Students' Preferences for Printed and Digital Materials and the Calibration Accuracy of Their Performance

Eman Salah Daha
Asst. Prof., Educational psychology department, Faulty of Education, Damanhour University, Egypt, *Eman_daha@edu.dmu.edu.eg*

Digital transformation has become a basic requirement in Damanhour University. Paper books gradually turned into digital books. This study explored students' preferences for printed and digital materials and their perceptions of their learning through it. It also aimed to investigate the effect of the medium used on students' performance and their calibration accuracy of it which reflect their metacognitive monitoring. A questionnaire about students' preferences followed by five open-ended questions was applied on 612 undergraduate students; their responses on open questions were analysed qualitatively. The experimental study was conducted using groups rotation design on 100 of them as volunteers, they were divided into two equal groups, each group could study two topics, one in printed form and the other digitally in a balanced order so that each topic is followed by a test measured ILOs from the content ended by a question measures calibration accuracy. The results revealed that students prefer printed papers, especially males, literary disciplines, theoretical subjects that include long items, or that are followed by an essay test. A positive effect of printed reading was found, increased with the higher levels of Bloom's taxonomy. Better calibration was in favour of the group that used printed materials.

INTRODUCTION

Officials at Damanhour University are calling for the need to convert all paper books into digital books. Is this consistent with students' preferences in studying in all subjects? Does it positively affect their performance and achievement at different levels of learning? Does it improve the quality of their metacognitive monitoring, which will be reflected in the calibration accuracy of their performance?

The potential effects of digital technologies and distance learning on student learning and performance have been the focus of many researchers' attention (Burdina,et.al, 2019; McKnight,et.al, 2016). The field of reading had the largest share in these researches. Students' perceptions, their preferences for both reading on printed and

digital reading, the advantages and disadvantages of each on processing and comprehension outcomes were one of these research areas (Singer Trakhman & Alexander ,2017a, 2017b).

Many researchers were interested in investigating the differences between printed versus digital reading in processing, the impact of their physical properties on these differences, and the extent of difference of mental approach used in both of them.

Differences were found between printed and digital mediums in terms of reading comprehension and processing speed (Kaufman & Flanagan, 2016).

At the same time, some studies comparing printed versus digital reading reveal no difference in comprehension scores, even though participants often thought they did better with printed material (Baron, et. al, 2017).

Because of the increased use of digital reading, some studies have done descriptive analysis of some empirical study's findings that compared comprehension through printed versus digital texts such as the analysis of Clinton (2019); Delgado, et. al, (2018). The most important results of the meta-analysis were that printed texts are generally better in understanding.

Sidi, et. al, (2016) concluded that students' preference of working on paper indicates the existence of reliable metacognitive judgments reflects the general low quality of on-screen metacognitive processes. Working in computerized environments is associated with shallow cognitive processing, which leads to poor cognitive performance. Individuals often engage in continuous reading on paper. While they are on the screen, they engage more in intermittent and multitasking reading which hinders information recall (Daniel & Woody, 2013).

The correlation between shallow processing level and low level of screen learning is related to the deficiency of metacognitive processes. It leads to poor 'calibration', which relates to the relationship between students' perceptions of how well they are doing on a task versus their actual performance.

Ackerman & Goldsmith (2011) examined the effects of the medium on meta-comprehension processes. They found more apparent over-confidence among screen learners compared to paper learners. Ackerman & Lauterman (2012) also found over-confidence of screen learners under time pressure, while paper learners showed better calibration.

Recent calibration studies have also revealed that while users perceive better comprehension performance through digital reading, they do better with printed reading (Golan, et. al, 2018; Singer Trakhman & Alexander, 2017a).

It is noted that most of these studies were in the field of reading in general, not in an academic field related to mandatory academic courses, so there was a need to test the effect of the two mediums in academic reading on learning outcomes. Will printed reading remain the most effective in achieving the intended learning outcomes? Especially since digital textbooks are increasingly replacing paper books in educational

environments. Will students' calibration accuracy of their learning differ across the two mediums?

There was also a need to explore students' perceptions of their learning in the two mediums through quantitative and qualitative analysis. The need for this study increased, especially with the scarcity of researches related to this field in the Arab environment and the results of studies in this regard were mixed.

Context and Review of Literature

Definition of Printed and digital materials and Calibration Accuracy

Printed materials are books and printed paper applications that are within hand reach of students during studying and learning, while digital materials are books and resources displayed digitally that students browse through digital screens.

Calibration is considered a basic process in self-regulation, in which the individual's calibration reflects the degree of his judgment's consistency of his understanding, ability, and skills with his actual understanding, ability and skills (Hattie, 2013). Calibration is more accurate if self-judgments reflect the actual performance better. Full calibration means consistentency between student confidences with the actual correct percentage, this state reflects the quality of metacognitive monitoring (Stone, 2000). When the confidence is greater than the actual performance, then it is (Over confidence), and if it is less, then it is (Under confident) (Alexander ,2013). Individuals often misjudge their own knowledge. Glenberg, et. al, (1982) refered to this as 'Illusion of Knowing' in which there is a false correspondence between subjective and objective evaluation.

