The Impact of Flipped Learning on Student Performance and Engagement: A Systematic Literature Review

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***Abstract*—Within the last decade, the flipped learning pedagogy has emerged as a viable alternative to traditional, lecture-style teaching. Adopting a flipped method involves students reviewing learning materials before coming to class, whilst in-class time is devoted to exploring topics in greater depths via collaborative problem-solving and peer instruction. The approach has been touted as a method to improve teaching and learning outcomes. This systematic literature review assesses the empirical evidence investigating the impact of flipped learning on student performance and engagement in tertiary education. 42% of studies reported an increase in student performance with the introduction of flipped learning, while 38% reported no significant difference, and the remainder showed mixed results. For student engagement, 79% of studies reported improvements in student engagement, while 21% reported negative impacts. The results indicate that adopting flipped learning may lead to positive impacts, but further empirical research is required.**

***Index Terms*—blended, flipped learning, student performance, engagement, satisfaction, active learning, inverted classrooms**

I. Introduction

Amongst the increasing demands, challenges and expectations of modern tertiary instruction, educators are exploring new approaches to teaching and learning in the classroom [1]. Flipped learning is emerging as a viable alternative to traditional, lecture-style teaching [2] and is defined as a model in which "direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter" [3].

As a reversal of the learning process of traditional classrooms, adopting a flipped instructional method involves students reviewing learning materials before coming to class, whilst in-class time is devoted to exploring topics in greater depths via collaborative problem-solving and peer instruction [3]. Strayer [4] further describes the approach as "combining the effectiveness and socialization opportunities of the classroom with the technological enhancements of online learning." As such, students are required to take more responsibility over their learning, but can receive more differentiated instruction, personalized assistance and deeper learning in return [4]-[6].

Driven by complex catalysts for change, the flipped learning pedagogy has been widely associated with increased student performance, engagement, and satisfaction [7]. Several studies posit that students in flipped classrooms outperform their peers in traditional lecture-based classrooms [1], [8]-[10], whilst also reporting higher levels of student engagement [7]. However, some studies question the method's effectiveness and validity [11], [12], and indicate that results may not be comprehensively positive – if change is detected at all [10].

Accordingly, this study investigates the available empirical research on the impacts of flipped learning by conducting a Systematic Literature Review (SLR). The following research questions are considered:

RQ. What is known about the impact of flipped learning? (main research question)

RQ1. What is the relationship between flipped learning and student performance?

RQ2. What is the relationship between flipped learning and student engagement?

II. Background

The current literature exploring the relationship between flipped learning and various student outcomes (such as performance and engagement) is limited, and shows conflicting results to date [4], [12], [13]. Thus, debate about the value of the flipped learning model continues.

Despite increasing interest in the flipped learning pedagogy, interpretations and implementations of this model abound. Whilst no implementation can or should be identical [5], the Flipped Learning Network [3] proposes four pillars which underpin flipped learning: a flexible environment, a learning-centered cultural approach, intentional content, and professional educators.

As summarized by Strayer [4], flipped learning has been implemented in tertiary education across a variety of disciplines, such as physics, chemistry, nursing, education,

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pharmaceutics, foreign languages and STEM courses. However, the literature exhibits confusion and ambiguity with flipped learning's relationship(s) to other complementary instructional methods such as active learning, problem-based learning, collaborative learning and blended learning. Indeed, some researchers consider these methods as synonymous with the concept of flipped learning [9], whereas others draw distinctions between their oft-overlapping boundaries [12].

Many existing studies consist primarily of case reports from facilitators [7], [10], [14]. Whilst informative, they are frequently not empirical and thus offer limited value [5]. Meanwhile, there are several comparative studies reporting conflicting trends in student performance and engagement within a flipped learning pedagogy [7], [9], [15]. However, though high-quality empirical studies are slowly emerging, the available literature remains limited.

Thus, the aim of this systematic literature review is to identify, evaluate and integrate the findings of all relevant, high-quality empirical studies to date addressing the research questions. This paper contributes to the literature by: (1) presenting an evaluation and summary of empirical results assessing student performance and engagement, and (2) proposing new insights, causative mechanisms, and future research directions.

