



Profiles of undergraduate student writers: Differences in writing strategy and impacts on text quality

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ABSTRACT

This study aimed to identify undergraduate students' writing profiles based on quality of planning output, revision changes between the first and final drafts, and quantity of Internet searches while writing digitally. To investigate the performance of each profile, the differences in text quality according to students' profile membership were also examined. 260 Korean undergraduate students participated in the study and wrote an opinion essay. Latent profile analysis and one-way MANOVA were adopted as analytic tools. Four profiles emerged: Revision-based, Plan-based, Search-based, and Correction-based Writers. Correction-based Writers who showed many surface-level changes represented the majority. Revision-based Writers who showed many sentential and textual changes outperformed the other three profiles; the other profiles did not show significant differences in text quality between each other. The research findings corroborated evidence for the existing issue of planning vs. revising strategies and presented educational implications based on analyzing the current state of undergraduate students' writing.

1. Introduction

One of the effective ways to address individual differences in cognitive activities is to find patterns and group them (Alexander & Murphy, 1999). In educational settings, characterizing students' patterns using various profiling tools has been one of the most efficient ways to consider individual differences (Hickendorff, Edelsbrunner, McMullen, Schneider, & Trezise, 2018). As can be seen in some profiling studies, the profiles and their specific features might suggest instructional guidelines for what different students need (Kleinsz, Potocki, Ecalle, & Magnan, 2017; Pastor, Barron, Miller, & Davis, 2007).

However, in writing research, writing profiles have been rarely and restrictively researched. Although many attempts have been made to categorize students' or children's literacy activities, most of them were focused on reading profiles. For example, reading researchers have produced various profiling studies based on differences in reading competence (Bonifacci & Tobia, 2016; Kleinsz et al., 2017; Wolff, 2010), early literacy (Karlsson et al., 2018; Ren, Hu, & Wu, 2019), and adult literacy (MacArthur, Konold, Glutting, & Alamprese, 2012; Mellard, Fall, & Mark, 2009; Sebastián & Moretti, 2012). Some early literacy studies provided incorporated profiles of reading and writing (Farrington-Flint, 2015; Ford, Cabell, Konold, Invernizzi, & Gartland, 2013). However, writing-only profiles have rarely been investigated except for a few studies (e.g., Torrance, Thomas, & Robinson, 1994,

2000); among them, large-scale studies have been much scarcer.

Thus, the present study explores a profiling analysis and its consequences on writing for better understanding of undergraduate students' writing performance. Although writing performance can be influenced by various contexts (e.g., writing task, genre, and situation), writers in post-secondary education tend to maintain or prefer certain strategic choices when they write under the same conditions (Torrance et al., 2000; Torrance, Thomas, & Robinson, 1999). Therefore, a person-centered profiling approach (i.e., writers' profile) may be adopted to investigate patterns in undergraduate students' writing performance. Among various features that can represent the current state of undergraduate students' writing performance, planning, revision, and information seeking behaviors were selected to reflect the ongoing major issues in writing research and the usual context of digital writing. Besides the profiling results, the performance of each profile was also analyzed by examining the differences in text quality according to students' profile membership. Therefore, we may better understand undergraduate students' writing strategies by considering their individual differences and the efficiency of their writing performance.

1.1. Categorizing individual differences in writing

Cognitive processes in writing have been studied by modeling the mental operations of sub-processes like planning, translating, and

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revising (Alamargot & Chanquoy, 2001). Since the model of Hayes and Flower (1980)—the representative model of explaining dynamic and recursive features of sub-processes—, many researchers have presented various models to explain the writing process as a whole or to focus on one of the sub-processes (Chenoweth & Hayes, 2003; Flower, Hayes, Carey, Schriver, & Stratman, 1986; Hayes, 1996, 2012; Kellogg, 1996; Van den Bergh & Rijlaarsdam, 1996; Van Wijk, 1999). Some researchers have sought to reflect the developmental or individual differences in their writing models (Bereiter & Scardamalia, 1987; Galbraith, 1999, 2009). For example, Bereiter and Scardamalia (1987) claimed that the dual process of knowledge-telling and knowledge-transforming can be distinguished in terms of novice and professional writers, writing genre, and aims and tasks, etc. Galbraith (1999) have more centered on dispositional differences among individuals rather than developmental differences. By introducing a knowledge-constituting model, he explained how writers choose various writing strategies. Subsequently, Galbraith (2009) proposed a dual-process model that would encompass both explicit rhetorical planning (problem-solving approach) and dispositionally guided text production (synthesized approach).

In line with these theoretical modeling approaches that have investigated individual differences in writing, a few studies have attempted to categorize individual differences in writing. For example, Torrance et al. (1994) distinguished three writing profiles (planners, revisers, and mixed-strategy writers) using cluster analysis on the survey data of 228 undergraduate students. In contrast, Torrance et al. (2000) extracted four patterns of writing strategies (outline-and-develop, detailed-planning, minimal-drafting, and think-then-do) in terms of principal component analysis using a questionnaire during the writing process. Their series of studies were differentiated not only in their analytic techniques, but also in their data types: Torrance et al. (1994) used the questionnaire on students' recall of ordinary habits, whereas Torrance et al. (2000) depended on a retrospective questionnaire that enabled students to answer on just a previous process. In the domain of L2 writing research, Jarvis, Grant, Bikowski, and Ferris (2003) investigated multiple profiles of highly rated timed compositions and explored the relationships with their linguistic features.

Some researchers investigated the patterns of activities in sub-processes, albeit not a person-centered profiling approach. Eklundh and Kollberg (2003) presented three different styles of revision in digital writing: repetitive, embedded, and sequence of revisions. Van Hell, Verhoeven, and van Beijsterveldt (2008) verified differences in pause-time patterns between novice and competent writers by digitizing handwriting movement. Van Waes and Schellens (2003) collected pause and revision data from 20 undergraduate students and confirmed five profiles of revision behaviors in terms of cluster and discriminant analyses. Some researchers have sought to measure process data and find some patterns that affect text quality (Breetvelt, van den Bergh, & Rijlaarsdam, 1994; Tillema, van den Bergh, Rijlaarsdam, & Sanders, 2011; Van den Bergh & Rijlaarsdam, 2001).

1.2. Planning vs. revision

Among various sub-processes in writing, many researchers have concentrated on exploring either planning or revision (Eklundh & Kollberg, 2003; Faigley & Witte, 1981; Flower et al., 1986; Hayes & Nash, 1996; Kellogg, 1996; Lindgren, 2005; Olive & Passerault, 2012; Witte, 1987). Regarding *planning*, some researchers have interest in explicit planning activities (e.g., outlining); they showed that explicit planning activities were effective since they allow writers to reduce cognitive overload by concentrating on planning activities during the prewriting stage (Kellogg, 1988; see also Galbraith, Ford, Walker, & Ford, 2005; De Smet, Brand-Gruwel, Broekkamp, & Kirschner, 2012). Some researchers proved that students in the outlining condition outperform those in the no prewriting or other prewriting conditions such as clustering or listing ideas without organization (Kellogg, 1988, 1990; Limpo & Alves, 2018; Piolat & Roussey, 1996). Other researchers

produced some useful planning or planning instruction strategies in various educational settings. According to them, outlining strategies may be beneficial regardless of school level (De La Paz & Graham, 2002; De Smet et al., 2012; Kirkpatrick & Klein, 2009), and whether special care is needed (De la Paz & Graham, 1997; Kiuahara, O'Neill, Hawken, & Graham, 2012). De Smet et al. (2012), De Smet, Brand-Gruwel, Leijten, and Kirschner (2014), and Evmenova et al. (2016) proposed to use electronic outlining to consider digital writing circumstances. However, outlining itself may not guarantee the quality of writing. The effects of outlining can vary according to the writing genre and tasks (Slotte & Lonka, 1998), writing competence (Galbraith et al., 2005), and the writers' disposition or beliefs (Baaijen, Galbraith, & de Gloppe, 2014; Galbraith, 1992, 1999).