Students' preferences and perceptions of printed and digital materials

A line of research has focused on users' perceptions, and reasons for choosing printed or digital reading. These previous studies have shown a split regarding the preferences of the reading medium (Oroz, 2016); for example, Duran & Alevli (2014) used content analysis regarding a sample of eighth graders' thoughts about Screen reading. The results revealed that students had both positive and negative opinions about screen reading and also revealed that most students generally prefer screen reading compared to printed reading.

Kazazoğlu (2020) concluded that digital reading has a greater impact than printed reading in terms of its availability and accessibility. At the same time, some studies have found that printed materials provide better reading comprehension and concentration and that students' preference depends on the purpose of reading (learning or fun) (Seok& DaCosta, 2016). It is better with academic content (Singer Trakhman & Alexander, 2017b).

Also Singer Trakhman & Alexander (2017a) revealed that students preferred digital texts and also expected better comprehension when reading digitally. However, performance was not consistent with students' preference and expectations.

Mizrachi, et. al, (2018) conducted across-cultural study of readers perceptions included more than 10,000 college students in 21 countries. It yielded similar results where they found a majority of participants (78% of them) prefer reading printed academic materials, especially for longer texts (73%), where their concentration is better (82%).

In addition, Seok& DaCosta (2017) revealed that there were significant differences between the sexes, as females had a stronger preference for digital reading.

Student performance on printed and digital materials

Both studies of Rasmusson (2015) and Eyre, et.al, (2017) found that reading comprehension scores were in favor of reading on paper.

Støle,et. al, (2020) compared reading comprehension on paper and screen in younger children (10 years). The results showed that their scores in the digital test were lower compared to paper test. The negative effect of digital reading was more pronounced among high performers. In addition, the effectiveness of printed reading was confirmed for a sample of middle school students only on longer texts (more than 500 words) in Goodwin, et. al, (2020).

Kazazoğlu (2020) used different types of texts. The results revealed that the higher scores were with printed texts, and the lowest scores were with texts that contain links to text images and hypertexts. The results also revealed that students preferred digital text that contains links while their performance was not the best on it.

One of the recent studies in this regard is the study of Grancha, et. al, (2022) on university students who prefer digital sources. The results revealed that performance was slightly higher in the printed case, while higher performers were better on the digitally reading comprehension task. In addition to Ronconi,et. al, (2022) research which showed that the reading medium did not affect the reading time, but there was an interactive effect of the medium with gender on reading time where boys were faster when reading on screen than on paper.

Some research has investigated the effect of external factors such as physical properties of printed and digital text on differences in learning and comprehension. For example, Baron, et. al, (2017) found that many participants' comments about what they like about printed reading relate to holding the book in hands and being able to turn pages. They also revealed that the outline allowed in printed reading helps readers remember what they have read and where they have read it.

Mangen, et. al, (2019) also found that those who read the story in paper form were more able to locate the event in the text and reconstruct the sequence of events; they concluded that the motor information arising from physical movement during paging may contributes to reading comprehension and remembering.

An external factor that was also studied is the use of paging versus scrolling. Proaps & Bliss (2014) found that scrolling leads to a lower level of comprehension, indicating that it places greater cognitive demands on readers than paging; where a fixed page text display provides readers with a temporary physical framework that readers take as

primary reference points. Readers often remember where they saw specific information on the printed page. Zechmeister & McKillip (1972) previously stated that the ability to mentally designate the place in which textual information appears is also related to comprehension.

Furthermore, hyperlinks in digital reading can impede the mental continuity of the reader. DeStefano & LeFevre (2007) concluded That following hyperlinks increases the cognitive load of readers, and often leads to poor performance because the use of navigating through hyperlinks exceeds the working memory capacity of some readers. This result was confirmed by Kazazoğlu (2020) where lower performance scores were with texts containing hypertext links and higher scores were with printed texts.

"Metacognitive skills" that refer to awareness of thinking processes that occur in an individual's mind when engaging in a cognitive activity (Djatmika,et. al,2022), may affect performance and memory in the two mediums. The speed with which individuals process digital text may lead to the loss of many of these skills, resulting in lower performance (Singer Trakhman, et. al, 2019).

Among the internal factors that researchers also paid attention to is the construction of cognitive maps during digital reading versus printed texts. Digital reading may make it difficult to create cognitive maps, which can be valuable for understanding and memory, especially with the large number of digital navigation tools such as search, find, scrolling and hyperlinks (Baron, 2021).