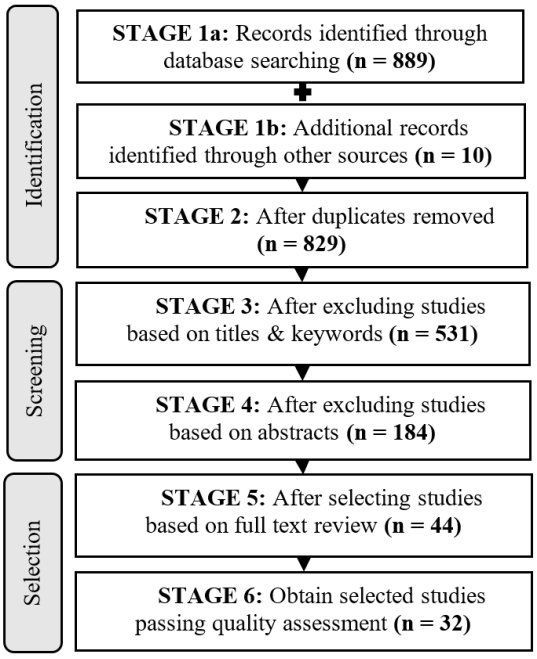

Figure 1. Systematic literature review search model

III. Research Method

This study has been undertaken as a systematic literature review (SLR), based on Kitchenham's guidelines for software engineering [2]. As a formal, structured and repeatable method, the SLR allows for a rigorous and fair evaluation of available and relevant research.

This study's protocol comprises of: (1) research goals and questions; (2) data sources and search strategy; (3) inclusion and exclusion criteria; (4) study selection process; (5) quality assessment; (6) data extraction; and (7) data synthesis.

IV. Data Sources and Search Strategy

The study's search strategy involved utilizing renowned, relevant and respected electronic databases, as well as manual methods of searching. Structured search strings were applied to all data sources, as further discussed. The following databases were used:

- IEEE Xplore (www.ieeexplore.ieee.org/Xplore)
- EBSCO Host (www.ebscohost.com)
- ACM Digital Library (www.portal.acm.org/dl.cfm)
- Springer (http://link.springer.com/)
- AEIPT: Australian Education Index Plus Text (https://search.informit.com.au/)
- ProQuest (www.proquest.com)
- INSPEC OVID: Institute of Engineering and Technology (http://www.ovid.com/)
- Google Scholar (https://scholar.google.com.au)
- Elsevier ScienceDirect (www.sciencedirect.com)

A global search string was constructed from relevant search terms and keywords which were identified and grouped into the categories of (1) flipped learning, (2) teaching and education, and (3) impacts on performance and engagement. The search string included relevant search terms, keywords found in relevant studies, synonyms and/or misspellings of keywords, and the use of Boolean operators as recommended by Kitchenham [2].

((flip OR flipped OR blended) AND (teach OR learn OR class OR education OR subject) AND (student)) AND (perform OR motivat OR engage OR grade OR mark OR satisfy OR feedback OR success))

Different combinations of search terms were used, depending on the database's requirements or limitations. For example, some databases did not allow for Boolean statements over a certain length and thus the search string had to be split into two or more statements. In addition, manual searching was conducted in education journals and databases.

A. Inclusion and Exclusion Criteria

A study qualified for inclusion based on the following criteria: (1) Qualitative, quantitative or mixed measurement studies; (2) academic, experimental or commercial projects; (3) case study, conference paper, journal, experimental or comparative study, meta-analysis, or literature review; (4) published from June 2007 onwards; (5) full text available in English; and (6) passed the quality assessment. Meanwhile, papers such as magazines, blogs and podcasts were excluded, as well as duplicate studies.

As our research questions cover the impact of flipped learning more broadly (not limited to a specific software tool or method of implementation), studies that focused on a specific platform, technology or model were still included if they satisfied the rest of the inclusion criteria at this stage.

B. Study Selection Process

Using the results obtained by the search strategy and applying the inclusion and exclusion criteria, there were 899 initial "hits" across all data sources. 829 of these were unique. In selecting relevant and appropriate studies from the initial results, several stages were involved including reviews of titles, keywords, abstracts and full texts. Figure

1, adapted from the PRISMA Literature Search Flow model [16], shows the overall review process with the number of papers identified at each stage. Table I presents the number of studies sourced from each database across every study selection stage.