Regarding *revision*, many researchers have concentrated on the effectiveness according to the type of revision (Adams, Simmons, Willis, & Pawling, 2010; Bridwell, 1980; Flower et al., 1986; Kehagia & Cox, 1997; McCutchen, Francis, & Kerr, 1997; Sommers, 1980). Some researchers demonstrated that there are differences in the types of revision between novice and competent writers; while novice writers focused mainly on surface-level revision, competent writers were more proficient in structure- and meaning-level revision (Flower et al., 1986; Kehagia & Cox, 1997; McCutchen et al., 1997; Sommers, 1980). Regarding these differences, some researchers reported that undergraduate students still depended more on surface-level revision even though surface-level revision negatively correlated with their text quality (Adams et al., 2010; Bridwell, 1980).

Some researchers have more centered on the writers' strategic choices during writing. As Kieft, Rijlaarsdam, Galbraith, and van den Bergh (2007, p. 566) well documented, two most well-defined strategies that have been adopted in writing research are a *planning strategy* and a *revising strategy*. Writers who tend to rely on the planning strategy usually "concentrate on working out what they want to say before setting pen to paper, and only start to produce full text once they have worked out what they want to say"; in contrast, writers who prefer the revising strategy (also called as an interactive drafting strategy) tend to "work out what they want to say in the course of writing and in which content evolves over a series of drafts" (Galbraith & Torrance, 2004, p. 64). Some researchers have argued that these differences in writing strategies would not result in the differences in the quality of writing but can be regarded as differences in dispositional choices (Galbraith, 1992, 1999; Galbraith & Torrance, 2004; Tillema et al., 2011; Torrance & Galbraith, 2006). Kieft et al. (2007) and Kieft, Rijlaarsdam, and van den Bergh (2008) argued that writing instruction should be implemented according to students' habitual writing strategies (either planning or revising strategy) to help them produce better texts. By applying experimental designs of outline plan vs. synthetic plan, Baaijen et al. (2014) and Baaijen and Galbraith (2018) drew a similar conclusion as the above-mentioned research in that both plans can be admitted as effective strategies in certain conditions. However, these studies tended to conflict with precedent research that have emphasized the effectiveness of outlining (De La Paz & Graham, 2002; De Smet et al., 2012; Kellogg, 1988; Kirkpatrick & Klein, 2009; Kiuahara et al., 2012; Limpo & Alves, 2018; Piolat & Roussey, 1996). In other words, it can be supposed that some researchers emphasize superiority of the planning strategy whereas other researchers focus more on the effectiveness of writers' dispositional choice for their own strategies.

Considering that many studies on sub-processes in writing have adopted experimental designs, e.g., outlining or non-outlining (De La Paz & Graham, 2002; De Smet et al., 2012; Kellogg, 1988; Kirkpatrick & Klein, 2009; Limpo & Alves, 2018; Piolat & Roussey, 1996), measuring the extent to which students perform planning or revision activities may suggest a new perspective. Regarding planning activities, for example, planning outputs from students can vary according to their quality, amount, or format. Sometimes, students would produce intermediate forms between outlining and drafting in their usual writing performance. Thus, choosing between either outlining or non-outlining may

not reflect the variety of students' usual writing performance. Some researchers have attempted to measure writers' planning activities during prewriting (Chai, 2006; De la Paz & Graham, 2002; Koutsoftas & Gray, 2013). Among various ways to measure planning activities, some researchers have suggested several ways of measuring the quality of planning output using a five-point scale. De la Paz and Graham (2002) suggested a holistic measure for the quality of planning, ranging from no advanced planning to accurate and fully developed planning. In contrast, Chai (2006) proposed an analytic measure as a way of independently scoring several features of writing plan outputs: association (degree of classification), arrangement (degree of structure), levels of response (number of idea units), and elaboration (degree of detail). Koutsoftas and Gray (2013) used a mixed tool to measure planning activities by counting the number of ideas and using a five-point scale. For example, they used a five-point scale when they measured the degree of *organization* (similar to 'arrangement' of Chai's scoring criteria).

As for measuring revision, precedent research has offered various ways to measure the quantity and quality of revision while writing (Bridwell, 1980; Daiute, 1986; Eklundh, 1994; Eklundh & Kollberg, 2003; Faigley & Witte, 1981; Kehagia & Cox, 1997; Koutsoftas & Gray, 2013). Recent studies have tended to use various measuring tools such as keystroke logging to capture digitalized features in revision (Eklundh, 1994; Eklundh & Kollberg, 2003; Leijten & Van Waes, 2013; Van Waes & Schellens, 2003); however, keystroke logging tools are not currently applicable for all languages. On the other hand, *revision changes* can also be adopted to measure changes between the first and final draft (Bridwell, 1980; Daiute, 1986; Faigley & Witte, 1981; Kehagia & Cox, 1997). Revision changes may have some relationships with writing quality. While Daiute (1986), Faigley and Witte (1981), and Kehagia and Cox (1997) used taxonomy based on the distinction between surface changes (formal and meaning-preserving changes) and text-based changes (micro- and macro-structure changes), Bridwell (1980) used taxonomy based on the different linguistic units such as surface, lexical, phrase, clause, sentence, and text level.

1.3. Internet searching during digital writing

To consider digital writing circumstances, the current study opted for *Internet searching* as one of the main predictors for profiling analyses. Internet searching is regarded as a subordinate concept of *information seeking* behavior (Marchionini, 1995; Thatcher, 2008; Wilson, 1999). While information seeking refers to "a process in which humans purposefully engage to change their state of knowledge", Internet searching focuses more on external human behaviors using computers and web environments to describe the activities of adjusting and showing information (Marchionini, 1995, p. 5). As a form of digital prewriting activity, many student writers depend on Internet searching since they have easy access to the Internet while writing with a computer. Burton and Chadwick (2000) suggested that Internet searching has been a main method for students to collect materials for writing. Moreover, digital writing environments promote source-based writing because writers have "easy access to a wide variety of sources that are only a mouse click away" (Leijten, van Waes, Schriver, & Hayes, 2014, p. 286). Thus, Internet searching can act as a source for writing and planning.

Regarding using information during writing, many writing researchers have already shown interest in *writing from sources* because it may be a fundamental and important way for students to write as they learn (Cerdán & Vidal-Abarca, 2008; Mateos et al., 2014; Perfetti, Rouet, & Britt, 1999; Segev-Miller, 2004; Spivey, 1997; Wolfe & Goldman, 2005). Writing from sources has been important issues not only in reading and writing expository texts (Boscolo, Ariasi, del Favero, & Ballarin, 2011; Cerdán & Vidal-Abarca, 2008; Kirkpatrick & Klein, 2009; Segev-Miller, 2004; Spivey, 1997), but also in argumentative writing (Kirkpatrick, 2012; Mateos et al., 2011; Rouet, Favart, Britt, & Perfetti, 1997; Wiley & Voss, 1999).