Calibration accuracy on printed and digital materials:

The most important results related to calibration in printed versus digital reading indicated that students' judgments are very confident in the digital medium compared to printed papers (Ackerman & Goldsmith, 2011), where confidence was misplaced, their performance on the screen was lower and their confidence was greater (Lauterman & Ackerman, 2014; Singer Trakhman & Alexander, 2017a). In addition, the meta-analysis of Clinton (2019); Kong, et. al, (2018), revealed that although the reading time did not differ between printed and digital materials, the calibration accuracy was better in the printed reading compared to the digital reading.

From these results, it appears that students are more biased when reading digitally. A reasonable explanation for this misevaluation of calibration can be attributed to the ease and speed of reading via digital screens where students exert less mental effort. This may negatively affect students' organization of their learning, monitoring of their performance and correction of their errors (Koriat, et. al, 2006).

At the same time, Halamish & Elbaz (2020); Singer Trakhman, et. al, (2018) found that students' calibration is not affected by the reading medium; Thus, the results were mixed and unresolved. It was necessary to indicate that with this low performance in digital materials it cannot be dispensed at the present time, it is not possible to demand for fully returning printed papers but it is useful to know the limits of each type and employ it to serve the goal, and this is what the current study aims at.

METHOD

Students' preferences questionnaire for printed and digital materials

It consists of an introductory question in the beginning in which the student determines the medium he prefers in learning academic subjects in general (paper materials / digital materials / both materials are alike) followed by 12 items with specific responses and five open-ended questions about (things students likes and dislikes in both printed and digital materials, their comments about questionnaire items; and their suggestions for improving digital screen learning). The validity of the questionnaire for application was verified.

To measure students' performance on printed and digital materials, two achievement tests were prepared by analyzing the target content, and determining the behavioral goals according to Bloom's levels and setting the specification table for each test. Formulating the test items (50 items) for each, five of them are short essay questions measure higher levels of learning outcomes (Analysis, Application and Creativity). The rest are objective questions. Instructions for the test have been developed and a question has been added at the end of the test to measure calibration accuracy, through its students anticipate their score on the test out of a total of (25). The validity of the test for application was verified by applying it to the psychometric sample. The reliability coefficient of the first test by alpha method was (0.940) and the second was (0.901), which indicates the reliability of each of them. In addition, the coefficients of difficulty in the two tests items ranged from (55.33% to 78.66%), and the values of the discrimination coefficients for all their items ranged between (0.880, 0.930).

To measure students' calibration accuracy for their performance.

The students' calibration accuracy of their performance was extracted by the absolute bias index which is the absolute value of the difference between an individual's estimate and their actual performance (the standard amount of judgment deviation from accuracy) (Stone, 2000). The degree of the test ranges between (zero: 25) and the student may expect his degree between them. If he predicted his degree of 25 and it was already so, then the bias is zero, and this is the highest accuracy, so he takes the highest degree in calibration accuracy, which is 25, vice versa.

The academic content:

It is represented in two topics in the individual differences and psychological measurement course. The content of each topic is prepared in two forms, the first is a printed paper, and the second is a PDF file in the same printed format so that each page is displayed on one screen. The content equivalence and tests has been verified in terms of ease and difficulty.

The study procedures were as following:

Determining the main study sample, who are the students of the fourth year in the Faculty of Education, Damanhour University, who are enrolled in the second semester of the academic year 2021/2022.

The questionnaire was applied to the students, and the number of students who responded was (612 male and female). With an average age of (22.9) and a standard

deviation of (0.56). The sample included students from different specialties of scientific and literary disciplines, as shown in Table (1):

Table 1
Distribution of the number of students responding to students' preferences questionnaire for printed and digital materials

Specialty	Male	Female	Total	Percentage
Scientific disciplines	0	272	272	44.44%
literary disciplines	49	291	340	55.56%
Total	49	563	612	
Percentage	8.01	91.99		

The results of the questionnaire items were analyzed quantitatively through descriptive statistics (the numbers of students who prefer each medium and their percentages). The students' responses to the open-ended questions were analyzed qualitatively to determine (things students' likes and dislikes in both printed and digital materials, their perceptions about learning in the two mediums, their comments about questionnaire items, and their suggestions for improving digital screen learning).

To conduct the experimental study groups rotation design was used on 100 male and female students from 612 students as volunteers. They were divided randomly into two groups (50) male and female students in each group. The equivalence of the two groups in the average academic performance scores for the previous academic year (2020/2021) calculated in percentages was verified using independent samples T-test and the value of (t) was not statistically significant (t = 0.388) and therefore they can be considered equivalent.

Students have been informed that each topic to be studied will be followed by a test, but they are not allowed to return to the scientific resources during the test.

Teaching the two topics in a balanced order so that the first topic content for the first group presented in paper form and for the second group in digital screen, and vice versa for the second topic, an achievement test was applied after each topic presented in the same medium.

