Typing speed: how is it calculated and why does it matter?

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Typing speed is defined as the number of words someone can accurately type in one minute. Despite the seemingly simple definition, the process used to compute one's typing speed is much more difficult. The speed is affected by several factors such as the complexity of the text, one's typing patterns, the use of backspace, and many other elements which we're going to cover below.

In general terms, the speed (**W**) is computed as a function of two variables: the time (in milliseconds) it takes to type a text (**T**), and the number of characters in the text (**N**):

$$W(\frac{T_{ms}}{N_c}) = \frac{N_c/5}{T_{ms}/60.000}$$

This function is used to calculate typing speed in absolute terms. However, it isn't sufficient to provide thorough information on an ever-evolving typing performance of a student. Let's suppose that you type a lesson that only contains a few basic keys. If your speed on this lesson is 80 WPM, does it mean that your typing speed is 80 WPM? It certainly doesn't. It only indicates the speed at which you can type those few characters. Similarly, if you typically type at 80 WPM and start learning how to type symbols which causes your speed to drop to 20 WPM, it doesn't mean that your typing speed is 20 WPM.

For this reason, TypingClub recognizes two sets of speed metrics to calculate typing speed: **Attempt Typing Speed (ATS)** and **Profile Typing Speed (PTS)**.

1. Attempt Typing Speed

$$ATS = W(\frac{total\ typing\ time\ spent\ on\ the\ attempt}{number\ of\ correct\ characters\ typed})$$

The attempt typing speed (ATS) is the speed recorded after a lesson is completed. The typing time is the total time spent on a lesson while the lesson was in typing or play mode. The timer doesn't turn on until the first key is typed. If the use of backspace is allowed and the user deletes all the characters typed thus far, then the counter is reset. If the cursor goes idle for 10 seconds, the timer pauses. This is indicated by a blue "Start Typing" message on the screen. The number of correct characters includes the characters that were typed correctly in the first place along with the ones that were initially mistyped but corrected.

In simple terms, the speed of an attempt (ATS) is calculated as the number of words typed correctly (a word is standardized as having **5** characters) divided by the time it took to type them. For the purposes of this demonstration, let's examine how the speed is calculated and how it changes due to errors and corrections on a series of short examples.

Exhibit 1.1
A student types all **68 characters** in the following lesson correctly on the first try. The total typing time is **20 seconds** and **100% accuracy**. If we plug these values into the above formula, the speed on this attempt equals to 41 WPM.

This is a sample text to demonstrate

how typing speed is calculated.

$$W(\frac{T_{ms}}{N_c}) = \frac{N_c/5}{T_{ms}/60.000}$$

$$W(\frac{T_{ms}}{N_c}) = \frac{68/5}{20/60} = \frac{13.6}{0.33} = 41.21$$

$$W \simeq 41\ \text{WPM}$$

Exhibit 1.2
A student types the same lesson of 68 characters, but this time around, 8 mistakes are made, resulting in **60 characters** typed correctly. The real **accuracy is 88%**. The total typing time is still **20 seconds**. If we plug these values into the formula, the speed on this attempt equals to 36 WPM.

This is a sample text to demonstrate

how typing speed is calculated.

$$W(\frac{T_{ms}}{N_c}) = \frac{N_c/5}{T_{ms}/60.000}$$

$$W(\frac{T_{ms}}{N_c}) = \frac{60/5}{20/60} = \frac{12}{0.33} = 36.36$$

$$W \simeq 36\ \text{WPM}$$

Exhibit 1.3

A student types the same lesson and makes 8 mistakes that are immediately corrected**,** resulting in **68 characters** typed correctly**.** After corrections**,** the real **accuracy is 100%** again**.** The total typing time**,** however**,** has increased to **23.5 seconds** due to the extra time it took to correct errors**.** If we plug these values into the formula**,** the speed on this attempt equals to 35 WPM.

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This is a sample text to demonstrate

how typing speed is calculated.
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$$W(\frac{T_{ms}}{N_c}) = \frac{N_c/5}{T_{ms}/60.000}$$

$$W(\frac{T_{ms}}{N_c}) = \frac{68/5}{23.5/60} = \frac{13.6}{0.39} = 34.87$$

$$W \simeq 35 \text{ WPM}$$

Exhibit 1.4

A student types the same lesson and makes 8 mistakes, 4 of which are immediately corrected, resulting in **64 characters** typed correctly. After corrections, the real **accuracy is 94%**. The total typing time has decreased to **21.75 seconds** due to the extra time it takes to correct half of the errors from the previous exercise. If we plug these values into the formula, the speed on this attempt equals to 36 WPM.