Compared to the aforementioned studies that have mostly emphasized on synthesizing and constructing texts from multiple sources, how information is collected for writing has been much less explored. A few writing researchers have investigated students' performance on collecting information from the Internet for writing. Olive, Rouet, François, and Zampa (2008) revealed that free and easy navigation between windows would relate to the better performance in summary writing. Li (2012) conducted an explorative study on Internet searching and reading for undergraduate students' writing assignments and discussed their ways of using search engines and reading search terms and content. Other researchers have tended to more focus on exploring patterns of writers' use of the Internet. Kirkpatrick and Klein (2016) analyzed Grade 12 students' strategies for writing from the Internet and revealed two global strategies according to whether they created mediating planning documents or not. They concluded that writers' strategies maximized the affordances of the Internet and digital writing medium. Zheng (2013) described four cognitive strategies to manage cognitive load during writing and searching using data from 12 undergraduate writers: minimal online reading strategy, deep online information engagement strategy, offloading useful web information strategy, and searching and reading behavior self-monitoring strategy. Brand-Gruwel, Wopereis, and Vermetten (2005) developed a qualitative coding frame to determine how much students used Internet searching strategies according to three different searching patterns. Some researchers have emphasized the importance of *information literacy*, which mainly focuses on collecting and evaluating information, in relation to writing. Clark (1995) presented some grounds for recognizing information literacy as a major educational purpose in a writing center. Shao and Purpur (2016) proved the positive relationship between information literacy and students' writing scores.

While many studies mentioned above qualitatively analyzed writers' Internet searching behaviors, there has been very few attempts that quantitatively measured Internet searches while writing. For example, Li (2012), Kirkpatrick and Klein (2016), Zheng (2013), and Brand-Gruwel et al. (2005) used qualitative measurements to examine writers' Internet searching behaviors. In contrast, Thatcher (2008) measured them by counting the time to complete the task, number of steps and queries, and answer correctness. However, both qualitative and quantitative measurement may offer meaningful information for better understanding of writing from Internet sources.

1.4. The present study

To examine undergraduate students' pattern of writing strategies and its association with writing quality, the present study employed a person-centered analytic approach by using some process and product data from planning, revision, and Internet searching activities. To this end, a profiling analysis was fulfilled by a Latent Profile Analysis (LPA) and then a one-way Multivariate Analysis of Variance (MANOVA) was applied to identify differences in text quality between profiles. Regarding profiling analyses, two variables for planning, two for revision, and one for Internet searching were employed as observed predictors based on undergraduate students' digital writing performance. All variables were measured by applying existing criteria developed by relevant precedent research; quality of plan output (Chai, 2006; Koutsoftas & Gray, 2013), revision changes (Daiute, 1986; Kehagia & Cox, 1997), and number of Internet search steps (Thatcher, 2008) were introduced in the present study. Next, a one-way MANOVA was conducted to examine whether students' profile membership indicated differences in writing quality. Text quality was also measured by referring to relevant research (Breetvelt et al., 1994; van den Bergh & Rijlaarsdam, 2001; Weigle, 2002).

The present study is differentiated from precedent research in the following ways. First, there has been seldom research on person-centered profiling approach in writing research, especially with large sample size. Thus, categorization of more than 200 undergraduate

students would offer recent information on undergraduate students' writing. Second, unlike precedent research on writing profiles, the present study not only yielded categorized results but also explored the differences between profiles. By associating profiling results with text quality, we may find some implications for writing instruction that considers individual differences. Third, contrary to precedent research, the present study measured the extent of students' writing activities rather than applied controlled experimental designs (e.g., whether outlining or not). Thus, the current results would reflect the differences in the extent of students' writing activities and their dispositional choices. Fourth, to consider digital writing circumstances, the present study adopted Internet searching behaviors as one of the main variables for the profiling analysis. Considering that precedent research on writing profiles has seldom included variables regarding digital writing, the results may also contribute to explaining the relationships between Internet searching and the other writing activities. Finally, precedent research concerning Internet searching during writing has tended to use qualitatively measured variables. However, regarding measuring revision and Internet searching behaviors, the current study opted for quantitative measurement to concentrate more on reliable and convenient data collection considering large sample size. As can be seen in other profiling studies (Karlsson et al., 2018; Ren et al., 2019), specific hypotheses about the number of profiles and their characteristics cannot be mentioned. Rather, we can expect that undergraduate students' profiles using the variables extracted from planning, revision, and information seeking will well explain the current state of their writing performance and that differences in writing quality according to the profiles will reveal the effectiveness of each profile.

2. Methods

2.1. Participants

260 Korean undergraduate students (73% female) aged 19–23 years ($M = 19.92$, $SD = 0.95$) participated in the present study. They were 2nd (74%) and 3rd (26%) year college students and recruited from the departments of education at three universities in Seoul, South Korea. Since college writing courses are mandatory for freshmen at those three universities, they had all completed a basic writing course. Meanwhile, those who had completed additional or intensified writing courses after the basic ones were excluded from recruitment to control the difference in their educational experiences. Among the 260 writing samples from each participant, 26 were excluded from the analysis because of data error, missing values, etc.; thus, the overall valid number of observation cases used in the actual analysis was 234. The required sample size was calculated according to two main analysis tools: LPA and one-way MANOVA. Although there is no definite guideline for minimum sample size for clustering tools, > 70–200 participants have been accepted as a minimum condition for the posterior verification of LPA (Nylund, Asparouhov, & Muthén, 2007; Tein, Cox, & Cham, 2013; Wurpts & Geiser, 2014). Prior power analysis for MANOVA indicated that we required at least 100 participants (power = 0.8, $p < .05$). Thus, the total number of valid cases ($n = 234$) can be admitted for the relevant analysis. The research design was approved before data collection by the university's IRB and all participants were asked to submit written consent by its regulation. Private information was deleted or changed to unique identifiers prior to analysis.

2.2. Procedures and materials

All participants were asked by the researcher to write an opinion essay for about an hour in the large computer rooms at each university using Haansoft Office version 2010 SE+ (Haansoft office (version 2010 SE+) [computer software], n.d.) (similar to MS Word and adaptive to Korean orthography) and Internet access. Camtasia Recorder version 3.0.2 (Camtasia recorder (version 3.0.2) [computer software], n.d.) (the

monitor screen recording software without disrupting any activity of computer users) was also used to record their writing processes to examine planning activities and count the amount of Internet searching behavior. Writing genre was limited to argumentative writing. The writing task was to write a completed essay as a response to 'Is copyright protection helpful for the advancement of culture and art?' by choosing an obvious position on the issue. Participants were free to do planning and Internet searching activities when needed. However, they were not provided with any information about how they plan or search the Internet; thus, they had to rely on their own prior knowledge and disposition with regard to their writing strategies. Since one of the study's aims is to investigate the current status of undergraduate students' writing, participants were encouraged to write their essays as they usually did and were allowed to do so in as naturalistic a way as possible. However, they were asked to produce separate pages for planning so as to distinguish it from the main text as long as they performed any prewriting or outlining. Since any additional tool was not allowed for planning and drafting, they only used the limited functions of the word processor software (e.g., typing letters and signs, line or space breaking, etc.). To collect revision data, they were asked to produce two drafts, a first draft and a revision. Participants were informed that once completing the first draft they should save it as a different file and then revise it. Thus, the materials collected from each participant were the Haansoft Office files for prewriting and a first and final draft, and a screen recorded file during writing via Camtasia recorder.