FINDINGS

The first question: What is the preferred medium for students in learning (printed, digital, or both materials are alike)? The results are shown in Table (2)

Table 2
Students' preferences for learning medium in relation to gender and specialization

Medium	Specialty	Male		Female		total	
		Number	Percentage for sex	Number	Percentage for sex	Number	Percentage for Specialty
Printed	Scientific	0	0	126	22.38	126	46.32
Digital	disciplines	0	0	10	1.78	10	3.68
Both alike	272	0	0	136	24.16	136	50
Printed	literary	29	59.18	194	34.46	223	65.59
Digital	disciplines	10	20.41	19	3.37	29	8.53
Both alike	340	10	20.41	78	13.85	88	25.88

Table (2) indicates: for the scientific disciplines, (included females only, and both mediums printed and digital materials were equal for 50% of them, whereas students' percentage who preferred printed materials was slightly less (46.32%), The lowest percentage was for those who preferred digital screens (3.68). For literary disciplines the largest percentage was for those who preferred printed materials 65.59%. On the gender level, all males were from literary disciplines, where 59.18% of them preferred printed papers, while the rest were divided equally between preferring digital screens and both mediums are alike with a rate of 20.41% for each. For females, 56.84% of them preferred printed papers. (22.38% of scientific & 34.46% of literary disciplines).

As for the students' preferences on the questionnaire's items, they are shown in Table (3).

Table 3

Number of students and their responses percentage on the questionnaire's items

Items	Printed papers		Digital screen		Both materials are alike	
	Number	Percentage	Number	Percentage	Number	Percentage
The introductory question. I generally prefer... at learning and reading, why?	349	%57.03	39	%6.37	224	%36.60
The medium that I prefer for its physical characteristics in the way of dealing and reading is	379	%61.93	68	%11.11	165	%26.96
The best in learning for subjects that require concentration and mental effort	486	%79.41	39	%6.37	87	%14.22
The best in learning for the compulsory academic subjects of a theoretical nature.	447	%73.04	68	%11.11	97	%15.85
The best in learning for compulsory academic subjects of an applied nature.	272	%44.44	146	%23.86	194	%31.70
The best in learning for subjects that have long paragraphs and articles.	476	%77.78	39	%6.37	97	%15.85
The best in learning for subjects that have short paragraphs and articles.	291	%47.55	156	%25.49	165	%26.96
The best in learning for subjects followed by an essay exam...	486	%79.41	29	4.74	97	%15.85
The best in learning for subjects followed by an objective exam...	330	%53.92	126	%20.59	156	%25.49
The best in learning in terms of materials and stories used for entertainment and fun	184	%30.07	253	%41.34	175	%28.59
The cost is greater to read through	233	%38.07	204	%33.33	175	%28.59
In my opinion, the need for re-reading is greater in	223	%36.44	292	%47.71	97	%15.85
In my opinion, I do a lot of multitasking while reading with	233	%38.07	272	%44.44	107	%17.48

Table (3) indicated that the study sample in general preferred printed papers, as 57.03% of the total sample preferred it, while only 6.37% of them preferred digital screens, while the remaining 36.60% of them did not prefer one over another, the order of percentages in general in most of the questionnaire items goes from those who prefer printed papers, then those who have equal mediums, after that those who prefer digital screens.

The percentage of those who preferred printed papers due to their physical characteristics was 61.93%, the percentage increased to 73.04% in subjects of a theoretical nature and increased further to 77.78% in the case of subjects that include

long articles and paragraphs. It reached 79.41% in the case of subjects that require concentration and mental effort or followed by an essay test.

The percentage of those who prefer digital screens while reading non-academic subjects was higher compared to other percentages%41.34.

Students' perceptions of the cost of reading were higher in the case of printed reading, 38.07% of students. The perceptions of 47.71% of the students that the need for re-reading would be greater through digital screens. For multitasking during reading time, the student's percentage who perceives this happening with digital screens was 44.44 %.

The second question: "To what extent do students perform differently at all levels of knowledge when using printed versus digital materials?

To answer it, the researcher conducted the experimental study on the two groups so that each group studies content in paper and digital alternately on the two different topics so that each topic is followed by a test presented in the same medium. The significance of the differences between averages at each cognitive level was calculated using an independent samples T test. Table (4) shows the results obtained.

Table 4

The significance of differences between students' scores averages at cognitive levels and their performance calibration accuracy in the two mediums

Topic		Group1		Group2		(T) value
		Mean	standard deviation	Mean	standard deviation	
Frist Topic	Remembering	3.96	0,880	3.86	0.808	0.592
	Understanding	5.2	0.904	5.1	0.678	0.626
	Application	5.8	0.808	5.46	0.862	2.035*
	Analysis	1.62	0.49	1.4	0.495	2.233*
	Evaluation	1.28	0.454	1	0	4.365**
	Creativity	2	0	1.2	0.404	14.000**
	Total	19.86	3.182	18.02	2.535	3.198**
	Calibration accuracy	15.36	3.379	12.48	1.832	5,298**
Second Topic	Remembering	3.86	0.808	3.96	0.88	0.592
	Understanding	5.1	0.678	5.2	0.904	0.626
	Application	5.1	0.678	5.2	0.904	0.626
	Analysis	1.4	0.495	1.62	0.49	2,233*
	Evaluation	1.06	0.24	1.28	0.454	3,032**
	Creativity	1.23	0.419	1.93	0.226	10,395**
	Total	17.75	2.85	19.19	3.194	2,378**
	Calibration accuracy	12.92	2.059	17.60	3.090	8.912**

