new discoveries, emotional responses, and conflicts emerged, and these were shaped by the participants' cultural backgrounds and ways in which they formed relationships.

The dynamics of exchange between groups of different cultural backgrounds are inherently unpredictable and difficult to control entirely. This finding suggests that learning and awareness emerge through the process of interaction among individuals from diverse cultural contexts rather than through a pre-determined instructional design.

6-2. Deepening Interest in Cultural Differences and Intercultural Exchange

Through his involvement in international exchange activities, the author has had the opportunity to interact with students not only in Japan but also in various Southeast and South Asian countries. Through repeated experiences, his interest in cultural differences and intercultural exchange deepened, and his research focus increasingly shifted toward intercultural communication alongside motivation theory. Consequently, in academic presentations and research activities, topics related to intercultural communication gradually took precedence over motivation research, reflecting the practical necessity observed in educational settings.

It also became evident that cultural differences significantly impact learner motivation. For instance, students from Vietnam and Nepal exhibited greater fluctuations in motivation compared to Japanese students, with their learning attitudes changing dramatically depending on contextual factors. The author empirically learned that without accurately assessing students' motivational states, teachers could not keep up with sudden shifts in engagement and enthusiasm.

These observations led to a stronger recognition of the necessity of considering cultural backgrounds when applying motivation theory. Prior research on cultural variations in motivation supports these findings.

- Triandis (1995) suggests that the ways in which autonomy, competence, and relatedness manifest, as well as their relative importance, may vary depending on cultural context.
- Chirkov et al. (2003) argued that while Self-Determination Theory is applicable across cultures, important cultural differences exist—for example, the support for competence is more critical in Western contexts.
- Goal-Setting Theory posits that clear and challenging goals enhance motivation; however, research indicates that goal acceptance and willingness to embrace challenges are influenced by cultural factors (Locke & Latham, 2002).
- Furthermore, research suggests that cultural differences affect how individuals commit to goals and translate those goals into concrete actions (Oettingen & Gollwitzer, 2001).

6-3. Development of Educational Practice Integrating Motivation and Intercultural Communication

The insights gained from both practical experiences and research have been actively incorporated into daily teaching activities and university administration. At present, the author is responsible for courses in "Intercultural Communication" and "Multicultural Coexistence" at the university where he teaches. Additionally, he has assumed leadership roles in shaping the university's internationalization policies and multicultural education initiatives.

This evolution in educational practice has demonstrated the potential of integrating motivation theory with intercultural communication as a novel pedagogical approach.

Traditionally, motivation theory has focused on individual learners' psychological factors. However, through the educational practices examined in this research, the importance of adopting an instructional approach that incorporates cultural factors and interpersonal relationships has become increasingly clear. This broadened perspective not only enhances learner motivation in intercultural contexts, but also provides valuable implications for education in multicultural societies.

7. Discussion and Summary

This study examined the author's 30 years of educational practice and its developmental trajectory through the lens of Self-Determination Theory (Deci & Ryan, 2000). The first decade of teaching focused on satisfying learners' needs for competence and autonomy. In the subsequent decade, the author recognized the importance of relatedness in language learning and sought to integrate this understanding into educational practice. In the most recent decade, the concept of relatedness has been further expanded, leading to a growing interest in intercultural exchange and an exploration of its educational significance.

A key perspective emphasized in this study is that competence, autonomy, relatedness, and intercultural exchange are not isolated concepts but develop in close interrelation. For instance, the first five years of educational practice were dedicated to rebuilding competence in students experiencing learned helplessness. This foundation, in turn, enabled the promotion of autonomy in the subsequent phase. For learners who lack confidence in their abilities to succeed, it is extremely challenging to engage in independent learning. Thus, the enhancement of competence and autonomy is a prerequisite for recognizing the significance of relatedness. Furthermore, as the understanding of relatedness deepened, this perspective extended beyond classrooms to include cross-cultural interactions, leading to the exploration of new directions in educational practice. In this way, the author's educational approach has evolved continuously, with each stage building upon the knowledge and insights gained from previous experiences.

The author did not initially establish a clear research agenda or develop motivational strategies. Instead, he accumulated practical knowledge by directly engaging with challenges in educational settings, thereby responding to students' immediate needs. However, through 30 years of sustained practice, the author was able to systematize an educational methodology that effectively enhances intrinsic motivation and facilitates learning. Today, this approach has reached a level at which the author is confident in supporting the motivation of learners from diverse cultural backgrounds, particularly those in the Asian region, in alignment with their individual learning goals.

Moreover, these experiences have contributed not only to student development but also to the author's professional and personal growth. Through sustained practice, the author has expanded his interpersonal networks and communication skills, overcoming initial difficulties in intercultural interactions. Additionally, he has gained confidence in conducting international exchanges using English, a development that would have been unimaginable 30 years ago. This suggests that continued engagement in educational practice fosters the growth of both learners and educators.

The findings of this study highlight the potential for a novel educational approach that integrates motivation theory and intercultural communication, offering practical implications for the field of education. In particular, further research is needed to systematize educational methodologies that enhance intrinsic motivation and to evaluate the effectiveness of pedagogical approaches that incorporate intercultural relationships. As the saying goes, "Persistence is power", and in education, the continuous pursuit of effective teaching practices that nurture learner growth remains essential. The insights presented in this study can serve as a valuable resource for future educational initiatives.

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