2.3. Measures

2.3.1. Planning

Referring to Chai (2006) and Koutsoftas and Gray (2013), five-point scales were adopted for measuring *plan elaboration* and *plan organization*. Plan elaboration refers to the degree of detail: one point for single words or fragmentary phrases and five points for significantly detailed ideas with a brief topic summary (Chai, 2006). Plan organization refers to the degree of structuralization: one point for no structural attempt and five points for an obvious three-part main structure with more than two respective subsections (Chai, 2006; Koutsoftas & Gray, 2013). Similar to the precedent studies, scores were given for the entire planning output as a unit, not for each of its idea. Two independently working coders scored all participants' planning outputs; their inter-coder reliability (Cohen's Kappa) was 0.78 for plan elaboration and 0.84 for plan organization. The final coding results were averaged between the two coders.

2.3.2. Revision

As discussed in Section 1.2, the current study adopted revision changes as a measurement of revision. The coding criteria were decided by applying the precedent taxonomies (Bridwell, 1980; Daiute, 1986; Faigley & Witte, 1981; Kehagia & Cox, 1997): *microscopic revision* and *macroscopic revision*. While microscopic revision refers to revision occurred at the surface, lexical, and phrase level, macroscopic revision refers to revision occurred at the clause, sentence, and text level. The distinction is closer to the taxonomy used in the research of Bridwell (1980) since the current study adopted linguistic units to distinguish microscopic and macroscopic revision; however, in common with Daiute (1986), Faigley and Witte (1981), and Kehagia and Cox (1997), linguistic units were divided again into small (surface-based) and large (text-based) units.

According to the criteria mentioned above, revision data was collected using one of the functions in Haansoft Office (v. 2010 SE+). Although this method cannot indicate concurrent and synchronous revision data, it allows a comparison of the first and final draft by automatically indicating all deleted and inserted parts between the two versions. Two independently working coders counted all participants' revision changes. Inter-coder reliability (Cohen's Kappa) was 0.79 for

microscopic revisions and 0.88 for macroscopic revisions. The inconsistent coding results were recounted by the first coder.

2.3.3. Internet searching behavior

The number of Internet searches was counted to examine how much writers depended on the Internet while writing. The detailed criteria of measurement used were from Thatcher (2008) because the current study focused on quantitative measurement for Internet searching. Among the four variables that he adopted to measure search performance, number of steps was applied for the current study; this refers to the total number of “mouse clicks and webpages visited” (Thatcher, 2008, p. 1314). Webpages with a different address (by at least a character) were counted as different webpages. Thus, when participants minimized the window and returned to it later, it was counted as the same webpage. However, if they revisited the same page via different search terms, it was counted as twice. Two independently working coders examined the screen-record of all participants and counted the number of steps according to the above-mentioned criteria. The inter-coder reliability (Cohen's Kappa) for the number of steps was 0.85. The inconsistent coding results were recounted by the first coder.

2.3.4. Text quality

The text quality of participants' final drafts was rated in terms of the analytic scoring criteria. Scoring rubrics were applied from the analytic scheme used in Breetvelt et al. (1994) and van den Bergh and Rijlaarsdam (2001). Considering that the participants of the current study were undergraduate students, the detailed descriptions and scoring levels were adjusted by referring to Weigle (2002, pp. 172–196). The analytic criteria were goal orientation, organization, audience awareness, and language use and style. Two independently working raters scored all participants' final drafts according to four criteria (1–10 points for each). The inter-rater reliability (Intraclass Correlation Coefficient) was 0.87 (goal orientation), 0.9 (organization), 0.85 (audience awareness), and 0.87 (language use and style). The final scores were averaged between the two raters.

2.4. Analysis

The analysis followed a three-step approach, in which each individual is assigned to a class/profile and that assigned class is used as a known categorical variable in further analyses (Bakk, Tekle, & Vermunt, 2013; Hickendorff et al., 2018). Thus, the current study adopted a Latent Profile Analysis (LPA) to detect the optimum number of writing profiles and a MANOVA to examine any difference in writing quality between the profiles. First, LPA, which was a latent variable mixture model, was applied to identify unobserved or latent similarities in a population and to find substantively meaningful groups of people based on their responses to observed variables (McMullen & Hickendorff, 2018; Muthén & Muthén, 1998-2017; Ren et al., 2019). LPA has been recognized as a statistically sophisticated and powerful

clustering tool since it enables the capturing of non-linear and qualitative differences and the assessment of individuals' posterior membership probabilities according to elaborate criteria (Hickendorff et al., 2018; McMullen & Hickendorff, 2018; Vermunt & Magidson, 2002). In the study, five observed variables regarding planning, revision, and Internet searching were used to obtain undergraduate students' writing profiles. Before analyses, these variables were transformed into z scores. Various model fit indexes were examined to estimate different numbers of latent profiles and select the best fit model: Entropy, the Akaike Information Criterion (AIC), the Bayesian Information Criterion (BIC), the Sample-size Adjusted Bayesian Information Criterion (SABIC), and the Bootstrapped Likelihood Ratio Test (BLRT) were examined.

The second step was implemented to get profile membership information. Maximum-probability assignment (modal assignment) was applied to decide participants' most likely class in terms of posterior class probability (Bray, Lanza, & Tan, 2015; Nagin, 2005). Statistical tools selected for obtaining the LPA results and profile memberships were Mplus (Muthén & Muthén, 1998-2017) and R software (R Core Team, 2019) and its packages: mclust (Scrucca, Fop, Murphy, & Raftery, 2017), tidyLPA (Rosenberg, Beymer, Anderson, & Schmidt, 2018), and devtools (Wickham, Hester, & Chang, 2018).

The third step was conducted by a one-way MANOVA with profile memberships as independent variable to examine the relationships between profiles and text quality. Some assumptions for the analysis were identified prior to the analysis: normality of the response variables, homogeneity of variance and covariance matrices. According to the Shapiro–Wilk normality tests, four response variables were all confirmed as non-normally distributed. The verification tools for MANOVA were decided according to the results of the Levene's test. Estimated Marginal (EM) means were reported to consider the residual and actual mean response for each factor of text quality and assessed to confirm the differences between group means. Partial eta-square was yielded to calculate effect sizes. Statistical analyses for the third step were also conducted using R and its packages: car (Fox & Weisberg, 2011), emmeans (Lenth, 2018), and heplots (Fox, Friendly, & Monette, 2018).

Table 1 presents descriptive statistics of the variables used in the analyses. Plan Elaboration and Plan Organization were measured by five-point scales, whereas Microscopic Revision, Macroscopic Revision, and Number of Search Steps were count variables. Four variables regarding text quality were measured by 10-point scales.

3. Results

3.1. Writing profiles

To select the optimal number of profiles, LPAs with one to five profiles were conducted. Table 2 presents model fit statistics. When interpreting the information criteria, the lowest index among the different models with different numbers of profiles is usually regarded as

Table 1
Descriptive statistics (n = 234).