Table (4) shows that: On the total level of the whole test, there is a statistically significant difference between the scores averages of the students of the first and second groups at the total level of both tests. The differences were in favor of the first group in the first topic, where the scores average of the two groups were (19,86, 18,02), respectively, and in favor of the second group in the second topic where the averages were (17.75, 19,19) respectively. This means the effectiveness of reading on printed papers in academic performance compared to digital reading. This result is consistent with Eyre, et. al, (2017); Grancha, et. al, (2022); Rasmusson (2015) in the field of reading comprehension

As for the sub-levels, it is clear that in the first topic, there is no statistically significant difference between the scores averages of the first and second groups at the level of remembering and understanding. While there were statistically significant differences in favor of the first group at 0.05 on the level of application and analysis, and at 0.01 on both evaluation and creativity levels. For the second topic, there is no statistically significant difference between students' scores averages at the level of remembering, understanding and application. While there were statistically significant differences in favor of the second group at 0.05 on the analysis level and at 0.01 on both the level of evaluation and creativity.

The third question: "To what extent does the calibration accuracy of performance differ for students when using printed versus digital materials?" Row (10 and 18) in Table (4) shows the independent samples T-test result. There is a statistically significant difference at 0.01 in calibration accuracy in favor of the first group in the first topic, where the averages for the first and second groups were (15. 36, 12.48), respectively, and in favor of the second group in the second topic, where the averages were (12.92, 17.60), respectively, and this means the positive effect of printed reading compared to digital reading on the students' calibration accuracy of their performance.

DISCUSSION

The preferred materials for students in learning

From table (2), it is clear that the students' preference was printed papers, especially for males and in literary disciplines. Both mediums are alike especially in scientific disciplines. Table (3) indicated the percentage of those who preferred printed papers increased due to its physical characteristics especially in subjects of a theoretical nature, subjects that include long articles and paragraphs, require concentration and mental effort or followed by an essay test.

Students' comments about these items explained these high percentages of preference for paper materials. Among the students' comments, "Theoretical materials often contain long paragraphs and items that require going back to the paragraph and re-reading it, and this is easy with printed papers," which explains the high percentage of students from literary disciplines who prefer printed papers 65.59%. Also, among the students' comments, "When the material is difficult and needs more concentration, I paraphrase its important paragraphs, write important points, and organize them in shapes and diagrams, printed papers help me to do that." In addition to some comments which states that if the method of evaluating the material, whether it is easy or difficult in the form of the essay test, they need to concentrate on the details that may be required in the answer key, not only on the important points that may suffice in the case of objective tests, and thus they need to read deeply, identify important points and summarize intrinsic ideas so printed reading was the best choice.

Most of the students' comments on open questions about the reasons for preferring printed materials compared to digital were related to its comfortable physical properties in terms of the paper holding, its controlling, the presence of margins that help writing the most important points and keywords, drawing diagrams and mind maps that facilitate

comprehension and increase concentration. From the comments that confirmed this "I interact with the text with my eyes, I can move the pen under the lines, outline and shade the important things in it with colored markers, my memory is able to memorize the shape of the paper, the format of the paper is fixed and the words are in a fixed place, which makes the information organized inside my mind and easy to retrieve unlike the digitally pages".

In addition, some comments were found about digital reading stating that, "There may be a sudden shift from the point I read with an unintended touch, which makes me distracted and bored." These comments explain the high percentage of students who prefer printed papers in learning in general and at the level of preference questionnaire items especially.

Table (3) also indicates that the percentage of those who prefer digital screens while reading non-academic subjects was higher compared to other percentages. Students' perceptions of the cost of reading were higher in the case of printed reading. Also, the higher percentage of student percept that re-reading and multitasking during reading time occurs more with digital screens.

Students' responses to the open question about the reasons for preferring digital reading included saving time because of its availability at any time in different places, even in the means of transportation. From this, it appears that the students' perceptions of both mediums and their reasons for preference are different.

Students' performance at knowledge levels when using printed versus digital materials

Table(4) indicates the absence of a significant difference in both the level of memorization and understanding in the two topics in addition to application level in the second topic .Berhaps this can be explained that the scientific content measured at these levels is easy to assimilate and retrieve in the two mediums, especially that the study sample is from the fourth year, which reached a high level of experience that enables them to become familiar with these levels of knowledge in any medium.