TABLE I. NUMBER OF STUDIES SELECTED AND REVIEWED FROM VARIOUS ELECTRONIC DATABASES

	Stages						
Data-base	One	Two	Three	Four	Five	Studies selected	% Selected
IEEE Xplore	66	66	43	31	11	8	25
EBSCO	149	84	59	18	4	3	9
ACM DL	121	111	11	6	2	2	6
Springer Link	46	46	41	31	16	9	28
AEIPT	129	129	99	31	0	0	0
Pro-Quest	48	47	34	24	1	1	0.1
INSPEC (OVID)	7	7	7	6	0	0	0
Google Scholar	9	9	8	4	0	0	0
Science Direct	324	323	227	32	10	9	28
Other	10	7	2	1	0	0	0
Total	*909*	*829*	*531*	*184*	*44*	*32*	100

In the Identification and Screening stages of the study selection process, database results and citations were exported into RefWorks, a bibliography and database manager. Throughout the selection process, a new sub-folder was created for each review stage, alongside a new Excel sheet for tracking purposes. This ensured full traceability and transparency.

Next, in the second stage, the title and keywords of studies were reviewed. At this stage, several papers were excluded for irrelevance, leaving 531 studies. Where it was not possible to decide on inclusion based on the title and keywords alone, then the paper was included for further review. In the third and fourth stages, the studies were reviewed based on their abstracts and then full text.

This resulted in in a final 32 studies selected for inclusion in the systematic review.

Throughout the identification, screening and selection processes, two researchers independently reviewed the selected papers at each stage. Conflicts or disagreements were discussed and resolved. The final 32 studies were verified and agreed upon by both researchers as relevant and suitable for this systematic literature review, as seen in Table I.

C. Quality Assessment

The quality of selected studies (both quantitative and qualitative) was evaluated using specific items from the quality checklists provided by Kitchenham and Charters [16], to exclude low quality papers. First, one researcher applied the quality checklist on the selected studies. Then, the second researcher independently verified the results. Finally, both researchers exchanged feedback and discussed potential conflicts until agreement was reached.

D. Data Extraction

A data extraction form was developed based on Dyba et al's [2] guidelines. The form captured information such as metadata (title, hyperlink, publication channel, database, year of publication), characteristics (research aims, context, teaching model adopted), research design (study design, methodology, time studied), experiment (sample size, participation criteria, control groups) and results (outcomes measured, results, and measurement tools). Many sections of the form were optional if not relevant. For example, some studies – particularly those which were exclusively qualitative – did not have a control group.

E. Data Synthesis

To analyse and synthesise all data, the collected results were manually coded against the research questions, namely by division into two categories: 1) impacts of flipped learning on student performance, and 2) impacts of flipped learning on student engagement. For each category, results were codified into "Positive", "Negative", or "Mixed" impacts.

For qualitative data, a thematic analysis [16] was conducted to identify patterns in students' feedback. Then, thematic codes and categories were transformed into Excel where further analysis and synthesis was completed.

V. RESULTS

The following section summarizes the results of the study. First, an overview of the selected studies will be presented. Then, the studies' characteristics, quality attributes, and scope of research will be explored. Finally, the impact of flipped learning on student performance and engagement will be put forward based on the extracted results.

A. Search Results

In total, 32 studies were identified and reviewed from a variety of publication channels. As seen in Table I, most papers were sourced from the Springer Link database (28%) and the ScienceDirect database (28%). 25% of papers were sourced from the IEEE database. Finally, the remaining papers were sourced from a combination of the ACM DL, EBSCOHost and ProQuest databases.

Despite searching databases that were specific to education and teaching, such as the AEIPT database, no unique studies were selected from this database due to the papers not meeting the inclusion and/or quality criteria.

Where papers were available through multiple channels, the most recent and complete record was used for the systematic literature review – with the rest marked as duplicate records and filtered out in Stage 2 of the study selection process (see Fig. 1).

All selected studies utilized empirical research. 94% of the selected studies utilized both quantitative and qualitative methodologies, 4% utilized quantitative results only, and the remaining 2% of selected studies relied on qualitative data only.

B. Quality Attributes

Each selected study was assessed against its quality attributes. Due to the wide range of study quality observed, it was decided to include a minimum quality check into the SLR's inclusion criteria.

Thus, all selected studies passed the quality assessment with a score of 50% or over, across both quantitative and qualitative studies.

C. Scope of the Selected Studies

The selected studies varied in their aims, scope of research, and outcomes measured. Such variations included the type of flipped learning being assessed (a fully flipped subject, a partially flipped subject, or a single intervention), the methods and tools of measuring outcomes, and additional dependent variables being introduced and/or measured.

Of the 32 studies, 41% measured the impact of flipped learning on student performance only; 25% on student engagement only; and 34% assessed both.