	Mean (SD)	Range	Skewness	Kurtosis	1	2	3	4	5	6	7	8	9
1. Plan Elaboration	2.29 (1.61)	1–5	0.72	–1.23	1.00								
2. Plan Organization	1.99 (1.31)	1–5	1.02	–0.29	0.85***	1.00							
3. Microscopic Revision	14.18 (8.73)	1–41	0.33	–0.78	0.06	0.10	1.00						
4. Macroscopic Revision	7.37 (4.95)	0–24	0.82	0.31	0.11	0.11	0.60***	1.00					
5. Number of Search Steps	3.81 (4.22)	0–24	1.49	2.55	0.21**	0.22***	0.17**	0.23***	1.00				
6. Goal Orientation	4.91 (2.08)	1–10	0.32	–0.67	0.11	0.10	–0.09	0.17**	0.12	1.00			
7. Organization	4.54 (2.13)	1–10	0.35	–0.81	0.06	0.04	–0.09	0.25***	0.11	0.66***	1.00		
8. Audience Awareness	5.21 (2.07)	1–10	0.09	–0.90	0.05	0.01	–0.15*	0.23***	< 0.001	0.44***	0.59***	1.00	
9. Language use and Style	5.82 (2.01)	1.5–10	–0.02	–0.76	0.08	0.07	–0.09	0.29	0.13*	0.57***	0.65***	0.66***	1.00

Note. Plan Elaboration and Plan Organization use five-point scales; Microscopic Revision, Macroscopic Revision, and Number of Search Step are count variables; Goal Orientation, Organization, Audience Awareness, and Language use and Style are response variables for the third-step analysis using 10-point scales; *p < .05, **p < .01, ***p < .001.

Table 2
Model fit information.

Model	Loglikelihood	No. of estimated parameters	Entropy	AIC	BIC	SABIC	BLRT (<i>p</i> value)
One profile	-1050.80	10	-	2121.59	2156.15	2124.45	-
Two profiles	-924.81	16	0.974	1881.61	1936.90	1886.18	251.98 (<i>p</i> < .001)
Three profiles	-813.25	22	0.969	1670.50	1746.51	1676.78	223.12 (<i>p</i> < .001)
Four profiles	-752.73	28	0.967	1561.46	1658.21	1569.46	121.04 (<i>p</i> < .001)
Five profiles	-742.82	34	0.978	1553.63	1671.11	1563.35	19.83 (<i>p</i> > .05)

Note. BLRT provides 2 times the loglikelihood difference and its *p* value to compare the increase in model fit between the *k*-1 and *k* profile models.

the best fit. However, Information criteria (AIC, BIC, SABIC, and entropy) did not show consistent results with each other (Table 2). Furthermore, considering that some researchers recommended to preferentially refer to BLRT in similar cases (Nylund et al., 2007), BLRT were mainly considered to select the final model. Regarding BLRT, the null hypothesis that the *k*-1 profile model has a better fit than the *k* profile model was rejected until the four profiles model (Table 2). Thus, the four profiles model was chosen for the profiling result.

Fig. 1 and Table 3 show detailed information for each profile. Fig. 1 indicates a profile plot according to best practices, focusing on the visualization of classification with lines connecting group centroids belonging to the same profiles (CI = 0.95). Bars reflect confidence intervals for the group centroids; boxes reflect the standard deviations within each profile. Since the analyses were conducted based on the standardized data, Table 3 was additionally presented to help interpreting the profiling results by showing descriptive statistics of each profile's raw data.

Profile 1 (*n* = 18) can be labeled *Revision-based Writers* because they tended to depend mainly on macroscopic revision (sentential and textual changes) rather than any other activity. Macroscopic revision was more predominant in this profile than in other profiles. However, Revision-based Writers were not the only profile that prominently performed macroscopic revision; Profile 4 showed obviously more macroscopic revision than the other two profiles did except for the Revision-based Writers (Fig. 1 and Table 3). Revision-based Writers were supposed to revise extensively, particularly in larger units, conduct a little planning as a prewriting activity, and scarcely search the Internet. In contrast, Profile 2 (*n* = 17) can be characterized as *Plan-based Writers* since they tended to depend relatively more on planning in both elaboration and organization. Planning was more predominant in this profile than in any other profiles; however, the difference in quality of plan output between profiles was relatively smaller compared to the other activities (Fig. 1 and Table 3). Except for the planning-related activities, Plan-based Writers tended to perform relatively little in the other activities (microscopic revision, macroscopic revision, and Internet searching). Profile 3 (*n* = 32), which was named *Search-based Writers*, was assumed to mainly depend on Internet searching behaviors throughout writing processes rather than use any other activity. They implemented relatively restrictive planning and revision. Internet searching behaviors were obviously predominant only in this profile. The quantitative difference in Internet searching between Search-based Writers and the other three profiles was relatively very large compared to the other activities (Fig. 1 and Table 3). Lastly, Profile 4 (*n* = 167), which was the largest group and included more than two-thirds of the participants, can be called *Correction-based Writers*. They depended more on microscopic revisions (e.g., correcting words and spelling errors) than any other activity. However, the group centroid of the Correction-based Writers was the second-highest in macroscopic revision, which was quite different from that of Plan-based and Search-based Writers (Fig. 1). Thus, Correction-based Writers were assumed to widely depend on revision activities at both microscopic and macroscopic levels; however, microscopic revision was more markedly used comparing to other variables. Considering that Revision-based Writers performed obviously less microscopic revision than Correction-based Writers, the difference between both profiles was assumed to be determined by the amount of microscopic revision rather than macroscopic revision.

3.2. Relations between profile membership and text quality

To examine whether the four profiles showed any difference in writing quality, one-way MANOVA and its posterior verification (Bonferroni correction) were conducted based on the profile membership results yielded from the first- and second-step analysis and the four response variables on text quality (goal orientation, organization, audience awareness, and language use and style). Tables 4 and 5 present the MANOVA results with the descriptive statistics and the univariate ANOVA results for each response variable on the four writing profiles, respectively. None of the response variables on the profiles violated any assumption about homogeneity of variance (all *ps* < 0.05, verified by Levene's test), and of covariance matrices (*p* > .01, verified by Box's M test). According to Table 4, the MANOVA results showed significant differences between the four writing profiles in terms of the combined response variables ($F = 2.78, p < .01$). Response variables were treated as if they were levels of a factor, and the results were averaged over the levels. These differences were also significant for each response variable taken by four univariate ANOVAs with Bonferroni correction (Table 5): goal orientation ($F = 5.97, p < .001$), organization ($F = 5.90, p < .001$), audience awareness ($F = 9.62, p < .001$), and language use and style ($F = 6.62, p < .001$). While effect size (η_p^2) of MANOVA indicated 0.05 (medium), effect sizes of each univariate analysis result ranged from 0.05 (medium) to 0.11 (close to large).

Regarding the post hoc contrast results corrected by the Bonferroni method comparing mean scores between the profiles on combined response variables (Table 4), Revision-based Writers wrote significantly better texts than the other profiles (*p* < .001). Plan-based Writers, Search-based Writers, and Correction-based Writers did not show any significant difference in their writing quality between each other. Revision-based Writers performed significantly better than the other three profiles for all response variables and the combined one (Tables 4 and 5). Revision-based Writers performed significantly better on goal orientation than Plan-based Writers (*p* = .007), Search-based Writers (*p* = .01), and Correction-based Writers (*p* < .001); better on organization than Plan-based Writers (*p* = .004), Search-based Writers (*p* = .02), and Correction-based Writers (*p* < .001); better on audience awareness than Plan-based Writers (*p* = .003), Search-based Writers (*p* < .001), and Correction-based Writers (*p* < .001); better on language use and style than Plan-based Writers (*p* = .003), Search-based Writers (*p* = .02), and Correction-based Writers (*p* < .001). Any difference except for the above-mentioned results was not significant.