The differences that indicate the effectiveness of printed reading compared to digital reading appeared in the application level in the first topic and in the analysis level in the second topic .The significance of the differences in both topics increased at levels of evaluation and creativity .That is, it can be said that the positive effect of printed reading versus digital reading increased as the level of knowledge increased, and these levels depend largely on the elaboration and depth of learning. This may be due to the difference in the mental way in which a student dealt with printed and digital text and the processing level in the two mediums, as students spend less mental effort on digital reading which reduces the opportunity to engage in deeper analytical thinking (Delgado, et. al, 2018). This superficial level of information processing makes screen inferiority appears with tasks that require constant attention and deep processing (Annisette & Lafreniere, 2017).

In addition, the reason for screen inferiority at higher cognitive levels may be due to some physical differences that affect learning elaboration and depth of processing. Printed papers allow easier construction of cognitive maps during study, which can be

valuable for understanding and memory (Baron, 2021). Many excerpts and maps related to essay items were found on the margins of the test papers, which assert that the effectiveness of the medium depends largely on the nature of the content and its requirements.

The appearance of differences between the two mediums clearly at the higher cognitive levels in favor of printed papers is consistent with the results by Singer Trakhman & Alexander (2017a), where the differences between printed and digital reading appeared when performance was measured by questions requiring more time and concentration.

The processing time in the current study could have a role in improving performance on printed papers. Although it was not measured as it was not a question in this study, the researcher noticed that the participants were slower in reading printed texts.

The speed with which individuals process digital text may lead to losing a lot of metacognitive skills that are responsible for shaping reading outcomes. Wickelgren (1977) expressed that by the speed-accuracy tradeoff hypothesis assuming that there is a trade-off between student's speed on the task and the quality of their performance. When students read faster in the digital case, this will reduce their accuracy and their performance, especially the higher levels of it.

Students' calibration accuracy of their performance when using printed versus digital materials

As shown from Row (10 and 18) in Table (4) there is a positive effect of printed reading compared to digital reading on the students' calibration accuracy of their performance. This result is consistent with the result of the second question, where the better calibration was in favor of the group with the best performance, as it was confirmed by Hattie (2013) that the more accurate calibrated students achieve better performance and best learning outcomes. This result is also consistent with the results of Ackerman & Goldsmith (2011); Lauterman & Ackerman (2014); Ronconi, et. al,(2022) where accurate judgment on performance was better when reading on paper and the bias was greater after reading digitally. The less effort, ease and speed of reading digitally may have contributed to students' miscalibration.

Perhaps the high calibration accuracy in printed papers is due to the depth of processing level and using self-regulation strategies including self-testing, monitoring, which increases calibration accuracy. Butler (1993) explained that deep information processing helps students access objective information related to how they perform what enable them to compare their actual performance with the intended performance and judge it objectively.

CONCLUSION

The current study revealed that students prefer printed papers, especially males, literary disciplines, theoretical subjects that include long items, or that are followed by an essay test. Also, students' perceptions of their learning through various mediums (printed and digital materials) are different and their preferences depend on the nature and the goal from the reading content.

The positive effect of printed reading was found increased with the higher levels of Bloom's taxonomy. So, each medium (papers and screens) has determinants that should be employed to serve learning. If the goal does not go beyond memorization, understanding and application in some circumstances, the advantages of digital screens can be benefited from, but if the goal exceeds that, papers should be used in presenting and evaluating content.

Also, the results revealed that better calibration was in favor of the group that used printed materials. This requires more future studies that should study how to overcome this inferiority in digital reading at a time it has become a necessity of learning and indispensable, by innovating methods that deepen the levels of information processing in addition to developing monitoring behaviors that enhance calibration accuracy and output quality.

LIMITATION

As participation in the study was voluntary, the percentage of males participating in the study was much less than the percentage of females. Males from the scientific disciplines were not represented in the sample. In addition, processing time was not measured across the two mediums where its difference across the two mediums during learning and testing was observed.

REFERENCES

Ackerman, R., & Goldsmith, M. (2011). Metacognitive regulation of text learning: On screen versus paper. *Journal of Experimental Psychology: Applied, 17*(1), 18–32, http://dx.doi.org/10.1037/a0022086

Ackerman, R., & Lauterman, T. (2012). Taking reading comprehension exams on screen or on paper? A metacognitive analysis of learning texts under time pressure. *Computers in Human Behavior*, *28*(5), 1816–1828. https://doi.org/10.1016/j.chb.2012.04.023

Alexander, P. A. (2013). Calibration: What is it and why it matters? An introduction to the special issue on calibrating calibration. *Learning & Instruction*, *24*, 1–3, http://dx.doi.org/10.1016/j.learninstruc.2012.10.003

Annisette, L. E., & Lafreniere, K. D. (2017). Social media, texting, and personality: A test of the shallowing hypothesis. *Personality and Individual Differences*, *115*, 154–158. https://doi.org/10.1016/j.paid.2016.02.043

Baron, N.S. (2021). Know what? How digital technologies undermine learning and remembering. *Journal of Pragmatics*, *175*(2021), 27-37. https://doi.org/10.1016/j.pragma.2021.01.011

