We know that the volume of the parallelepiped determined by $\mathbf{a}$, $\mathbf{b}$, and $\mathbf{c}$ is the magnitude of their scalar triple product, which is $\mathbf{a} \cdot (\mathbf{b} \times \mathbf{c}) = \begin{vmatrix} 5 & 3 & -1 \\ 0 & 2 & 3 \\ 6 & -3 & 4 \end{vmatrix} = 5 \begin{vmatrix} 2 & 3 \\ -3 & 4 \end{vmatrix} - 3 \begin{vmatrix} 0 & 3 \\ 6 & 4 \end{vmatrix}$ $+ \ (-1) \begin{vmatrix} 0 & 2 \\ 6 & -3 \end{vmatrix} = 5(17) - 3(-18) + (12) = 151$.

Thus the volume of the parallelepiped is 151 cubic units.