4. Discussion

The current study addressed two main objectives. First, the study aimed to identify the writing profiles of Korean undergraduate students based on some observable features of planning, revision, and Internet searching activities during digital writing. Second, it also attempted to examine whether the writing profiles differ in their text quality in terms of four analytic criteria: goal orientation, organization, audience awareness, and language use and style. Thus, four writing profiles were identified in the LPA: Revision-based Writers, Plan-based Writers, Search-based Writers, and Correction-based Writers. Among them, Revision-based Writers wrote significantly better texts than any other

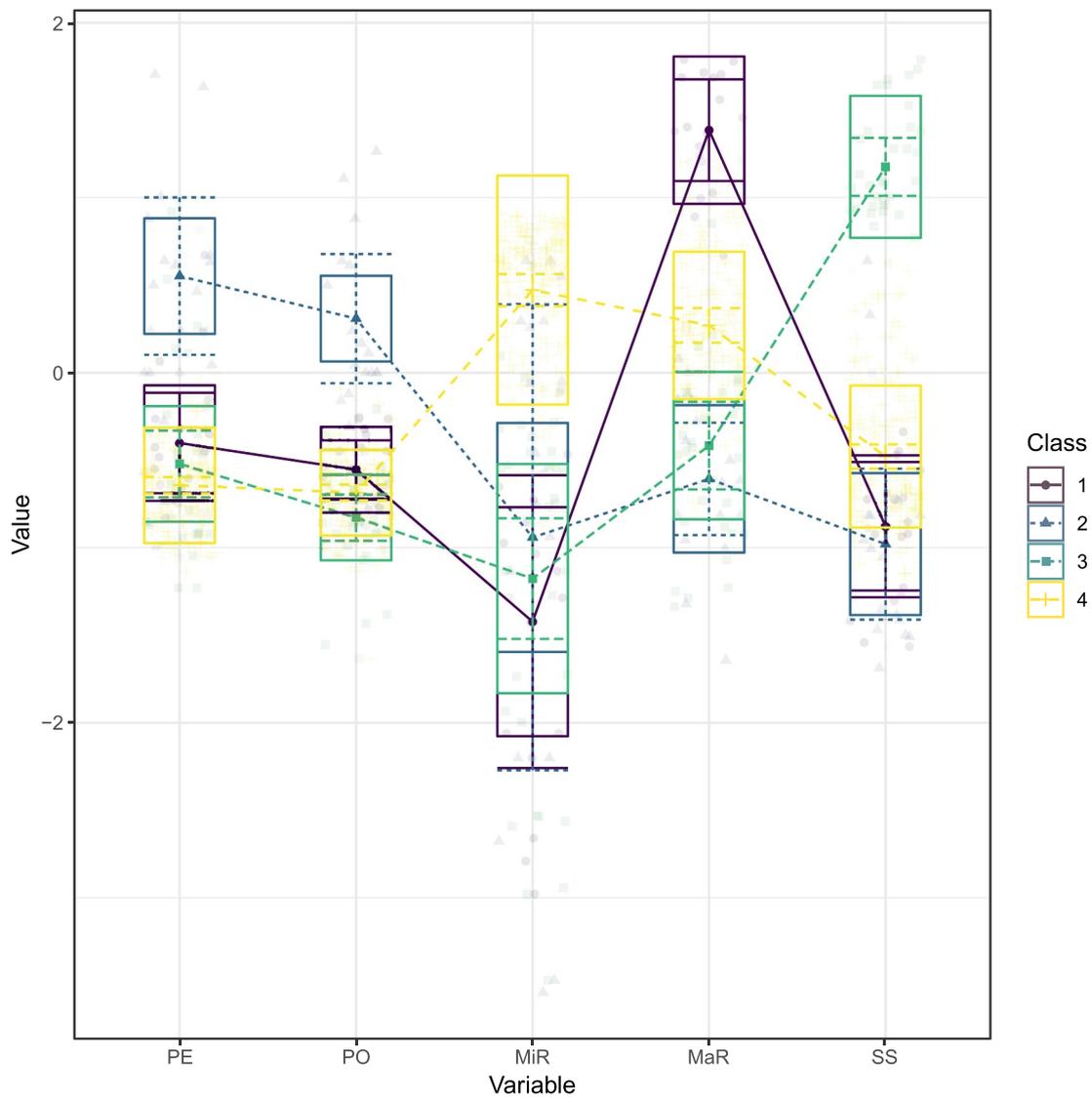


Fig. 1. Plot of the observed variables with lines connecting group centroids belonging to the same profiles.
Note. Class 1 is Revision-based, Class 2 is Plan-based, Class 3 is Search-based, and Class 4 is Correction-based profile; PE = Plan Elaboration, PO = Plan Organization, MiR = Microscopic Revision, MaR = Macroscopic Revision, SS = Number of Search Steps; bars reflect confidence intervals for the group centroids; boxes reflect the standard deviations within each profile; raw data, whose transparency is weighted by the posterior class probability, are plotted in the background.

profile. The other profiles did not show significant differences in text quality between each other.

4.1. *Categorizing individual differences in writing*

The present study's foremost finding was that the profiling results might partly explain the writing habits or strategies of undergraduate students. Since the study was designed to examine what undergraduate

students usually do when they write, we can expect that the results might partly reflect the current state of Korean undergraduate students' essay writing. Most undergraduate students (71.4%) who participated in the study were considered Correction-based Writers: They tended to scarcely or just roughly plan, briefly utilize Internet searching, and mainly depended on revision, particularly at the surface-level. The second largest group was Search-based Writers (13.7%): They tended to conduct plenty of Internet searching activities, and brief surface-level

Table 3
 Descriptive statistics of the profiles according to the observed variables.

	Profile 1: Revision-based (n = 18)		Profile 2: Plan-based (n = 17)		Profile 3: Search-based (n = 32)		Profile 4: Correction-based (n = 167)	
	mean (SD)	range	mean (SD)	range	mean (SD)	range	mean (SD)	range
Plan Elaboration	2.25 (1.59)	1–5	3.26 (1.67)	1–5	2.67 (1.76)	1–5	2.13 (1.54)	1–5
Plan Organization	1.83 (0.97)	1–4	2.88 (1.57)	1–5	2.11 (1.34)	1–5	1.90 (1.28)	1–5
Microscopic Revision	6.89 (5.90)	1–18	3.59 (2.12)	1–8	6.25 (4.93)	1–27	17.56 (7.59)	2–41
Macroscopic Revision	9.83 (7.45)	3–24	1.47 (1.28)	0–4	3.34 (2.24)	0–10	8.47 (4.36)	1–20
Number of Search Steps	1.17 (1.42)	0–5	0.82 (1.51)	0–5	8.22 (5.29)	2–24	3.55 (3.73)	0–17

Table 4
EM means and standard errors from the MANOVA, its post hoc test, and the effect size.

	Revision-based	Plan-based	Search-based	Correction-based
EM means (lower–upper CI)	7.13 (6.37–7.88)	4.79 (4.01–5.57)	5.25 (4.68–5.82)	4.91 (4.66–5.16)
SE	0.39	0.40	0.29	0.13
post hoc test	2 < 1 *** 3 < 1 *** 4 < 1 ***			
Test statistic/Effect size	F = 2.78 (p = .001, df = 3), $\eta_p^2 = 0.05$			

Note. Response variables were Goal Orientation, Organization, Audience Awareness, and Language use and Style; Response variables were treated as if they were levels of a factor, and the results were averaged over the levels; EM means = Estimated Marginal means; the Bonferroni correction method was employed for the post hoc test; η_p^2 = partial eta-square; * p < .05, ** p < .01, *** p < .001.

revisions and planning. The remaining two profiles, Revision-based Writers (7.7%) and Plan-based Writers (7.3%), represented the lowest percentage of participants among the four profiles. While Revision-based Writers tended to depend on structural revisions, Plan-based Writers produced more detailed and organized planning outputs.