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This is a sample text to demonstrate

how typing speed is calculated.
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$$W(\frac{T_{ms}}{N_c}) = \frac{N_c/5}{T_{ms}/60.000}$$

$$W(\frac{T_{ms}}{N_c}) = \frac{64/5}{21.75/60} = \frac{12.8}{0.36} = 35.55$$

$$W \simeq 36 \text{ WPM}$$

In conclusion, the Attempt Typing Speed is an absolute metric of one's typing speed on a single attempt. This metric is used when computing students' typing speed after each lesson. The ATS value is reported after completing each lesson as well as in the list of recent practices:

2. Profile Typing Speed

While the ATS is a reliable tool to measure one's speed on a single attempt, the Profile Typing Speed (PTS) is a prediction of a user's overall typing speed at any given time. The PTS is dependent on several factors:

- Character distribution in the text
- User's typing habits
- Attempt history

This means that given a new text with a character distribution similar to the ones from recent attempt history, and assuming that the user's typing speed and habits have not changed, we predict that the newly computed ATS will match the previously computed PTS.

While computing the ATS is relatively straightforward, computing the PTS is more complex. We keep a profile of each unique character in a given text, regardless of how many times that character occurs in the text. We construct a map of values for each character and the predicted average time it takes to type them. Then we aggregate these values based on the distribution observed in the recent typing history.

To construct the map, the average typing time (T) of a character is updated after each attempt. Each character in the text that was just typed is associated with a unique profile character. For each such character, we record how long the cursor stood in that position. The computed summary for each character includes all the times when the cursor observed that character, either going forward or backward (when backspace is used). For example, if a character is mistyped and later corrected, the total time of that character is the sum of 3 events: the typo, the deletion, and the correction. In addition, to account for the mistyped characters that were not corrected, we penalize these with an extra time that equals:

• the prediction we already have as to how long it takes to type the character, or
• the average time it took to correctly type the character in the current attempt, or
• the average time it took to type any correct character in the attempt

The average typing time (A) of a character for an attempt is computed as the average typing time of all the occurrences of the character in the text. Every time a character appears in the text, we update its value T as follows:
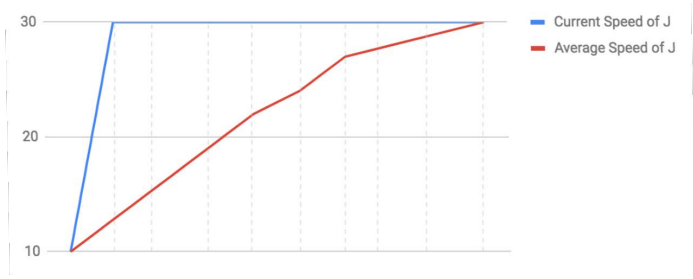
1) $T = A$, *if $T_{prev} = 0$*

2) $T = A$, *if $\left| A - T_{prev} \right| < 10\ ms$*

3) $T = T_{prev} + \frac{A - T_{prev}}{log(N+1)+1}$ *, otherwise (where $0 \leq N \leq 16$)*

N in the above formula is the number of times the character has been typed correctly the first time, out of the last 16 observations recorded. The formula is expected to apply small, gradual changes to T when there is high confidence in the previous values.

Exhibit 2.1
Suppose you typed the character j at 10 wpm (T_{prev}= 1200ms) and you typed it correctly the last 16 times. The next time you suddenly type it at 30 wpm (A = 400ms). The new value of T becomes 911ms, which is 13 wpm. The next time you type it at 30 wpm, T will indicate a speed of 16 wpm. After that, it will be 19 wpm, then 22, 24, 27, 28, 29 and finally 30.

Occurrence of J	Current Speed of J	Average Speed of J
Past 16 times	10 wpm	10 wpm
17th time	30 wpm	13 wpm
18th time	30 wpm	16 wpm
19th time	30 wpm	19 wpm
20th time	30 wpm	22 wpm
21st time	30 wpm	24 wpm
22nd time	30 wpm	27 wpm
23rd time	30 wpm	28 wpm
24th time	30 wpm	29 wpm
25th time	30 wpm	30 wpm

This table demonstrates that our formula applies gradual increments to the average speed of the character over time. If you were to isolate the later attempts without considering the past performance on the character, you may inadvertently jump to the conclusion that the student's speed is 30 wpm. That assumption would be correct for that particular attempt, however, holistically speaking, it would not be an accurate indication of the student's typing speed at that point in time.

The recent history of typed characters (H) is comprised of characters from recent attempts and up to a maximum of 1000 characters. Some lessons in TypingClub have a very skewed character distribution, especially the introductory lessons, and due to the fact that a user can attempt these lessons multiple times, we enforce a limit on the times a character can be seen in the history. If a character was already seen too many times, it will not be added in the history log again. TypingClub applies a formula which allows a maximum of 50 same-character occurrences within the last 1000 characters, 29 same-character occurrences within the last 500 characters, 18 within the last 250, and 13 within the last 125.

The final profile typing speed (PTS) is computed from the sum of the average typing time of each character occurrence in the history, and the length of the history:

$$PTS = W\left(\frac{\sum\limits_{c \in H} T_c}{|H|}\right)$$

In conclusion, the Profile Typing Speed is considered to be a true indication of one's typing speed at any given time. Most charts and graphs available for teachers and students on TypingClub use the PTS to measure the typing speed. The exceptions are attempt-based reports which evaluate students' performance on an isolated typing attempt or set of attempts.

TypingClub uses a sophisticated method to measure students' typing performance; one that encourages students to develop and maintain the correct typing habits while allowing them to learn and make mistakes.