TABLE II. RESULTS SHOWING IMPACT OF FLIPPED LEARNING ON STUDENT PERFORMANCE

Impact on student performance	Number of studies	Percentage of studies (%)
Positive	10	42
Mixed	5	21
No significant difference	9	38
Negative	0	NA
TOTAL	24	100

1) Teaching paradigms

Throughout the research process, it was identified that many overlapping but different teaching paradigms were being used interchangeably within the literature. For example, many studies referred to assessing the impacts of flipped learning, however further investigation revealed the study was assessing the efficacy of active learning only – independently of the class being flipped in any way. Similarly, other studies indicated research into blended and flipped learning, espousing them as a single and identical concept – whilst the paper only referred to blended learning techniques.

Thus, there appears to be significant confusion and/or disagreement within the literature on the definitions, similarities, and differences between key terms. These include: blended learning, active learning, collaborative learning, problem-based learning, and more.

Upon noticing these discrepancies, the research team conducted further secondary research to identify and confirm the differences, if appropriate, between these multiple independent (though oft-overlapping) teaching paradigms.

Based on renowned research [4, 5, 6, 12], it was decided to only include studies which involved flipping the classroom, at a minimum. Extra variables – such as flipping the classroom AND assessing the active learning or collaborative components – were also included. However, if a study looked at blended learning *only* (without any evidence of flipping the class or subject), then the study was excluded based on relevance.

2) Measured impacts

The selected studies measured the impacts of flipped learning on student performance, engagement, or both. 34% of the final studies measured the impacts on both student performance and engagement. Meanwhile, 41% of the final studies measured student performance only, and 25% measured student engagement only.

3) Subject areas

In terms of the subject areas covered, most studies (50%) were in the context of Science, Technology, Engineering and Maths (STEM) courses. Meanwhile, the subject area of Health (including nursing, dentistry and medicine) accounted for 25% of the selected studies. And finally, Arts & Social Sciences and Business subject areas accounted for 17% and 9% of the final studies respectively.

D. RQ1: Impact of Flipped Learning on Student Performance

For the 24 selected studies assessing student performance, Table II shows that most studies (42%) reported a positive impact on student performance when flipped learning was introduced, 38% reported no significant difference, and 21% reported mixed results. None reported negative impacts to a statistically significant degree.

The average time period studied across all three categories of results (positive, mixed, and no significant difference) was between 5 and 7 months, indicating consistency in the length of time that flipped learning was implemented and assessed.

In terms of sample sizes for the reviewed papers, it was found that studies had an average sample size of 116 students overall, whilst the median sample size was 70 students.

Finally, of the 24 studies assessing the impact of flipped learning on student performance, it was found that student performance was assessed in multiple ways. A frequency analysis on different measurement techniques was conducted, finding that 50% of the selected studies assessed student performance via in-class assessment items, at a minimum. These included in-class quizzes and in-class exams. Meanwhile, the final course exam results were measured in 38% of studies. The overall course grade was examined in 7% of papers, and out-of-class assessment items (such as take-home quizzes and homework) were measured in 4% of papers. Most studies utilized more than one measurement technique to assess student performance.

E. RQ2: Impact of Flipped Learning on Student Engagement

In total, 19 papers assessed the impact of flipped learning on student engagement, as seen in Table III. Flipped learning had a positive effect on student engagement in 79% of the reviewed studies, whilst 21%

reported a negative impact. No studies reported uncertain or inconclusive findings.

For the 15 studies concluding a positive effect on student engagement after the implementation of flipped learning, the average period studied was 5 months with an average sample size of 137 students. Meanwhile, studies showing a negative impact on student engagement were carried out over an average period of 14 months, and an average sample size of 65 students.

In measuring student engagement, it was found that the reviewed studies employed a wide variety of measurement methods and techniques. A frequency analysis was carried out to identify the range and prevalence of these methods.

It was found that 95% of all papers assessed student engagement via self-reported methods, such as surveys and questionnaires. One study utilized the widely-used Utrecht Work Engagement Scale (UWES), a validated and reliable questionnaire measuring vigor, dedication and absorption [17]. 47% of papers also used open-ended questions and feedback as another form of self-reported measurements of engagement. Additionally, statistical methods were also used to analyse student engagement, including reviewing class attendance records (26% of studies) and reviewing software analytics records (5% of papers).

VI. Discussion

A. Principal Findings

The goal of this SLR is to identify and review the impact of flipped learning on student performance and engagement in tertiary education. The principal findings are:

1) Student performance

Overall, the results show that flipped learning in a tertiary context appears to have a positive impact on student performance – further reaffirming research and reviews conducted to date [1], [5], [18], [19]. As displayed in Table II, 42% of studies reported positive impacts, 38% reported no significant difference in impacts to student performance, and 21% reported mixed results. None of the selected studies reported any negative impacts to a statistically significant degree.