Baron, N.S., Calixte, R.M., Havewala, M. (2017). The persistence of print among university students: an exploratory study. *Telematics Inf. 34*(5), 590-604. http://dx.doi.org/10.1016/j.tele.2016.11.008

Burdina, M.G., Krapotkina, I. E., & Nasyrova, L. G. (2019). Distance Learning in Elementary School Classrooms: An Emerging Framework for Contemporary Practice. *International Journal of Instruction*, *12*(1), 1-16. https://doi.org/10.29333/iji.2019.1211a

Butler, R. (1993). Effects of task- and ego-achievement goals on information seeking during task engagement. *Journal of Personality and Social Psychology*, *65*, 18–31. http://dx.doi.org/10.1037/0022-3514.65.1.18

Clinton, V., (2019). Reading from paper compared to screens: a systematic review and meta-analysis. *Journal of research in reading*, *42*(2), 288-325. http://dx.doi.org/10.1111/1467-9817.12269

Golan, D., Barzillai, M., & Katzir, T. (2018). The effect of presentation mode on children's reading preferences, performance, and self-evaluations. *Computers &Education*, *126*, 346–358. https://doi.org/10.1016/j.compedu.2018.08.001

Daniel, D. B., & Woody, W. D. (2013). E-textbooks at what cost? Performance and use of electronic v. print texts. *Computers & Education*, *62*, 18–23. http://dx.doi.org/10.1016/j.compedu.2012.10.016

Delgado, P., Vargas, C., Ackerman, R., Salmeron, L. (2018). Don't throw away your printed books: a meta-analysis on the effects of reading media on reading comprehension. *Educational research Review*, *25*, 23-38. http://dx.doi.org/10.1016/j.edurev.2018.09.003

DeStefano, D., LeFevre, J. A. (2007). Cognitive load in hypertext reading: a review. *Computers in Human Behavior*, *23*(3), 1616-1641. http://dx.doi.org/10.1016/j.chb.2005.08.012

Djatmika,D.,Prihandoko,L.,Nurkamto,J.(2022). Students' Profiles in the Perspectives of Academic Writing Growth Mindsets, Self-Efficacy, and Metacognition. *International Journal of Instruction, 15*(3),117-136. *http://dx.doi.org/10.29333/iji.2022.1537a*

Duran, E.,Alevli, O.(2014). Students' Opinions: Digital Text or Printed Text? *International Journal of Language Academy*, *2*(2), 110-126. https://www.researchgate.net/publication/309310890

Eyre, J., Berg, M., Mazengarb, J., & Lawes, E. (2017). Mode equivalency in PAT: Reading Comprehension. *Technical Report,*1-36. http://dx.doi.org/10.13140/RG.2.2.32130.07361

Glenberg, A. M., Wilkinson, A. C., & Epstein, W. (1982). The illusion of knowing: Failure in the self-assessment of comprehension. *Memory & Cognition*, *10*(6), 597–602. http://dx.doi.org/10.3758/BF03202442

Goodwin, A. P., Cho, S.-J., Reynolds, D., Brady, K., & Salas, J. (2020). Digital versus paper reading processes and links to comprehension for middle school students. *American Educational Research Journal*, *57*(4), 1837–1867. https://doi.org/10.3102/0002831219890300

Grancha, N., Jorques-Infante,M., Moret- Tatay,C.(2022). Reading digital- versus print-easy texts: a study with university students who prefer digital sources. *Psicologia: Reflexão e Crítica*, *35*(10), 45. https://doi.org/10.1186/s41155-022-00212-4

Halamish, V., & Elbaz, E. (2020). Children's reading comprehension and meta comprehension on screen versus on paper. *Computers & Education*, *145*, 1–11. https://doi.org/10.1016/j.compedu.2019.103737

Hattie,J.(2013). Calibration and confidence: Where to next? *Learning and Instruction, 24*(1) ,62-66. http://dx.doi.org/10.1016/j.learninstruc.2012.05.009

Kaufman, G., Flanagan, M. (2016). High-low split: divergent cognitive construal levels triggered by digital and non-digital platforms. *The 2016 CHI Conference,* 2773–2777. http://dx.doi.org/10.1145/2858036.2858550

Kazazoğlu, S. (2020). Is printed-text the best choice? A mixed-method case study on reading comprehension. *Journal of Language and Linguistic Studies*, 123(1), 138-149. http://dx.doi.org/10.17263/jlls.712879.