These profiling findings are obviously different from the precedent analyses (Torrance et al., 1994, 2000). Torrance et al. (1994) categorized undergraduate writers into three profiles (planners, revisers, and mixed-strategy writers). On the other hand, Torrance et al. (2000) proposed four profiles (outline-and-develop, detailed-planning, minimal-drafting, and think-then-do). Considering that Torrance et al. (1994, 2000) were based on handwriting, the different profiling results would stem from the different writing media. For example, according to Torrance et al. (2000), majority of undergraduate students started from planning both of content (86%) and structure (78%) before drafting. However, participants in the current study did not seem to much depend on explicit prewriting activities considering the mean scores of plan elaboration (M = 2.29, SD = 1.61) and plan organization (M = 1.99, SD = 1.31) and the percentage of Plan-based Writers (7.3%) as well. Overall tendency of low performance in explicit planning activities can relate to one of the characteristics in digital writing. While handwriting is much more constrained in drafting due to media characteristics (e.g., difficult to revise), students who write digitally are assumed to depend on less outlining and more drafting. It can be also corroborated by some studies that have investigated the differences between handwriting and digital writing (Bean, 1983; Collier & Werier, 1995).

Next, differences in measurement and used variables were also differentiated factors between previous and current research. While Torrance et al. (1994, 2000) used questionnaires to measure characteristics of writing processes, the current study measured the process and product data. Previous research mostly used the questions related to planning and drafting, whereas present research adopted variables of planning, revision, and information seeking. Another main difference is that the current study considered characteristics of digital writing by

Table 5
The means and SDs of text quality for the four profiles alongside univariate ANOVA results.

	Revision-based	Plan-based	Search-based	Correction-based	F (η_p^2)
	M (SD)	M (SD)	M (SD)	M (SD)	
Goal Orientation	6.81 (2.33)	4.56 (1.91)	4.98 (2.28)	4.72 (1.93)	5.97 *** (0.07)
Organization	6.44 (1.76)	4.03 (1.68)	4.66 (2.34)	4.36 (2.08)	5.90 *** (0.07)
Audience Awareness	7.56 (1.12)	5.18 (2.02)	5.31 (2.21)	4.94 (1.98)	9.62 *** (0.11)
Language use and Style	7.69 (1.58)	5.38 (1.82)	6.03 (2.14)	5.62 (1.94)	6.62 *** (0.08)

Note. * p < .05, ** p < .01, *** p < .001.

adopting a variable on Internet searching. Hence, it seems to be inevitable that the current profiling results showed obvious differences from previous ones.

The current findings were also differentiated from previous research in that they provided information not only about undergraduate students' writing patterns considering digital writing circumstances but also about the relationships between profiles and text quality. According to the third-step analysis, only Revision-based Writers performed significantly better than any other profile. Search-based Writers, Plan-based Writers, and Correction-based Writers did not show any significant differences in text quality between each other. These findings may be useful to propose some instructional tips; for example, some Revision-based writers may not need to be encouraged to make outlines if they don't want to. It is in line with writing models of Galbraith (1999, 2009) in that he claimed the effects of outlining might vary across writers' disposition.

4.2. Planning vs. revision

Including relevant predictors related to planning and revision let us gain profiling results that reflected the usage of undergraduate students' two representative strategies. The current findings corroborate the precedent evidence in two ways. First, it is closely related to the existing issue on whether planning or revision-centered strategies are effective. As discussed in Section 1.2, many researchers emphasized the superiority of outlining strategies not only for elementary and secondary school students (De La Paz & Graham, 2002; De Smet et al., 2012; Kirkpatrick & Klein, 2009), but also for undergraduate students (Kellogg, 1988; Limpo & Alves, 2018; Piolat & Roussey, 1996). However, some researchers proposed the possibility that outlining strategies cannot always guarantee text quality and is sometimes less efficient than revision strategies, albeit not obviously tested (Galbraith & Torrance, 2004; Kieft et al., 2007, 2008). The current study is in line with the latter studies in that only Revision-based Writers outperformed against the other three profiles. That is, there is a possibility that participants who revise much at the macroscopic level but not at the microscopic level produced better texts than those who make planning outputs in a more detailed and organized way. These findings are meaningful because planning strategies have been much more empirically corroborated than revision strategies among previous research.

However, the current findings cannot be interpreted as supporting the general superiority of revision strategies over planning strategies because the current study did not adopt any controlled experimental design. Unlike interpreting the results of controlled experiments, the current results that investigated the relationships between profile membership and text quality should be examined considering that the variables were measured using different scales without control. For example, the results from measuring quality of planning outputs should be differently interpreted with the results from the design of outlining vs. non-outlining. Likewise, because the current study did not control potential confound of students' capacity (e.g., intellectual capacity), we should not conclude that any writing strategy is superior than another. In current research, while the differences between profiles in planning-related variables were relatively small, those in macroscopic revision

seem obviously large (Table 3 and Fig. 1). Moreover, unlike Revision-based Writers, Plan-based Writers tended to focus solely on prewriting and showed the least activity in revision and Internet searching. Thus, it is probable that Revision-based Writers tended to depend a lot on structural revisions whereas Plan-based Writers did not tend to use planning strategies at high levels. In other words, Revision-based Writers may actively perform their main strategy, whereas Plan-based Writers may not depend on their main strategy as much as Revision-based Writers did. As mentioned in Section 4.1, the undergraduate students who participated in the study seemed relatively inactive when producing planning outputs, particularly regarding plan organization, comparing to other writing activities. This assumption can be supported by some studies that investigated the effects of special tools for electronic outlining. The current study did not adopt any special tool (e.g., computer-based organizers) except for the basic function in the word processor software. However, some researchers reported that it would not be easy to use any organizer during digital writing without special tools (De Smet et al., 2012, 2014; Evmenova et al., 2016). Although graphic organizers are not the only method to make outlines, digital writing circumstances may impose constraints on various prewriting activities without some technological supports. Furthermore, considering that word processor writing promotes more revision than handwriting does (Bean, 1983; Daiute, 1986), digital writing circumstances may be more advantageous for Revision-based Writers than Plan-based Writers. Thus, technological conditions should be considered when we try to investigate the effectiveness of Plan- and/or Revision-based Writers' strategies. In addition, since the research design was built to include students' choice of preferred strategy, the profiling results cannot encompass all possible comparisons with regard to the choice of planning and/or revision strategies; for example, some writers might tend to use both planning and revision strategies at high levels. Hence, it would be better to limit discussion within comparing profiles with each other than to compare strategies that each profile has centered on.