TABLE III. Results Showing Impact of Flipped Learning on Student Engagement

Impact on student engagement	Number of studies	Percentage of studies (%)
Positive	15	79
Uncertain	0	0
Negative	4	21
TOTAL	19	100

However, studies did differ dramatically in their interpretation and measurement of student performance, using various techniques such as in-class assessment methods, out-of-class assessment methods, final exams, overall course grades, and/or a combination of these. Accordingly, it may be difficult to extrapolate which measure or type of performance is impacted due to the variations in definitions of performance and corresponding measurement techniques.

Meanwhile, sample sizes averaged 118 students; a reasonable reflection of the population size affected within a single university course. However, in assessing the magnitude of the effect of flipped learning on student performance, further research with larger sample sizes is essential.

Student performance was measured over an average period of 5-7 months – or approximately a single semester – thus indicating consistency in the length of time that flipped learning was implemented and assessed. The shortest study was run over two weeks, whilst the longest was 24 months. However, with an average period of one semester, further studies across longer timeframes are highly recommended to increase reliability and validity.

A valid meta-analysis to derive the range and significance of flipped learning on student performance was not possible, due to significant statistical heterogeneity within the studies.

Variations included:

- Differing methods of measuring the dependent variable (performance), such as out-of-class assessments, in-class assessments, final exams, or the overall course grade (refer to Section V.D).
- Differences in research design and implementation of flipped learning, such as a single class intervention, flipping a few weeks, flipping the entire course, the addition of pre-reading, the introduction of a new Massive Open Online Course (MOOC) system, and/or various combinations of these.
- Wide variation in selection of control groups and comparison data sets, such as the same group of students (via pre-test and post-test interventions); students from previous semesters taught by the same instructor, or different instructors, or in different faculties, and comparing against historical university records.

2) Student engagement

As discussed in Section II Background, student engagement is a complex concept encompassing multiple dimensions. Described as "a broad construct intended to encompass salient academic as well as certain non-academic aspects of the student experience" [5], engagement is more than just participation or involvement. Rather, O'Flaherty and Phillips [12] assert that it requires feelings and sense-making, in addition to activities. Three main dimensions to engagement have been proposed by Fredricks and McColskey [15]: (1) behavioural engagement, (2) emotional engagement and (3) cognitive engagement.

Despite a prolific and robust body of literature drawing correlations between all dimensions of student engagement and positive student outcomes [2], [5], [7], [14]-[16], [20], research into the effects of flipped learning (in particular) on student engagement remains limited [12].

Within this review, the results in Table III show that flipped learning appears to have a positive impact on student engagement. In total, there were nineteen relevant studies. Of these, 79% demonstrated higher student engagement levels after the implementation of flipped learning.

However, across all papers, it is difficult to ascertain a) which dimension of student engagement was being studied, b) the validity of the measurement method utilised, and c) the possible impact of other factors on these results. Rather, papers differed widely in their definition and methods of measuring engagement.

The most common technique to measure engagement was the administration of self-reported questionnaires and surveys, both quantitative and qualitative (95% and 47% respectively). Within these survey instruments, 'engagement' was typically assessed through two to three questions only, as a subset of a larger set of questions evaluating other aspects of the course or facilitator. Most questions used a Likert scale (95%), whereas the rest had open-ended questions (47%) such as: *How engaged did you feel over the semester? Did you think flipped learning was more engaging than traditional learning? Did you complete more activities in this class than you normally would have, and why?*

Based on the selected studies, the majority of questions assessing engagement appear one-dimensional and simplistic, as described by Fredricks [15]. There was also little to no evidence of instrument validity (either internal or external) across any of the studies. Despite its prevalence [20], the use of self-reporting to assess engagement still has concerns and difficulties [12] (such as student dishonesty or inaccuracy, particularly if anonymity is not provided).

Also, it is interesting to note that studies reporting higher student engagement assessed students for an average of 5 months after implementation, but those reporting lower student engagement were conducted over an average of 14 months. Thus, one can hypothesize that student engagement increases in the months directly following implementation of flipped learning, but then appears to decrease as time goes on – perhaps due to the novelty effect [15]. However, such inferences are beyond the scope of this SLR, and more targeted research is recommended to explore the potential relationship between flipped learning and student engagement over time.