Kong, Y., Seo, Y. S., & Zhai, L. (2018). Comparison of reading performance on screen and on paper: A meta-analysis. *Computers & Education*, *123*, 138–149. http://dx.doi.org/10.1016/j.compedu.2018.05.005

Koriat, A., Ma'ayan, H., & Nussinson, R. (2006). The intricate relationship between monitoring and control in metacognition: Lessons for the cause-and-effect relation between subjective experience and behavior. *Journal of Experimental Psychology: General, 135*(1), 36–69. http://dx.doi.org/10.1037/0096-3445.135.1.36

Lauterman, T., Ackerman, R. (2014). Overcoming screen inferiority in learning and calibration. *Computers in Human Behavior*. *35*(1), 455-463. http://dx.doi.org/10.1016/j.chb.2014.02.046

Mangen, A., Olivier, G., Velay, J.-L. (2019). Comparing comprehension of a long text read in print book and on Kindle: where in the text and when in the story? *Frontiers in Psychology*, *10*, 38. http://dx.doi.org/10.3389/fpsyg.2019.00038

McKnight, K., O'Malley, K., Ruzic, R., Horsley, M. K., Franey, J. J., & Bassett, K. (2016). Teaching in a digital age: How educators use technology to improve student learning. *Journal of Research on Technology and Education*, *48*(3), 1–18 http://dx.doi.org/10.1080/15391523.2016.1175856.

Mizrachi, D., Salaz, A.M., Kurbanoglu, S., Boustany, J. (2018). Academic reading format preferences and behaviours among university students worldwide: a comparative survey analysis. *PLoS ONE*, *13*(5), e0197444. http://dx.doi.org/10.1371/journal.pone.0197444

Oroz, S. (2016*). Exploring the Reading Preferences in Digital and Printed Text. MA diss, Webster Vienna Private University*. Accessed July 27, 2021. https://www.researchgate.net/publication/312587561

Proaps, A. B., & Bliss, J. P. (2014). The effects of text presentation format on reading comprehension and video game performance. *Computers in Human Behavior*, *36*, 41–47 http://dx.doi.org/10.1016/j.chb.2014.03.039.

Rasmusson, M. (2015). Reading paper - reading screen. A comparison of reading literacy in two different modes. *Nordic Studies in Education*, *35*(1), 3–19. https://doi.org/10.18261/ISSN1891-5949-2015-01-02.

Ronconi,A.,, Veronesi,V., Mason,L., Manzione,L., Florit,E., Anmarkrud, Ø., Bråten,I.(2022).Effects of reading medium on the processing, comprehension, and calibration of adolescent readers. Computers & *Education*, *185*, 1-14. https://doi.org/10.1016/j.compedu.2022.104520

Seok, S., & DaCosta, B. (2017). Gender differences in teens' digital propensity and perceptions and preferences with regard to digital and printed text. *TechTrends*, *61*(2), 171–178. http://dx.doi.org/10.1007/s11528-016-0134-4

Seok, S., DaCosta,B.(2016). Perceptions and Preferences of Digital and Printed Text and Their Role in Predicting Digital Literacy. *Asian Social Science*, *12*(5),14-23. http://dx.doi.org/10.5539/ass.v12n5p14

Sidi, Y, Ophir, Y, & Ackerman, R. (2016). Generalizing Screen Inferiority - Does the Medium, Screen versus Paper, Affect Performance Even with Brief Tasks? *Metacognition and Learning*, *11*(1),15-33. https://link.springer.com/article/10.1007/s11409-015-9150-6

Singer Trakhman, L. M., Alexander, P. A., & Silverman, A. B. (2018). Profiling reading in print and digital mediums. *Learning and Instruction*, *57*, 5–17. https://doi.org/10.1016/j.learninstruc.2018.04.001

Singer Trakhman, L.M., Alexander, P.A., Berkowitz, L.E.(2019). Effects of processing time on comprehension and calibration in print and digital mediums. *Journal of Experimental Education*, *87*(1), 101-115. http://dx.doi.org/10.1080/00220973.2017.1411877

Singer Trakhman, L. M., & Alexander, P. A. (2017a). Reading across mediums: Effects of reading digital and print texts on comprehension and calibration. *The Journal of Experimental Education*, *85*(1), 155–172. http://dx.doi.org/10.1080/00220973.2016.1143794

Singer Trakhman, L. M., & Alexander, P. A. (2017b). Reading on paper and digitally: What the past decades of empirical research reveal. *Review of Educational Research*, *87*(6), http://dx.doi.org/10.3102/0034654317722961.

Støle, H., Mangen, A., & Schwippert, K. (2020). Assessing children's reading comprehension on paper and screen: A mode-effect study. *Computers & Education*, *151*, 103861. https://doi.org/10.1016/j.compedu.2020.103861

Stone,J.N.(2000). Exploring the relationship between calibaration and self-regulated learning. *Educational psychology review*, *12*(4),437-475. http://dx.doi.org/10.1023/A:1009084430926

Wickelgren, W. A. (1977). Speed-accuracy tradeoff and information processing dynamics. *Acta Psychological*, *41*(1), 67–85. http://dx.doi.org/10.1016/0001-6918(77)90012-9

Zechmeister, E. B., & McKillip, J. (1972). Recall of place on the page. *Journal of Educational Psychology*, *63*(5), 446–453. http://dx.doi.org/10.1037/h0033249