Second, the current findings can also be interpreted in terms of different revision types. The distinction between Revision-based and Correction-based Writers was mainly decided by the quantity of microscopic revisions (i.e. the frequency of surface-level changes). Since Revision-based writers outperformed Correction-based Writers, the current finding also relates to the precedent evidence that competent writers focused more on structure- and meaning-level revisions (Flower et al., 1986; Kehagia & Cox, 1997; McCutchen et al., 1997; Sommers, 1980), and that surface-level revisions might negatively influence the overall text quality (Bridwell, 1980). However, considering that the differences in macroscopic revision between both profiles were not large (Fig. 1 and Table 3), it is probable that the quantity of microscopic revision might more obviously influence to the text quality than that of macroscopic revision did. That is, we can assume that students who revised much at surface level may produce poor or moderate texts. At the same time, it should also be noted that revisions at the sentential and text level would not always guarantee the text quality. Although Correction-based Writers performed considerable macroscopic revisions, it did not seem to influence the quality of writing. Therefore, regarding macroscopic revision, further research may reveal more powerful influences by exploring its quality rather than the quantity. Furthermore, we should also consider that Correction-based Writers constituted the highest percentage (71.4%). This result can be interpreted in line with the existing study that undergraduate students still felt difficulties revising at the macroscopic level and tended to focus on microscopic revision (Adams et al., 2010). It is probable that Correction-based Writers would not be proficient at macroscopic revisions although they did them quite a lot. Since macroscopic revisions are more difficult than microscopic ones (Flower et al., 1986), the issue of writers' proficiency can also be raised apart from the amount of revisions. Further exploration of Correction-based Writers will also be needed in future.

4.3. Internet searching during digital writing

Among the four profiles produced in the study, only Search-based Writers had the highest number of searches, which was noticeable solely in this profile. The extent to which Search-based Writers performed Internet searching was supposed to be quite differentiated from the other profiles considering the huge range of the number of search steps (Table 1) and the difference in its distribution between profiles (Fig. 1). Since the number of steps was adopted as a measurement, Internet searching behaviors were counted from the quantitative perspective. Thus, Search-based Writers were assumed to actively and frequently search the Internet throughout the writing process.

Although the precedent studies have recognized Internet searching as an important method when collecting information for students' writing (Clark, 1995; Kirkpatrick & Klein, 2016; Li, 2012; Olive et al., 2008; Shao & Purpur, 2016), there has been a lack of research on the way in which Internet searching can enhance students' writing. Some researchers revealed a certain way of Internet use can be related with better writing performance (Olive et al., 2008); however, there has been seldom research that revealed significant influence of searching strategies or the amount of search. According to the present results (Tables 1 and 4), it is probable that a large amount of Internet searching itself cannot guarantee writing quality. There is a possibility that students who lack in prior knowledge may search the Internet a lot during writing and they may just restate what they find rather than generate their own ideas. Hence, students' searching strategies and their prior knowledge should be considered to investigate the effects of information seeking on text quality. Some researchers have sought to find and categorize a certain strategies that students used during writing from Internet sources (Kirkpatrick & Klein, 2016; Li, 2012; Zheng, 2013); nevertheless, most of them were conducted from the qualitative perspective and seldom has been verified regarding the efficiency of each strategy. Further research will be needed to understand how to enhance students' competence in using information from the Internet for efficient writing.

In addition, the amount of Internet searching behaviors may also explain why Plan-based Writers did not show as high an effect as expected. One possible explanation may be their lack of information collection (Fig. 1 and Table 3). Although Internet searching itself does not seem to be a direct factor that influences text quality, it might partly exert any effect on the effectiveness of planning. For example, Students who search the Internet a lot and make a detailed and organized plan as well may write a better text than those who only make a good plan. There is a possibility that Plan-based Writers' performance would be ameliorated if they search more information from the Internet. Further explanation will be needed with regard to how collecting information influences prewriting or vice versa in future research. It should also be noted that not only how to use the searched information but also how to seek information are important for understanding better ways of writing from sources.

5. Conclusion: limitations and implications

Four distinct writing profiles (Revision-, Plan-, Search-, and Correction-based Writers) that differ in number were identified from the study (7.7%, 7.3%, 13.7%, and 71.4%, respectively). Among them, Correction-based Writers represented the majority and Revision-based Writers outperformed the other three profiles.

Several limitations in the current study should be noted as follows. First, this study only focused on a tiny part of planning, revision, and Internet searching among all possible activities while writing to categorize writing strategies undergraduate students used. For example, the current study only adopted amount of search as the variable for measuring information seeking behaviors. Thus, another way of measuring Internet searching (e.g., Internet searching strategies, how students used Internet searching as part of the writing process, etc.) can possibly

bring about a different result. Future research needs to include more variables that are essential for better understanding of writing to gain various and plausible writing profiles. Second, it should be noted that the present research only included one writing performance per participant. Although [Torrance et al. \(1999, 2000\)](#) showed in their longitudinal study that undergraduate writers tended to consistently maintain their writing strategies, many writing researchers acknowledge that writers may use different writing strategies according to various contexts. Multiple writing opportunities per participant may yield different results from this study. Third, group sizes within each profile were considerably unequal. This limitation may be related to the moderate sizes of the effect ($\eta_p^2 = 0.05\text{--}0.11$). Thus, follow-up studies are required to get more powerful results. Fourth, although the participants were encouraged to perform as the way they normally do and were not urged to plan or revise, they might be a bit influenced by some tasks, such as using additional pages when they want to make plans or making different drafts when they revise. Thus, it should be noted that their way of writing may not be exactly the same as they usually did. Fifth, the way of Internet searching may be differentiated according to writing genre. Thus, different results can be produced when different genre is applied (e.g., expository texts). Sixth, since gender imbalance was quite large (73% female) in the recruitment, the results need to be interpreted within this condition. Finally, since the data for the profiling analysis were not collected in the manner of a controlled experiment (e.g., random assignment) but according to students' disposition, the associations between writing profile and writing performance cannot be interpreted causally.

Despite the limitations, the current study has important implications. The present study's central findings are that profiling results may reflect the current distribution of undergraduate students' writing patterns and that Revision-based Writers perform significantly better than the other three profiles. The research findings have implications for writing theory and writing instruction. From a theoretical perspective, considering the lack of profiling approach in writing research, the four profiles based on several predictors of planning, revision, and information seeking activities can be a significant finding for three reasons. First, contrary to previous research, the current profiling results offered information not only about the undergraduate students' writing patterns but also about the relations between each profile and text quality. Next, the current results can also be useful to consider the features of digital writing by interpreting profiling analyses. Lastly, the findings provided additional evidence for the existing issue of planning vs. revision strategies. Although we cannot conclude whether one of them is superior or not, it was useful to verify that Revision-based Writers outperformed the other profiles. Considering that superiority of planning strategies has been much more corroborated by the empirical studies than that of revision strategies, the current study may give insight into the usefulness of revision strategies. Particularly in digital writing circumstances, revision strategies may be of more importance than ever considering technological condition for convenient revision.

Educational implications can also be proposed. First, regarding the current state of Korean undergraduate students' writing, Correction-based Writers (71.4%) need to know why they concentrated on surface-level changes that might be negatively related to writing quality and to enhance their proficiency at relevant structural changes. Considering that they indicated a considerable quantity of macroscopic revisions, we need to examine whether their macroscopic revision had any quality problem. Thus, further research on the quality of macroscopic revisions is required to help Correction-based Writers.

Second, considering the current results, we need to reexamine South Korea's existing First-Year Composition (FYC) system. It is possible that the results would be influenced by the participants' condition (e.g., the same major); however, as any participant who has experienced another writing course except for the FYC was excluded in the study, we can gain an insight into the effectiveness of South Korea's FYC from the present study. In fact, the current findings contradict what has been

emphasized in the FYC curricula, which include the importance of outlining and various prewriting strategies regardless of writing genre. Therefore, two educational policies for FYC can be additionally proposed: We may provide more practical opportunities when we try to reinforce students' prewriting/outlining strategies considering various writing contexts and fit the needs of writers who do not want/need to make an outline before drafting.

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