More specifically, out of the nineteen selected studies, one paper did utilise the Utrecht Work Engagement Scale (UWES), a validated and reliable questionnaire measuring aspects of engagement such as vigour, dedication and absorption, and concluded positive impacts on engagement.

Meanwhile, the remaining selected studies used techniques such as class attendance records, statistical analysis of software usage, semi-structured interviews, and/or faculty observations regarding student engagement levels.

Accordingly, it is recommended that future studies assessing the impact of flipped learning on student engagement may consider adopting an existing questionnaire with high reliability and validity, such as the UWES, the National Survey of Student Engagement (NSSE) in the US and Canada, or the Australasian Survey of Student Engagement (AUSSE). Although the NSSE and AUSSE are extensive questionnaires with over one hundred items, this reflects the complexity and multi-faceted nature of assessing student engagement [21].

Fredricks & McColskey [15] posit that each method of measuring engagement has its strengths and weaknesses, though "more systematic and thoughtful attention to the measurement of student engagement is one of the most pressing and imperative directions for future research" [22].

B. Limitations

Limitations were identified for selected studies via risk assessments.

1) Selection bias

Most studies allocated participants to comparison groups in a non-random manner, such as by inviting interested students to optionally participate in the flipped (experimental) classroom or offering additional bonus marks for doing so. A minority (three studies) confirmed that randomization with allocation concealment was carried out, thus reducing the risk of selection bias. For the majority, however, the inherently high risk of selection bias may have influenced the occurrence of positive results [23].

2) Performance bias

Next, a high risk of performance bias was identified in studies assessing the impacts of the flipped learning approach through exposure to additional factors other than the intervention of interest. For example, some studies redesigned the teaching curriculum at the same time as introducing flipped learning. Others introduced new MOOC systems to supplement student learning, also at the same time as the intervention. And yet other studies had facilitators who reported their choice to increase their staff contact hours and personal motivation alongside the implementation of flipped learning. Accordingly, it is difficult to ascertain whether results were obtained due to the intervention itself (flipped learning), or a variety of other uncontrolled variables found in external studies [24, 25, 26].

3) Attrition bias

On average, a low to medium risk of attrition bias was concluded from quality assessments of the selected studies. At least eleven studies acknowledged withdrawals from the course or intervention, thus leading to potential outcome attrition. However, exclusion bias may also exist in some studies, whereby facilitators selected non-random groups for interviews or offered bonus marks to participants who completed surveys and questionnaires.

4) Reporting bias

Finally, it is interesting to note that none of the relevant studies assessing flipped learning on student performance demonstrated a negative impact, thus potentially highlighting reporting bias.

Meanwhile, in terms of the limitations of this systematic literature review, a rigorous and transparent protocol was

adopted to reduce researcher and search selection bias, as discussed in Section III. However, grey literature was excluded from this SLR. This may be a limitation of this study, as the inclusion of grey literature could assist in reducing the potential impact of publication bias [16]. Additionally, some relevant papers may have been missed due to their unavailability via electronic resources at the time of conducting the review.

VII. Conclusions and Future Work

In summary, the results of this SLR indicate that adopting a flipped learning methodology may lead to positive impacts on both student performance and engagement in tertiary education, though further research is required to increase confidence in these preliminary findings.

In terms of student performance, 42% of studies indicated an improvement, whereas 38% indicated no significant difference was found, and the remainder showed mixed results. However, the difference between positive outcomes and those of no significant difference amount to only a single study, thus clearly further research is necessary. In terms of student engagement, 79% reported higher levels of student engagement due to the implementation of flipped learning, with the remaining 21% of studies reporting negative effects instead.

However, as discussed in Section VI.B, there are significant challenges and limitations identified within this review. These include ambiguity in the definition and implementation of flipped learning, variations in interpretations of outcomes such as performance and engagement, different measurement methods, and apparent risks of bias within the selected studies.

Accordingly, future research may focus on contributing further empirical studies on the impacts of flipped learning in tertiary education, particularly over longer periods of time, with larger sample sizes, and across varying subject areas (see Section VI.A.i). It may also be interesting to investigate other factors that may influence flipped learning outcomes, such as active learning, facilitator motivation and training, student perceptions and satisfaction, subject and faculty suitability, and cultural considerations.

Additionally, it is recommended that future research is more explicit in its definition of the construct of student engagement, and that greater consistency in measuring engagement is adopted (see Section VI.A.ii). This may enable more accurate and insightful comparisons into the effects of flipped learning on various facets of student engagement as well as performance.

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